Attachment A: Attachments to Comment Letter No. 22 (Center for Biological Diversity with San Bernardino Audubon Society) and Comment Letter No. 33 (San Gorgonio Chapter of the Sierra Club via Shute, Mihaly & Weinberger)

Attachments to Comment Letter No. 22 (Center for Biological Diversity with San Bernardino Audubon Society)

Attachment D

Final Supplement to the AB 32 Scoping Plan Functional Equivalent Document

California Environmental Protection Agency

AIR RESOURCES BOARD

Released August 19, 2011

considered at the

August 24, 2011 Board Hearing

Modified Text (Clean Copy)

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PREFACE

The Air Resources Board (ARB) released a draft Supplement to the AB 32 Scoping Plan Functional Equivalent Document (Supplement) on June 13, 2011, for a 45-day public review and comment period that concluded on July 28, 2011. A total of 109 comment letters were received during the public review period, as well as a number of oral comments from a workshop meeting that was held on July 8, 2011.

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1.0 INTRODUCTION AND BACKGROUND

This document is a Supplement to the AB 32 Scoping Plan Functional Equivalent Document (FED) that was included as Appendix J (Volume III) to the AB 32 Scoping Plan document (ARB 2009) prepared in accordance with the California Environmental Quality Act (CEQA) and the Air Resources Board's (ARB or Board) certified regulatory program (title 17, California Code of Regulations (CCR) sections 60005-60008). In 2008, ARB, acting as the lead agency, prepared a FED for the AB 32 Scoping Plan (2008 Scoping Plan). The 2008 Scoping Plan outlines the State's strategy to reduce greenhouse gas (GHG) emissions to 1990 levels by 2020, as required by the Global Warming Solutions Act of 2006 (AB 32; Núñez, Chapter 488, Statutes of 2006). A "scoping plan" is required by one provision of AB 32 (Health and Safety Code (HSC) section 38561), and ARB's adoption of GHG reduction measures is authorized under a separate provision (HSC section 38562). It is not required that a particular measure be encompassed in a scoping plan in order for ARB to pursue such a measure as a proposed regulation.

In this FED Supplement, "2008 Scoping Plan" refers to the plan considered by the Board in December 2008, with final adoption May 11, 2009 (ARB 2009), and "Proposed Scoping Plan" refers to the plan being brought back to the Board for reconsideration along with this Supplement. (See Section 1.1 below for a description of the anticipated process for environmental review and Board action.)

The 2008 Scoping Plan considered a range of GHG emission reduction measures, including direct regulations, Alternative compliance mechanisms, monetary and non-monetary incentives, voluntary actions, a market-based cap-and-trade system, and a fee regulation to fund the program. A draft of the 2008 Scoping Plan was released for public review and comment on June 26, 2008, followed by workshops in July and August 2008. On October 15, 2008, the 2008 Scoping Plan was released for a 45 day public review and comment period along with a FED that analyzed the potentially significant environmental impacts that could result from implementing the measures considered in the plan. The FED included an analysis of a range of five alternatives to the proposed 2008 Scoping Plan, including: a "no project" alternative, a plan relying primarily on a cap-and-trade program for the sectors included in a cap, a plan relying more on source-specific regulatory requirements with no cap-and-trade component, a plan relying on a carbon fee or tax, and a plan relying on a variation of proposed strategies and measures. Following the public review and comment period, the 2008 Scoping Plan and the FED were considered by the Board at a December 11, 2008 public hearing, and were subsequently finally approved by the Board's Executive Officer on May 11, 2009.

As discussed in the next section, subsequent events have caused ARB to create a supplement to the FED and to schedule a Board hearing in order to facilitate the Board's reconsideration of its previous decision, based on an expanded environmental analysis of the project alternatives.

1.1 Purpose and Scope of Supplement

This Supplement is being prepared to provide an expanded analysis of the five project alternatives discussed in Section V of the 2008 Scoping Plan FED (ARB 2009). The Supplement provides a revised analysis that, if approved by the Board, will supersede and replace the project alternatives section of the FED found at pages J-74 to J-90.

In currently pending litigation, a California State trial court found that the analysis of the alternatives identified in the FED was not sufficient for informed decision-making and public review under CEQA (*Association of Irritated Residents, et al. v. California Air Resources Board, et al.*, San Francisco Superior Court, Case Number CPF-09-509562, May 20, 2011). ARB disagrees with the trial court finding and has appealed the decision. However, to remove any doubt about the matter, and congruent with ARB's interest in public participation and informed decision-making, ARB is revisiting the Scoping Plan alternatives. Therefore, staff is providing this supplemental analysis of the project alternatives.

Based on the expanded analysis of project alternatives in this Supplement, the Board will reconsider its approval of the 2008 Scoping Plan. As explained in Section 1.0 above, since the Plan is being brought back for reconsideration, it is referred to in this Supplement as the "Proposed Scoping Plan." The Proposed Scoping Plan contains the same objectives and framework for GHG reduction as the 2008 Scoping Plan. There are, however, a few changes that have occurred since the 2008 Scoping Plan was adopted that are taken into account in this new expanded alternatives analysis. First, this Supplement relies on emissions projections updated in light of current economic forecasts (i.e., accounting for the economic downturn since 2008). In addition, the Proposed Scoping Plan excludes one measure identified in the 2008 Scoping Plan that has been adopted as of publication of this Supplement, and one measure no longer under consideration by ARB. More detailed information about these changes is provided below in Section 1.2 under the heading 'Proposed Scoping Plan Description.'

The five alternatives analyzed in this Supplement are the same as those considered in the 2008 FED, i.e., the No-Project Alternative, as required by CEQA, and four action alternatives. Each of the action alternatives is a feasible alternative to the proposed project that could potentially attain most of the project's basic objectives, including reducing statewide GHG emissions to 1990 levels by 2020, as mandated by AB 32. This document, like the FED it supplements and others typical for policy and regulatory matters, contains a programmatic level of environmental review. (See CCR section 15168 ["Program EIR"].) One of the purposes of a program environmental document is to consider broad policy and regulatory alternatives to a proposed project (see CCR section 15168(b)(4)), which is the primary goal of this Supplement. The level of detail in this Supplement reflects that the project is a broad plan, and therefore, the analysis does not provide the level of detail that will be provided in subsequent environmental documents prepared for each regulation ARB pursues to reduce GHGs. (See CCR section 15152.)

1.2 AB 32 Background and the Proposed Scoping Plan Overview

To provide context for the analysis of the project alternatives, this section presents an overview of the statutory and regulatory framework behind the Proposed Scoping Plan, followed by a description of Scoping Plan objectives and a brief description of the Proposed Scoping Plan.

Statutory and Regulatory Framework

On September 27, 2006, Governor Schwarzenegger signed Assembly Bill AB 32. By requiring in law a reduction of GHG emissions to 1990 levels by 2020, California set the stage for its transition to a sustainable, clean energy future. ARB is the lead agency for implementing AB 32, which set major milestones for establishing the overall program.

More specifically, AB 32 includes the following requirements for ARB:

- Identify the statewide level of GHG emissions in 1990 to serve as the emissions limit to be achieved by 2020 (HSC section 38550). In December 2007, the Board approved the 2020 emission limit of 427 million metric tons of carbon dioxide equivalent ($MMTCO_2E$) of GHGs.

- Adopt a regulation requiring the mandatory reporting of GHG emissions (HSC section 38530). In December 2007, the Board adopted a regulation requiring the largest industrial sources to report and verify their GHG emissions.

- Identify and adopt regulations for Discrete Early Actions that could be enforceable on or before January 1, 2010, (HSC section 38560.5). Beginning in 2007, the Board identified and approved nine Discrete Early Action measures including regulations affecting landfills, motor vehicle fuels, refrigerants in cars, port operations and other sources.

  Develop a "Scoping Plan" that outlines the State's strategy to achieve the 2020 GHG emissions limit. A Scoping Plan sets forth those strategies that, at the time of the adoption of the Plan, ARB believes would be best to pursue. Adoption of a Scoping Plan does not, however, mean that ARB is giving final approval to every strategy contained in that Plan. A substantial number of the strategies contained in an approved Scoping Plan will require their own regulatory processes, at the end of which ARB may choose a course that is different from that set forth in a Scoping Plan. Furthermore, adoption of a Scoping Plan is not a condition precedent for the adoption of greenhouse gas reduction measures ARB may pursue under other provisions of AB 32.

- Convene an Environmental Justice Advisory Committee (EJAC) to advise the Board in developing the Scoping Plan and any other pertinent matter in implementing AB 32 (HSC section 38591). The EJAC met numerous times, providing comments on the proposed Early Action measures and the development of the Scoping Plan, and submitted its comments and recommendations on the 2008 draft Scoping Plan.

- Appoint an Economic and Technology Advancement Advisory Committee (ETAAC) to provide recommendations for technologies, research and GHG emission reduction measures (HSC section 38591). After a year-long public process, the ETAAC submitted a report of their recommendations to the Board in February 2008. The ETAAC also reviewed and provided comments on the 2008 draft Scoping Plan.

- On or before January 1, 2011, adopt greenhouse emission limits and emission reduction measures by regulation to achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions in furtherance of achieving the statewide greenhouse emissions limit, to become operative beginning on January 1, 2012 (HSC section 38562).

Scoping Plan Objectives

The objectives in adopting a Scoping Plan are important in considering the Proposed Scoping Plan and the project alternatives. In addition to discussing the environmental effects of the project alternatives, this Supplement also addresses whether and how the Proposed Scoping Plan and the project alternatives meet these objectives. The following objectives are derived from the requirements of AB 32 for the Scoping Plan (HSC section 38561) and for the adoption of emission reduction measures by regulation (HSC section 38562), including market-based regulations (HSC section 38570). ARB's consideration of the ability of the Proposed Scoping Plan and the project alternatives to meet these objectives is conducted at a programmatic level, and the analysis herein does not replace the more detailed "project level" review for proposed measures or regulations pursued pursuant to Health and Safety Code sections 38562 and 38570.

1. Establish regulations to meet the 2020 goal – to establish regulations that implement reduction strategies covering the state's GHG emissions in furtherance of California's mandate to reduce GHG emissions to 1990 levels by 2020;

2. Reduce fossil fuel use – to reduce California's reliance on fossil fuels and diversify energy sources while maintaining electric system reliability;

3. Link with partners – to link, where feasible, with other Western Climate Initiative (WCI) partner programs to create a regional market system;

4. Design an enforceable, amendable program – to design a program that is enforceable and that is capable of being monitored and verified;

5. Ensure emission reductions – to pursue emissions reductions that are real, permanent, quantifiable, verifiable and enforceable;

6. Achieve technologically feasible and cost-effective reductions – to achieve the maximum technologically feasible and cost-effective reductions in GHG emissions in the aggregate from sources or categories of sources under the cap, in furtherance of achieving the statewide GHG emissions limit (HSC section 38562, subd. (a) and (c);

7. Avoid disproportionate impacts – to ensure, to the extent feasible, that activities undertaken to comply with the regulations do not disproportionately impact low-income communities (HSC section 38562, subd. (b)(2));

8. Credit early action - to ensure, to the extent feasible, that entities that have voluntarily reduced their GHG emissions prior to the implementation of regulations receive appropriate credit for early voluntary actions (HSC section 38562, subd. (b)(3));

9. Complement existing air standards – to ensure, to the extent feasible, that activities undertaken pursuant to the regulations complement, and do not interfere with, efforts to achieve and maintain national and California Air Quality Attainment Standards and to reduce toxic air contaminant (TAC) emissions (HSC, section 38562, subd. (b)(4));

10. Consider a broad range of public benefits – to consider overall societal benefits, including reductions in other air pollutants, diversification of energy sources, and other benefits to the economy, environment, and public health (HSC section 38562, subd. (b)(6));

11. Minimize administrative burden – to minimize, to the extent feasible, the administrative burden of implementing and complying with the regulation (HSC section 38562, subd. (b)(7));

12. Minimize leakage – to minimize, to the extent feasible, leakage of emissions to states and countries without a mandatory GHG emission cap (HSC section 38562, subd. (b)(8));

13. Weigh relative emissions – to consider, to the extent feasible, the contribution of each source or category of sources to statewide emissions of GHGs (HSC section 38562, subd. (b)(9));

14. Achieve real emission reductions in market-based strategies – to ensure that GHG emission reductions achieved through any market-based compliance mechanisms are real, permanent, quantifiable, verifiable and enforceable by the Board (HSC section 38562, subd. (d)(1));

15. Achieve reductions over existing regulation using market-based strategies – to ensure that the reductions from any market-based compliance mechanisms are in addition to any GHG emissions reductions otherwise required by law or

regulation, and any other GHG emissions reduction that would otherwise occur (HSC section 38562, subd. (d)(2));

16. Complement direct measures – to ensure, if applicable, that the GHG emissions reduction from a market-based compliance mechanism occurs over the same time period and is equivalent in amount to any direct emissions reduction required pursuant to AB 32 (HSC section 38562, subd. (d)(3));

17. Consider emissions impacts – to consider, to the extent feasible, the potential for direct, indirect, and cumulative emissions impacts from a market-based compliance mechanism, including localized impacts in communities that are already adversely impacted by air pollution (HSC section 38570, subd. (b)(1));

18. Prevent increases in other pollutant emissions – to design, to the extent feasible, any market-based compliance mechanism to prevent any increase in the emissions of criteria air pollutants or TACs (HSC section 38570, subd. (b)(2));

19. Maximize co-benefits – to maximize, to the extent feasible, additional environmental and economic benefits for California, as appropriate (HSC section 38570, subd. (b)(3)); and

20. Avoid duplication – to ensure that electricity and natural gas providers are not required to meet duplicative or inconsistent regulatory requirements HSC sections 38501(g) and 38561(a)).

Proposed Scoping Plan Description

The Proposed Scoping Plan referenced in this Supplement is substantially the same Scoping Plan considered by the Board in 2008, and therefore, contains the same objectives and framework of measures for GHG reduction described in the 2008 Scoping Plan (ARB 2009).

The Proposed Scoping Plan, as described within the 2008 Scoping Plan document, was developed by ARB in coordination with the Climate Action Team and considers a comprehensive set of actions designed to reduce overall GHG emissions in California, improve the environment, reduce dependence on oil, diversify energy sources, save energy, create new jobs, and enhance public health. The Plan analyzes a mix of measures that provide a comprehensive approach to reduce GHG emissions to achieve the 2020 target, and to initiate the transformations required to achieve the long range target reflected in California Executive Order S-3-05 (an 80 percent reduction from 1990 levels by 2050). The emission reduction measures are described in detail in the Scoping Plan document (ARB 2009). A description of the proposed actions is also provided in the FED at pp. J-20 - J-21, Volume III of the 2008 Scoping Plan (ARB 2009, pp. J-20 - J-21). The information below is provided to summarize and supplement that description to provide context for this expanded analysis of project alternatives.

Overview of Strategies in the Proposed Scoping Plan

Because discussions of the alternatives sometimes use the Proposed Scoping Plan as a point of comparison, it is helpful to summarize the key strategies in the Proposed Scoping Plan as a foundation of the alternatives analysis. A description of the Proposed Scoping Plan actions is also provided in the FED at pp. J-20 - J-21, in Volume III of the 2008 Scoping Plan (ARB 2009, pp. J-20 - J-21).

Achieving the goals of AB 32 in a cost-effective manner will require a wide range of approaches. Every part of California's economy needs to play a role in reducing GHGs. ARB's comprehensive GHG emissions inventory lists sources ranging from the largest refineries and power plants to small industrial processes and farm livestock. The measures in the Proposed Scoping Plan were developed to reduce GHG emissions from key sources and activities while improving public health, promoting a cleaner environment, preserving natural resources, and ensuring that the impacts of the reductions are equitable and do not disproportionately impact low-income and minority communities. These measures also put California on a path to meet the long-term 2050 goal of reducing California's GHG emissions to 80 percent below 1990 levels. This trajectory is consistent with the reductions that are needed globally to help stabilize the climate.

In developing the 2008 Scoping Plan, ARB staff evaluated a comprehensive array of candidate approaches and tools that could best achieve these emission reductions. Based on available data and literature, staff concluded that reducing GHG emissions from the wide variety of sources could best be accomplished though a comprehensive set of measures that includes market-based regulatory approaches, other regulations, voluntary measures, fees, policies, and programs. This comprehensive approach is still reflected in the Proposed Scoping Plan. ARB will monitor implementation of the measures pursued to ensure that the state meets the 2020 limit on GHG emissions. As proposed, an overall limit on GHG emissions from most of the California economy – the "capped sectors" – would be established by the Cap-and-Trade Program. Within the capped sectors, some of the reductions would be accomplished through direct regulations, such as improved building efficiency standards and GHG emission standards for vehicles. Whatever additional reductions are needed to bring emissions within the cap would be mandated by the firm cap on emissions; the actions taken to reduce emissions would be motivated by the emissions allowance prices. Together, direct regulation and the emissions cap assure that emissions are brought down cost-effectively to the level of the overall cap. Staff also recommends specific measures for the remainder of the economy, i.e., the "uncapped sectors."

Key elements of Proposed Scoping Plan for reducing California's GHG emissions to 1990 levels by 2020 include:

- Expanding and strengthening existing energy efficiency programs as well as building and appliance standards;

- Achieving a statewide electricity generation portfolio consisting of 33 percent renewable sources;

- Developing a California Cap-and-Trade Program that links with other Western Climate Initiative partner programs to create a regional market system;

- Establishing targets for transportation-related GHG emissions for regions throughout California and pursuing policies and incentives to achieve those targets; and

- Adopting and implementing measures pursuant to existing State laws and policies, including California's clean car standards, goods movement measures, and the Low Carbon Fuel Standard (LCFS).

The total reduction for the measures recommended in the 2008 Scoping Plan was originally estimated at 174 $MMTCO_2E$, as measured against the level of emissions that would result if there were no reductions measures, and if the State were to proceed on its pre-AB 32 emissions track. This benchmark is referred to as "business as usual", or "BAU." Staff notes that after the passage of AB 32, the BAU level of emissions is prohibited by law, because AB 32 requires the State to adopt regulations to achieve the maximum technologically feasible GHG emissions reduction in order to reduce GHGs. The measures listed in Table 1.2-1 would lead to emission reductions from sources within the capped sectors and from both sources or sectors not covered by the Cap-and-Trade Program. Table 1.2-1 also lists several other recommended measures that would contribute toward achieving the 2020 statewide goal, but whose reductions are not (for various reasons including the potential for double counting) additive with the other measures.

This mix of measures builds on a strong foundation of previous action in California to address climate change and broader environmental issues. The Proposed Scoping Plan relies on implementing existing laws and regulations that were adopted to reduce GHG emissions and other policy goals; strengthening and expanding existing programs; implementing the Discrete Early Actions adopted by the Board beginning in 2007; and proposed measures developed during the Scoping Plan process, itself.

Table 1.2-1 Greenhouse Gas Reduction Measures and Estimated Reductions as Originally Proposed in 2008

Recommended Reduction Measures	Reductions Counted Toward 2020 Target ($MMTCO_2E$)
Estimated Reductions Resulting from the Combination of Measures	**146.7**
California Light-Duty Vehicle Greenhouse Gas Standards • Implement Pavley standards • Develop Pavley II light-duty vehicle standards	31.7
Energy Efficiency • Building/appliance efficiency, new programs, etc. • Increase CHP generation by 30,000 GWh • Solar Water Heating (AB 1470 goal)	26.3
Renewables Energy Portfolio Standard (33 Percent by 2020)	21.3
Low Carbon Fuel Standard	15
Regional Transportation-Related GHG Targets[1]	5
Vehicle Efficiency Measures	4.5
Goods Movement • Ship Electrification at Ports • System-Wide Efficiency Improvements	3.7
Advanced Clean Cars • Medium/Heavy Duty Vehicles • Heavy-Duty Vehicle Greenhouse Gas Emission Reduction (Aerodynamic Efficiency) • Medium-and Heavy-Duty Vehicle Hybridization	2.1 1.4
High Speed Rail	1.0
Industrial Measures (for sources covered under Cap-and-Trade Program) • Refinery Measures • Energy Efficiency & Co-Benefits Audits	0.3
Additional Reductions Necessary to Achieve the Cap	34.4

Table 1.2-1 Greenhouse Gas Reduction Measures and Estimated Reductions as Originally Proposed in 2008

Recommended Reduction Measures	Reductions Counted Toward 2020 Target ($MMTCO_2E$)
Estimated Reductions From Uncapped Sources/Sectors	**27.3**
High Global Warming Potential Gas Measures	20.2
Sustainable Forests	5.0
Industrial Measures (for sources not covered under Cap-and-Trade Program) • Oil and Gas Extraction and Transmission	1.1
Recycling and Waste (landfill methane capture)	1.0
Total Reductions Counted Towards 2020 Target	**174**
Other Recommended Measures	**Estimated 2020 Reductions ($MMTCO_2E$)**
State Government Operations	1-2
Local Government Operations	TBD
Green Buildings	26
Recycling and Waste • Mandatory Commercial Recycling • Other measures	9
Water Sector Measures	4.8
Methane Capture at Large Dairies	1.0

[1] This number represents an estimate of what may be achieved from local land use changes. It is not the SB 375 regional target. ARB established regional targets for each Metropolitan Planning Organization (MPO) region following the input of the Regional Targets Advisory Committee and a public consultation process with MPOs and other stakeholders per SB 375.
Source: ARB 2009

Updated BAU Emissions Projections

Since 2008, ARB has updated projected BAU emissions based on current economic forecasts (i.e., as influenced by the economic downturn) and reduction measures already in place. The BAU projection for 2020 GHG emissions in California was originally estimated to be 596 $MMTCO_2E$. Table 1.2-2 indicates an updated calculation of the Proposed Scoping Plan's estimates for projected emissions in 2020 as of October 2010, based on current economic forecasts. ARB staff derived the updated emissions estimates by projecting emissions from a past baseline estimate using three-year average emissions, by sector, for 2006-2008 and considering the influence of the recent recession and reduction measures that are already in place. Growth factors specific to each of the different economic sectors were used to forecast emissions to 2020. This three-year average of known emissions dampened unusual variations in any single year that would make the baseline year unrepresentative for forecasting.

Table 1.2-2 Updated 2020 Business-as-Usual Emissions Forecast

Sector	$MMTCO_2E$	Percent
Uncapped Sectors (electricity, industrial, transportation, agriculture/forestry, commercial, residential, high GWP gases)	97.9	19.3
Broad Scope Fuels Capped Upstream (gasoline, distillate, propane, natural gas)	236.3	46.6
Capped Industrial (cement, cogeneration, hydrogen plants, refineries, other, combustion)	74.2	14.6
Imported Electricity (capped)	53.5	10.6
In-state Electricity (capped)	44.8	8.8
Emissions Total	**506.8**	

Considering the updated BAU estimate of 507 $MMTCO_2E$ by 2020, a 16 percent reduction below the estimated BAU levels would be necessary to return to 1990 levels (i.e., 427 $MMTCO_2E$) by 2020. No one sector has a sufficiently large share of GHG emissions to become the primary focus for emission reductions. Significant reductions are needed in the transportation, electricity, commercial and residential, and industrial sectors, as well as contributing reductions from the other sectors of the economy. Consequently, multi-faceted GHG emissions strategies have been initiated and are underway since the 2006 enactment of AB 32.

While ARB has compiled, analyzed, and described its full range of proposed, necessary GHG strategies as part of the Proposed Scoping Plan, many of these strategies have either been implemented and are ongoing or have authority under other statutes and will proceed regardless of the outcome of the reconsideration of the Proposed Scoping Plan. (Please refer to the more detailed discussion and measures listed in the Section 2.3, Table 2.3-1, under the No-Project Alternative.) One measure identified in the 2008 Scoping Plan, Refrigerant Management Program, was proposed and approved by the Board following their initial approval of the Scoping Plan in 2008. The regulations for the Refrigerant Management Program are in effect, and therefore, this measure will proceed because it is already codified. The 2008 Scoping Plan also included a measure to reduce GHG emissions from high global warming potential (GWP) gases via a fee. However, staff's evaluation of this measure since the 2008 Scoping Plan was initially developed, indicates that at this time a regulation to levy a fee to reduce emissions from high GWP gases would not be feasible. Therefore, this measure will no longer be pursued as part of the Proposed Scoping Plan (see discussion under Alternative 3).

Considering the ongoing, approved, or otherwise authorized measures that would occur even if no Scoping Plan measures were implemented (a result not allowed under AB 32), and the updated calculation of the estimated BAU emissions, the shortfall from the AB 32 target that would need to be obtained by remaining measures in the Proposed Scoping Plan would be approximately 22 $MMTCO_2E$. This estimate is summarized in Table 1.2-3, below.

Table 1.2-3 Estimate of Emissions Reductions Needed from Proposed Scoping Plan Measures Not Yet In Place

Emission Category	2020 MMTCO2E
Revised 2020 Baseline (Business-as-Usual) Forecast	507
Reductions from measures (other than the Cap-and-Trade Program and Advanced Clean Cars)	58
2020 Emissions Target set by AB 32 (i.e., 1990 level)	427
Reductions Needed from Cap-and-Trade and Advanced Clean Cars as Proposed	**22**

The shortfall of the AB 32 target is the allocation of GHG reduction that has been estimated to be gained from a Cap-and-Trade Program (18 $MMTCO_2E$) and an advanced clean car program (4 $MMTCO_2E$) that are included as measures to be pursued as part of the Proposed Scoping Plan.

The mix of measures in the Proposed Scoping Plan provides a comprehensive approach to reduce emissions to achieve the 2020 target, and to initiate the transformations required to achieve the 2050 target set forth in Executive Order S-03-05 (80% below 1990 levels by 2050). The Cap-and-Trade Program included in the Proposed Scoping Plan would cover about 85 percent of GHG emissions throughout California’s economy. ARB recognizes that due to several factors, including information discovered during regulatory development, technology maturity, and implementation challenges, actual reductions from individual measures aimed at achieving the 2020 target may be higher or lower than current estimates. The inclusion of many of these emissions within the Cap-and-Trade Program, along with a margin of safety in the uncapped sectors, would help ensure that the 2020 target is met.

2.0 SCOPING PLAN ALTERNATIVES

This section provides an overview of the regulatory requirements and guidance regarding the alternatives analyses under CEQA, a description of each of the alternatives to the Proposed Scoping Plan, a discussion of whether and how each Alternative meets the project's objectives, and an analysis of each alternative's environmental impacts.

2.1 Alternatives Development and Approach to Analysis

California Environmental Quality Act and Functional Equivalency

ARB's process of adopting regulations is a Certified State Regulatory Program under CEQA. Public Resources Code (PRC) section 21080.5 allows public agencies with regulatory programs to prepare a plan or other written document in lieu of an environmental impact report once the Secretary of the Natural Resources Agency has certified the regulatory program. The California Secretary for Natural Resources has determined that ARB's regulatory program meets the criteria for a Certified State Regulatory Program (CCR section 15251(d)). This certification allows ARB, when adopting rules, regulations, standards and plans, to use a substitute, functional equivalent document in lieu of formal Initial Studies, Negative Declarations, or Environmental Impact Reports (EIRs) required by CEQA. The 2008 Scoping Plan FED and this Supplement was prepared pursuant to the ARB Certified Regulatory Program to assess the potential environmental effects of the GHG emissions reduction programs and strategies.

Requirements for Alternatives Analysis

ARB's Certified Regulatory Program (CCR sections 60005 – 60007) requires that where a contemplated action may have a significant effect on the environment, a staff report shall be prepared in a manner consistent with the environmental protection purposes of the state board's regulatory program and with the goals and policies of CEQA. Among other things, staff reports are required to address feasible alternatives to the proposed action that would substantially reduce any significant adverse impact identified. The regulation specifies that:

> Any action or proposal for which significant adverse environmental impacts have been identified during the review process shall not be approved or adopted as proposed if there are feasible mitigation measures or feasible alternatives available which would substantially reduce such adverse impact. For purposes of this section, "feasible" means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors, and consistent with the state board's legislatively mandated responsibilities and duties (CCR section 60006).

No more specific guidance (e.g., number, nature, location, or characteristics of alternatives) is provided in the regulation.

While ARB, by virtue of its Certified Regulatory Program, is exempt from Chapters 3 and 4 of CEQA and corresponding sections of the State CEQA Guidelines, the Guidelines nevertheless contain useful information for preparation of a thorough and meaningful alternatives analysis. CEQA Guidelines section 15126.6(a) speaks to evaluation of "a range of reasonable alternatives to the project, or the location of the project, which would feasibly attain most of the basic project objectives but would avoid or substantially lessen any of the significant effects, and evaluate the comparative merits of the alternatives." The purpose of the alternatives analysis is to determine whether or not a variation of the project would reduce or eliminate significant project impacts, within the basic framework of the objectives, a principle that is consistent with ARB's Certified Regulatory Program requirements.

Thus, alternatives considered in an environmental document should be feasible and should attain basic project objectives. Under AB 32, ARB is required to adopt a Scoping Plan to guide its future regulatory efforts under AB 32. Objectives of a Scoping Plan are described in Section 1.2, above, and speak primarily to GHG emissions reduction, and creation of a system to achieve those reductions that is administratively feasible, enforceable, cost-effective, efficient, and fair.

The range of alternatives studied in an environmental document is governed by the "rule of reason," requiring evaluation of only those alternatives "necessary to permit a reasoned choice" (CCR 15126.6(f)). Further, an agency "need not consider an Alternative whose effect cannot be reasonably ascertained and whose implementation is remote and speculative" (CCR 15126.6(f)(3)). The analysis should focus on alternatives that are feasible (defined above) and that take economic, environmental, social, and technological factors into account. Alternatives that are remote or speculative need not be discussed. Furthermore, the alternatives analyzed for a project should focus on reducing or avoiding significant environmental impacts associated with the project as proposed.

Direction from the Superior Court Regarding the Alternatives Analysis

On May 20, 2011, the San Francisco County Superior Court (Case Number CPR-09-509562) issued its Final Order. The Order stated, inter alia, that "ARB… failed to proceed in a manner required by law by inadequately describing and analyzing Project Alternatives sufficient for informed decision making and public participation." The court further ordered ARB to "set aside Board Resolution 08-47 and Executive Order G-09-001 adopting and approving the Climate Change Scoping Plan to reduce greenhouse gases in California ("Project") as it relates to cap-and-trade." As stated above, while ARB disagrees with these findings and is appealing the decision, and has not taken action to set aside Board Resolution 08-47 and Executive Order G-09-001 at this time, in the interest of public participation and informed decision-making, this FED

Supplement has been prepared to elaborate on the Project Alternatives. (See Section 1.1, Purpose and Scope of This Supplement.)

The Court did not find the number and nature of alternatives considered in the Scoping Plan FED to be insufficient. Therefore, this FED Supplement addresses the same alternatives, but with more in-depth description of those alternatives, and more expansive analysis of potential environmental impacts.

As noted above, ARB will reconsider its decision to adopt the Proposed Scoping Plan. At a public meeting, the Board will make a new decision whether to adopt the Proposed Scoping Plan, one of the action alternatives discussed in this Supplement, or a variation of the Proposed Scoping Plan or an alternative, based on the information contained in the FED, the Supplement, public comments, and responses to comments.

2.2 Description and Analysis of Alternatives

Introduction

If adopted and approved by the Board, this alternatives description and analysis of the alternatives will supersede and replace the alternatives discussion presented in the Scoping Plan FED, released in October 2008, at pp. J-20 - J-21, in Volume III of the 2008 Scoping Plan (ARB 2009, pp. J-20 – J-21). (A Notice of Decision regarding the Board's action on the Scoping Plan was filed with the Secretary of the California Resources Agency on May 9, 2009.) This document expands the description and analysis of the alternatives to assist both the Board and the public in their consideration of alternatives to the Scoping Plan. The five alternatives discussed are the same as those that were originally presented in the 2008 Scoping Plan FED; however, they have been updated and re-ordered to reflect current circumstances. The order in which the alternatives are discussed is changed from the FED to the Supplement to present the alternatives that focus on single strategies first, followed by the alternatives considering a combination of those strategies.

Range and Description of Alternatives

Because a Scoping Plan is a framework document made up of a set of numerous individual GHG emission reduction measures that can be combined in different ways, there is, in theory, an almost limitless number of potential alternatives that could serve as the Proposed Scoping Plan. The five alternatives discussed in this section represent a reasonable range of representative alternatives that will allow the public and Board to understand the differences between different types or combination of approaches.

ARB staff developed the range of representative alternatives based on a thorough, informed, and public process. In 2008, ARB staff originally determined the range of alternatives based on extensive input from the public and advisory committees during the course of a lengthy public process in the development of its Proposed Scoping Plan. In addition to input from the public, ARB received and relied upon input on Scoping Plan alternatives from three specially formed advisory committees. The

Environmental Justice Advisory Committee (EJAC) and the Economic and Technology Advancement Advisory Committee (ETAAC), both formed by ARB pursuant to HSC section 38591, provided both oral and written recommendations and comment to ARB. Further, ARB received input from the Market Advisory Committee (MAC), formed in 2006 by Governor Executive Order S-20-06. The MAC included leading experts from universities, government, non-governmental organizations and private industry.

ARB staff and Board members also met with representatives of national and sub-national governments that are currently operating programs to reduce GHG emissions, including emissions trading programs. For example, ARB staff and/or Board members met with representatives of the U.S. Environmental Protection Agency (U.S. EPA), which manages the Acid Rain and NO_x emissions trading programs; the South Coast Air Quality Management District (SCAQMD), which administers the Regional Clean Air Incentives Market (RECLAIM) emissions trading program; the Environmental Ministry of British Columbia, which has established a carbon fee program for GHG emissions from transportation fuels and is developing a cap-and-trade program for industrial and power sector GHG emissions; and the British Government and the European Commission, which oversees the European Union's Emissions Trading Program (EU-ETS).

Further, ARB staff has collected and reviewed an extensive library of literature on reduction programs, including cap-and-trade, fees, taxes, source-specific standards and limits, and other regulatory approaches. Documents incorporated by reference are listed in Section 3.0.

<u>Adoption of Regulations for Any Alternative</u>

Typically, air quality and GHG controls would be implemented by adoption of regulations. If ARB pursued regulations to implement any of the GHG reduction alternatives discussed in this Supplement, each regulation would go through the Administrative Procedure Act (APA) process. It is a rigorous process that includes technical, environmental, and economic analysis, as well as public review and input. The APA provides very specific rules for this process of adopting new regulations. This process must be completed within one year of the notice date (see below), pursuant to Government Code section 11346.4(b).

First, a notice of proposed action must be filed with the Office of Administrative Law (OAL), consistent with Government Code section 11346.5. The Initial Statement of Reasons (ISOR), also known as the Staff Report, is published at the same time as the notice, and contains all of ARB's reasoning for the proposed regulations (Government Code section 11346.2(b)). Concurrently with the publication of the notice and ISOR, the specific terms of the proposed regulation(s) must also be made available (Government Code section 11346.2(a)). The initial publication of the notice, ISOR, and proposed regulations results in the "notice date."

The public is given at least 45 days to provide comments on the proposed regulation and, if a public hearing is scheduled (which ARB does for almost all regulations), the commenters may also provide comment at the hearing (Government Code section 11346.4(a)). ARB must consider public comments and, in conjunction with any Board direction, make any substantive changes warranted in light of the comments or Board direction. Substantive changes must be made available for an additional 15 days of public review (Government Code section 11346.8(c)). If additional substantive changes are required after the 15-day review, the regulations must be made available for subsequent 15-day periods until all substantive changes are complete.

After the conclusion of all 15-day public comment periods, ARB prepares a Final Statement of Reasons (FSOR), which includes ARB's responses to each comment received during the public comment periods. After final approval by ARB, staff also compiles the remainder of the rulemaking file, which includes the Updated Informative Digest, all of the comments received, the transcript of the hearing, the final regulation text, the table of contents of the rulemaking file, various economic analyses required by the Department of Finance, and mailing statements.

Within the one year provided from the initial notice date, ARB must file the documents listed above with OAL. Within 30 working days, OAL must review the file to ensure that ARB complied with all of the APA requirements, and must make a decision on whether to approve or disapprove the regulation. A regulation does not become legally effective unless it is approved by OAL. When OAL approves a regulation, it is filed with the California Secretary of State and becomes effective 30 days after filing, although an earlier effective date may be requested.

Analysis of Alternatives

This Supplement examines the "range of reasonable alternatives" to the project to evaluate whether reasonable alternatives to the Proposed Scoping Plan would reduce or eliminate the project's significant effects on the environment, while meeting at least most of the basic project objectives. (See CCR section 15126.6(a).) Pursuant to ARB's Certified Regulatory Program, the second part of this section contains an analysis of each alternative's feasibility and its ability or inability to substantially reduce any significant adverse environmental impacts identified in the FED's analysis of the Proposed Scoping Plan (CCR sections 60005(b) and 60006).

The basic project objectives of the Proposed Scoping Plan are discussed in Part 1.2, above. The analysis that follows the descriptions of the alternatives includes a discussion of the degree to which each Alternative meets those basic project objectives.

Range of Alternatives

The five alternatives to the Proposed Scoping Plan evaluated by ARB in this Supplement are:

- **Alternative 1: No-Project Alternative.** The No-Project Alternative is based on existing conditions and what would be reasonably expected to occur in the foreseeable future. As a result, the description of this Alternative has been updated to reflect the current status of ARB programs. Existing conditions, therefore, include the suite of GHG reduction actions that are in operation, such as the million-solar-roofs program, the AB 1493 (Pavley) motor vehicle GHG emission standards, and the Low Carbon Fuels Standard. In addition, for purposes of this analysis, ARB has included as "reasonably expected to occur in the foreseeable future," those GHG reduction actions with additional statutory authority, such as the 33 percent Renewable Energy Portfolio Standard (RPS) for electricity generation, which is now authorized by Senate Bill 2 of the first extraordinary sessions of 2011 (Simitian, Statutes of 2011) (SB1X 2), but excluded rulemakings pursuant to AB 32 that are still in process, such as the California Cap on GHG Emissions and Market-Based Compliance Mechanisms (also known as the Cap-and-Trade Regulation). ARB believes that the proposed Cap-and-Trade Regulation and other emission reduction measures are independently authorized by the HSC section 38562, irrespective of the Scoping Plan; however, the issue is presently the subject of the litigation noted in Section 2.1, above.

- **Alternative 2: Adopt a Program Based on Cap-and-Trade for the Sectors Included in the Cap.** This Alternative relies primarily on a cap-and-trade program for achieving the remaining reductions (i.e., approximately 22 $MMTCO_2E$ after other ongoing, implemented, or otherwise authorized measures) needed to meet the 2020 GHG reduction target. The description of Alternative 2 has been updated to reflect the October 2010 proposed Cap-and-Trade Regulation that has been evaluated in a separate FED that ARB released for public review in October 2010 (ARB 2010b).

- **Alternative 3: Adopt a Program Based on Source-Specific Regulatory Requirements.** Under this alternative, ARB would adopt a program that relies on additional direct regulatory control of specific sector sources of GHG emissions to achieve the remaining reductions (i.e., approximately 22 $MMTCO_2E$ after other ongoing, implemented, or otherwise authorized measures) needed to meet the 2020 GHG reduction target. Also sometimes called a direct regulatory approach, Alternative 3 would involve adopting regulations that establish source-specific emissions limits or performance standards and require regulated entities to stay within those limits.

- **Alternative 4: Adopt a Program Based on a Carbon Fee or Tax.** Under this alternative, ARB would adopt a program that relies on a carbon fee or tax program to achieve the remaining reductions (i.e., approximately 22 $MMTCO_2E$ after other ongoing, implemented, or otherwise authorized measures) needed to meet the 2020 GHG reduction target. Alternative 4 could involve a regulation setting fees payable to the state based on the GHG emissions by covered entities, and directing the expenditure of the fee revenue for specified uses, subject to substantial administrative constraints. The description also discusses a carbon tax, which would require a legislative supermajority for authorization, but is not subject to the same administrative constraints.

- **Alternative 5: Adopt a Variation of the Proposed Strategies or Measures.** Under this alternative, ARB would adopt either a subset or a different combination of the measures considered among the other previous three action alternatives.

As presented previously, a shortfall of approximately 22 $MMTCO_2E$ from the AB 32 target in 2020 would occur after accounting for the ongoing, approved, or otherwise authorized GHG reduction measures that would continue if the full scope of the Proposed Scoping Plan did not proceed. The alternatives described below are discussed in light of the need to achieve this additional 22 $MMTCO_2E$ reduction.

Detailed descriptions of the five alternatives are presented below.

2.3 Alternative 1: No-Project Alternative

Goal of Alternative 1

The goal of Alternative 1 is to describe a reasonably expected scenario if ARB did not adopt the Proposed Scoping Plan or any of the action alternatives to the Proposed Scoping Plan. The No-Project Alternative is included only to assist in the analysis and consideration of the Proposed Scoping Plan and the action alternatives. ARB cannot adopt the No-Project Alternative described in this document because AB 32 requires ARB to prepare and approve a Scoping Plan (HSC section 38561(a)).

Role of Alternative 1 in the Range of Alternatives

ARB's Certified Regulatory Program does not mandate consideration of a "No-Project Alternative." (See CCR section 60006.) Under the Certified Regulatory Program, the alternatives ARB considers, among other things, must be "consistent with the state board's legislatively mandated responsibilities and duties" (CCR section 60006). Here, ARB is legislatively mandated to produce a Scoping Plan "as that term is understood by the Board, for achieving the maximum technologically feasible and cost-effective reductions in GHG emissions from sources or categories of sources of GHGs by 2020 under this division"(HSC section 38561).

Although not in response to a regulatory mandate, it is useful to include a "No-Project Alternative" in this analysis for the same reasons that this type of Alternative is called for in the State CEQA Guidelines. As noted in the Guidelines, "the purpose of describing and analyzing a no-project Alternative is to allow decision-makers to compare the impacts of approving the proposed project with the impacts of not approving the proposed project" (CCR section 15126.6(e)(1)). In addition, the No-Project Alternative also provides an important point of comparison to understand the potential environmental benefits and impacts of the other alternatives. In addition, while CEQA documents typically assume that the adoption of a No-Project Alternative would result in no further action by the project proponent or lead agency, this is not true for some of the actions identified in the Scoping Plan, which pre-date and have been approved or implemented prior to its adoption or are underway pursuant to other statutory authority. The State CEQA Guidelines indicate that the no-project Alternative can address the continuation of an existing plan or policy into the future (CCR section 15126.6(e)(3)(A)). For purposes of this analysis, the No-Project Alternative takes into account the components of the Proposed Scoping Plan that are either already implemented or being carried out under authority additional to AB 32.

Precedents or Examples of the Approach in Alternative 1

The No-Project Alternative is not modeled after a precedent or example from other GHG reduction programs. Rather, it is defined using the suite of reduction strategies that have already been implemented by the State or are reasonably expected to occur even without a Scoping Plan.

Attributes of Alternative 1

The No-Project Alternative has been updated in this Supplement to reflect current conditions. The primary condition that has changed since the original formulation of the Proposed Scoping Plan in 2008 is the implementation of a portion of the strategies included within it in the interim period. To understand the relative environmental impacts of instituting a No-Project Alternative in 2011, it is important to factor in the GHG reduction strategies that are already underway and reducing emissions at this time, or would be reasonably expected to continue because they are approved as part of AB 32 implementation or authorized by other statutes.

To determine the emissions resulting from the No-Project Alternative as defined above, this document first presents updated forecasts of the GHG emissions that would be expected from all sources by 2020, assuming (for the purposes of analysis) no further regulatory controls (i.e., business-as-usual, or BAU). The document then discusses the GHG emission reductions from measures that have been implemented or would be implemented independent of any upcoming action on the Proposed Scoping Plan by ARB and compare the resulting emissions to the AB 32 target, i.e., 1990 emissions levels.

If GHG reduction measures in the Proposed Scoping Plan were not implemented and BAU resource and energy use occurred at the rates existing when AB 32 was enacted (based on extrapolating 2004 data, the most current data available in 2006), 2020 GHG emissions in California were originally estimated to be 596 $MMTCO_2E$.
Table 1.2-3 indicates an updated calculation of the Proposed Scoping Plan's estimates for projected BAU emissions in 2020 as of October 2010. ARB staff derived the updated emissions estimates by projecting emissions from a past baseline estimate using three-year average emissions, by sector, for 2002-2004 and considering the influence of the recent recession and measures that are already in place. Growth factors specific to each of the different economic sectors were used to forecast emissions to 2020. This three-year average of known emissions dampens unusual variations that could make any single year unrepresentative for forecasting purposes. As shown in Table 1.2-2 (Section 1.2, above), the updated BAU estimate is 507 $MMTCO_2E$ by 2020, which is 16 percent above 1990 levels (i.e., 427 $MMTCO_2E$).

The measures identified in the Proposed Scoping Plan that have already been implemented include actions that preceded the Proposed Scoping Plan and discrete early-action measures intended to begin to reduce GHG while the more complicated proposals in the Proposed Scoping Plan were being evaluated. These precedent and discrete early-action strategies would continue as part of the No-Project Alternative. In addition, two measures have separate authority, Senate Bill 375 (Steinberg, Statutes of 2008) authorizing reductions in car and light truck GHG emissions through adoption of Sustainable Communities Strategies or Alternative Planning Strategies and achievement of a 33-percent RPS as authorized by SB1X 2. Implementation of these programs is reasonably expected to continue regardless of further action by ARB on a Scoping Plan, so they are included as part of the No-Project Alternative. One measure listed in the Proposed Scoping Plan, Refrigerant Management Program, has already been approved by ARB and regulations are in effect; therefore, this measure will proceed, because it is already codified. Consequently, it is included in the No-Project Alternative. The ongoing, approved, or foreseeable measures that constitute the No-Project Alternative are summarized in Table 2.3-1.

The two main drivers of GHG emissions in the No-Project Alternative involve population growth and current laws and regulations. Population growth in California will result in more vehicle miles traveled, more goods movement, greater water and energy demands, and more consumer products. In coordination with the local air districts, ARB submits a State Implementation Plan to the U.S. EPA Administrator that provide for implementation, maintenance, and enforcement of the ozone and particulate matter national ambient air quality standards. The SIP would remain in place, even if the Scoping Plan were not adopted, and would have an influence on GHG emissions.

Presented below is a summary of sector-based conditions that would reasonably be expected in the event that the No-Project Alternative could be implemented. Descriptions of the 2020 BAU forecasts for the major sectors of the emissions inventory, summarized in Table 1.2-2 (Section 1.2) are provided in the discussion. Reduction strategies that are ongoing, already implemented, or approved based on additional authority would reduce emissions below the BAU forecasts, as summarized in Table 2.3-1, but not sufficiently to meet the AB 32 goal by 2020. In addition to the reductions depicted in Table 2.3-1, an additional 5 $MMTCO_2e$ reduction is attributed to forests that reflects current conditions of a 5 $MMTCO_2e$ annual sink (a CO_2 uptake by forests). This results in "no net loss" of 5 $MMTCO_2e$ (or -5) annually to 2020. This sink is to be maintained via forest management practices.As discussed below, the shortfall from the AB 32 target would be approximately 22 $MMTCO_2E$. This shortfall reflects the absence of the Cap-and-Trade Program (18 $MMTCO_2E$) and advanced clean car program (4 $MMTCO_2E$), which are not a part of the No-Project Alternative.

Table 2.3-1 Measures That Compose the No-Project Alternative

1) MEASURES IN PROCESS PRIOR TO THE PROPOSED SCOPING PLAN

Measure (Measure No.)	Status	Reduction (If Applic.)
Title 24 Building and Appliance Energy Efficiency Standards (E-1, CR-1)	Ongoing	11.9
Solar Water Heating (CR-2)	Ongoing	0.1
20 Percent Renewable Portfolio Standard (E-3)	Ongoing	12.0
Million Solar Roofs (E-4)	Ongoing; Began Jan 2007	1.1
Pavley I	Considered by Board Sept 2004; Operative Oct 2005; Effective Jan 2006	26.1

2) DISCRETE EARLY ACTION MEASURES UNDERWAY

Measure (Measure No.)	Status	Reduction (If Applic.)
Shore Power (T-5)	Considered by Board Dec 2007; Effective Jan 2009; Amended June 2010	0.2
High GWP Consumer Products (H-4)	Considered by Board June 2008; Effective July 2009	0.2
Smart Ways - Heavy-Duty Trucks (T-7, T-8)	Considered by Board Dec 2008; Effective Jan 2010; amended May 28, 2009 (on-board diagnostics); Amendments considered by Board Dec 2010; Due to OAL Oct 28, 2011	0.9
Reductions from Mobile Air Conditioners (DIY Cans) (H-1)	Considered by Board Jan 2009; Effective March 2010	0.2
Semiconductor Manufacturing (H-3)	Considered by Board Feb 2009; Effective Jan 2010	0.2
SF6 Reductions (Non Electrical) (H-2)	Considered by Board Feb 2009; Effective Jan 2010	0.0
Tire Pressure Regulation (T-4)	Considered by Board Mar 2009; Effective Sept 2010	0.6
Low Carbon Fuel Standard (T-2)	Considered by Board April 2009; Effective April 2010	15.0
Landfill Methane Capture (RW-1)	Considered by Board June 2009; Effective June 2010	1.5

Measure (Measure No.)	Status	Reduction (If Applic.)
Energy Efficiency Audits for Industrial Sources (I-1)	Considered by Board July 2010; Filed with OAL May, 2011	0.0
SF_6 Leak Reduction in Electrical Appliances (H-6)	Considered by Board Feb 2009; Effective Jan 2010	0.1

3) MEASURES IN THE PROPOSED SCOPING PLAN, BUT HAVE AUTHORITY OUTSIDE AB 32

Measure (Measure No.)	Status	Reduction (If Applic.)
SB 375 Implementation (T-3)	Regional Targets established by Board Sept 2010	3.0
33-Percent Renewable Energy Portfolio Standard (E-3)	Authorized by SB1X 2 (Statutes of 2011); Planning and development actions underway.	11.4
High Speed Rail (T-9)	In design and development by High Speed Rail Authority. Voters approved Proposition 1a.	1.0

4) MEASURES IN THE PROPOSED SCOPING PLAN, ONLY AB 32 AUTHORITY, FINALIZED THROUGH OAL

Measure (Measure No.)	Status	Reduction (If Applic.)
Refrigerant Management Program (H-6)	Considered by Board Dec 2009; Effective Nov 2010	5.8

Source: ARB 2010c, updated October 28, 2010

State and Local Governments

State government would continue its current practices, policies, investments, and its influence with California local governments and other states. California state government would influence emissions from agricultural activities, forests, water use, resource use, electricity, vehicle fleets, buildings, planes, trains, and automobiles. The state owns and operates prisons, hospitals, military bases, veterans' homes, fairs, and office buildings. State government also leases hundreds of buildings, vehicles, and pieces of equipment, and can affect thousands of companies with whom it does business. State government's contribution to BAU conditions is included in the sectors below.

Local governments have authority over how and where business, commercial, and residential land uses are developed and operated in their communities. Working closely with metropolitan planning organizations, ARB recently adopted regulations that set transportation-related GHG reduction targets for automobiles and light trucks pursuant to SB 375. The intent of the law and the reduction targets are to help shift land use patterns, improve transit opportunities and use, and build on successful planning processes that support environmentally sustainable communities. This law is related to but independent of AB 32. Local governments' contribution to BAU conditions is included in the sectors below.

Transportation

Petroleum-based fuels supply 96 percent of California's transportation needs and will continue to provide a substantial portion into the future. The BAU forecast of GHG emissions in 2020 from the transportation sector as a whole are expected to increase from current levels to 183.9 $MMTCO_2E$. This forecasted increase is dominated by increases in emissions from on-road transportation, i.e., passenger cars and heavy-duty trucks. To forecast on-road transportation emissions, ARB staff used 2007 fuel sales data obtained from the California Board of Equalization and estimated 2020 emissions based on the growth in projected vehicle miles traveled (VMT) derived from the 2007 Emissions Factor Model (EMFAC2007). This BAU forecast assumes no change in vehicle fleet mix over time. The BAU forecast also assumes no reductions in VMT or airplane traffic due to the High Speed Rail (HSR) by 2020, although the HSR has completed environmental evaluations and is continuing through the design and development process independently of AB 32 implementation. Measures that are already in place to reduce transportation emissions are Pavley 1 and the Low Carbon Fuel Standard (LCFS). Pavley 1 was considered by the Board in September 2004 and went into effect in January 2006, with a reduction target of 26.1 $MMTCO_2E$. The LCFS was considered by the Board in April 2009 and made effective April 2010 with a reduction target of 15.0 $MMTCO_2E$.

Goods movement activities in California are projected to increase up to 250 percent between 2006 and 2020, as the United States increases its exports and imports in the globalized economy. This increase translates to more ship and truck trips in and around ports, and more truck activity between and at rail yards and distribution centers. Rail trips will probably not increase, as improvements in locomotive efficiencies accommodate larger hauls. Some of this growth may require new infrastructure to relieve traffic congestion and improve efficiencies, such as port and highway expansions. ARB adopted and is implementing a Goods Movement Emission Reduction Plan to reduce emissions from goods movement activities and to address regional ozone and particulate matter standards, as well as impacts on already adversely affected communities, which can be located near ports, railyards, and distribution centers.

California Energy Commission's (CEC) *2009 Integrated Energy Policy Report* indicates that by 2020, at current trends, more than 44 million Californians will consume between 14.5 and 15 billion gallons of gasoline and diesel fuel each year (after peaking at about

16 billion gallons in 2014). Such consumption, while decreasing somewhat as a result of high prices, improved efficiency, and Alternative fuels, would still require major investments in petroleum refinery and delivery infrastructure (CEC 2009, pp. 147-150). Assembly Bill 1007 (Pavley, Chapter 371, Statutes of 2005) directed the CEC and ARB to develop a plan to increase the use of Alternative fuels in California, effectively reducing California's demand on refineries. California's refineries also supply other western states, which are currently expected to increase their demands for gasoline and diesel into the future due to population growth. Fuel diversity has also been identified as a major policy objective in the CEC's *2003 Integrated Energy Policy Report*, and Governor Schwarzenegger's Executive Order S-06-06 and resultant Bioenergy Action Plan.

California's population is continuing to grow at 1.2 percent per year. Changes in land use decision-making will be needed to foster more compact, urban and transit-served development, which directly relates to the number of vehicle miles traveled (VMT). VMT growth further degrades air quality and increases detrimental health effects. A substantial proportion of the gains made by introducing cleaner vehicles and fuels could be eroded by increased VMT unless more efficient methods of urban and community planning and transit service measures are implemented.

Electricity and Natural Gas

Under the No-Project Alternative, population growth in California will affect electricity demand in two ways: the number of residents will increase the overall demand for electricity and natural gas, and the location of those residents, primarily in the state's inland areas, will change the pattern of energy use. Peak electricity demand is expected to increase from slightly under 63,000 MW in 2010 to 71,000 MW by 2020 (CEC 2009, p. 55). Trends toward larger homes and increases in electronic equipment will also increase demand. Historically, California's appliance and building efficiency standards were able to hold our per capita electricity and natural gas demands steady, but under a BAU scenario these programs will not be able to continue this trend through 2020 and new capacity would be needed (CEC 2007). As demands increase, older, less efficient and dirtier power plants would be expected to operate more frequently.

The pattern of energy use is important, because the electrical system is sized to accommodate peak demands. The base of the state's electrical demand is a minimum amount of energy demanded by the state all the time. The peak demand is the difference between this base and the maximum amount of energy needed, usually during periods of extreme weather. Power plants that provide base energy are the most cost-effective, because they are run fairly constantly. "Peaker" power plants, on the other hand, can be run as little as 4 hours a day on a few very hot summer days, and the low duration of operation tends to result in higher co-pollutant emissions than their base counterparts on a per MW basis. Power plants are typically dispatched starting with the most efficient sources, which are generally also those with the lowest emissions. Under BAU conditions, many new power plants will need to be built in California to accommodate load growth and to replace the existing fleet of aging power plants that have low efficiencies and relatively high co-pollutant emissions. There are also several coastal plants that could be closed in response to proposed environmental requirements for their once-through cooling systems (SWRCB 2010).

Power plants are typically located close to power recipients, suggesting that new power plants would most likely follow population growth in the state. Repowering old plants or constructing new plants in the South Coast, where the state's greatest demand is located, has been identified as particularly problematic due to the region's air quality constraints and permitting requirements.

Along with reliable power plants, important components of a reliable electricity system are distribution, transmission, and availability of fuel supplies. Like power plants, distribution systems are aging, and require substantial infrastructure investments to ensure their continued reliability. The construction of new transmission lines is needed to increase the state's renewable electricity sources to meet the existing statutory goals of 33 percent. If these goals are not met, the price of electricity could increase as utilities incur financial penalties. These issues have all been identified in the 2007 and 2009 Integrated Energy Policy Reports (IEPR) as high priorities for the state in the near term (CEC 2007; CEC 2009).

A third challenge is from the effects of climate change such as increasing frequency and magnitude of extreme weather events. This could drastically affect the duration and magnitude of peak demands, increasing reliance on aging power plants. During the summer months, California also imports energy generated by hydropower from the Northwest to meet peak demand. Decreasing snowpack within California and throughout the west is likely to reduce the availability of this clean and relatively inexpensive hydropower source, further exacerbating the problem. In addition, a large number of power plants in California are located along the coast. The potential for sea level rise associated with climate change could impact the operation of those plants.

The 2020 BAU greenhouse gas emissions forecast for the electric power sector is 110.4 $MMTCO_2E$. These emissions are the result of in-state power generation plus specified and unspecified imported power. BAU forecasted emissions assume that all growth in electricity demand by 2020 will be met by either unspecified imports or in-state natural gas-fired power plants. Measures that are already in place to reduce energy-generation and use emissions are the 20 Percent RPS and the energy efficiency program. The 33 Percent RPS was enacted by SB1X 2 and is expected to result in about 11.4 $MMTCO_2E$ in 2020.

The 2020 BAU forecast for emissions from specified sources of imported electricity (i.e., power received from specific out-of-state power plants) is assumed to decrease resulting from the closure of one coal-fired power plant previously supplying imported electricity. The demand previously served by the closed plant was replaced by in-state natural-gas generation. Based on outputs from the CEC electricity demand models, in-state electricity generation and specified imports would not meet the state's full electricity demand in 2020. The remaining demand is assumed to be met by unspecified imported electricity (i.e., power received from a mix of power generating sources outside the state).

The Emissions Performance Standard (EPS) was established by SB 1368 (Perata, Chapter 598, Statutes of 2006), and will effectively reduce emissions from imported, coal-generated electricity. Regulations adopted pursuant to SB 1368 by the CPUC for investor-owned utilities and by the CEC for publicly-owned utilities prevent all California utilities from entering into long-term contracts that fail to meet an emissions performance standard. As existing agreements expire, coal-intensive electric utilities will need to respond to the established EPS with lower emission portfolios to maintain their California contracts. Such utilities will need to plan to replace coal-generated electricity with energy efficient, renewable and less carbon-intensive resources. ARB does not consider the EPS in the forecasted 2020 emissions. This allows the Scoping Plan reductions from increasing renewable power generation to be counted against with the BAU forecasted 2020 emissions without double-counting the reductions.

The California Public Utilities Commission (CPUC) recently promulgated a Decision to approve a settlement on CHP that had been negotiated by utilities and CHP proponents. The settlement requires investor owned utilities (IOUs), electrical service providers (ESPs), and community choice aggregators (CCAs) to reduce emissions from the electrical sector by retaining existing CHP and contracting with new CHP to secure a portion of the Scoping Plan's 6.7 MMTs of GHG reductions from CHP. The IOUs, ESPs, and CCAs have until 2020 to meet the Settlement's 4.8 MMTCO2E emission reduction target. One of the purposes of the settlement was to develop a method for CPUC jurisdictional utilities to achieve their portion of the Proposed Scoping Plan CHP measure. Additional CHP is expected from publicly owned utilities, but requires considerable analysis to determine what reductions are feasible. The electricity demand forecast in the 2011 Integrated Energy Policy Report being prepared by the California Energy Commission will include GHG reductions from CHP.

Electricity and Natural Gas in Residential and Commercial Properties

The Commercial and Residential sector is expected to contribute 45.3 $MMTCO_2E$ or about eight percent of the total statewide GHG emissions in 2020. Forecasted BAU emissions from the Commercial sector include combustion emissions from natural gas and other fuels (e.g., diesel) used by office buildings and small businesses. Residential emissions result primarily from natural gas combustion used for space heating and for hot water heaters. Growth in emissions from the Commercial and Residential sector is due primarily to the expected increase in population and assumed increased use of natural gas. Emissions from the use of other fuels, such as diesel fuel, are assumed to remain relatively constant over time.

Population growth in California will continue to increase electricity demand. The extent of the increase depends on natural gas used and the location of the users. Trends towards larger homes and increases in electronic equipment will also increase demand.

According to the Attorney General, since 2007, an unprecedented number of communities across the state implemented environmentally sensitive, or "green" building requirements to increase energy efficiency and decrease GHG emissions and other environmental impacts within their jurisdictions. In the first half of 2008 alone, nearly a dozen mandatory green building ordinances have taken effect, requiring private developers to utilize and document green building practices used throughout the construction and life of the project. Other California cities, like San Francisco, San Leandro, Santa Rosa, Hayward and Los Altos Hills are currently developing ordinances for enactment in the near future.

In January 2010, the California Building Standards Commission adopted the nation's first mandatory green building code. Called "CalGreen," the code became effective in early 2011 and lays out specific requirements for newly constructed buildings. It requires builders to install plumbing that cuts indoor water use by as much as 20 percent, to divert 50 percent of construction waste from landfills to recycling, and to use low-pollutant paints, carpets, and floors. It also mandates inspection of energy systems to ensure that heaters, air conditioners, and other mechanical equipment are working efficiently. For non-residential buildings, it requires the installation of water meters for different uses. The code also allows local jurisdictions to retain stricter green building standards, if they already exist, or to adopt stricter versions of the state code if they choose. The Scoping Plan encourages communities to adopt building codes that go beyond the state code (ARB 2009, pp. 57-59).

The experience of municipal actions and the adoption of the CalGreen building code have shown that bold, ambitious action to reduce carbon emissions is possible. These efforts have taken place without the Green Building measures being adopted as part of the Scoping Plan.

Water

Most of California's water supply originates and is stored as snow. The variability of annual precipitation, compounded by changing climatic conditions, can dramatically affect the availability of water from year to year. The allocation of water to satisfy competing urban, agricultural, and environmental interests represents a significant challenge for water managers. Notably, the allocation of water from the Colorado, Delta, and Klamath water supply systems has been subject to numerous legal challenges.

Water and energy are intricately linked. Water generates electricity, while electricity is required to distribute and treat water. In California, hydropower provides about 15 percent of the total electricity while approximately 19 percent of the state's electrical demand comes from transporting, treating and using water.

The California Water Plan is the State's strategic plan for management of water resources. The California Water Plan Update 2009 examined three scenarios extending to the year 2050: Current Trends, Slow & Strategic Growth, and Expansive Growth. The fundamental purpose of the water plan scenario analysis is to measure the resiliency of future water policies and actions. The scenarios consider a range of key variables including population, land use, agricultural practices, environmental water needs, and climate change. Overall future water demand is projected to increase if California continues to grow consistent with current trends, but a slow and strategic approach to growth could reduce future water demand. (California Water Plan Update 2009. Volume1 Strategic Plan, pp. 5-22 to 5-36).

Long-term solutions to balancing California's water supply and use will require a combination of improved efficiency and use, conservation, and infrastructure improvements, none of which are anticipated to be completed by 2020.

Green Buildings

There are several policies, codes, and plans in place to increase the environmental efficiency of new and existing commercial, residential, and state buildings by 2020, including the new mandatory California Green Building Standards Code adopted by the Building Standards Commission adopted in January 2010, and made effective in early 2011. The California Public Utilities Commission (CPUC) also has established "zero net energy" (ZNE) goals for new construction in California. By 2020, the goal is that all new homes will be ZNE. For commercial buildings, the target date is 2030. In the best case, if the state is able to transform new housing and building stock into "net zero energy" stock, and existing buildings are retrofitted for greater energy and water efficiency, the demand for water and energy from buildings will be similar to or lower than what it is today. This will depend on both the degree to which new stock is built or existing stock is converted and the degree to which they incorporate environmental efficiency over the next twelve years.

Industry

The Industry Sector as defined in the Scoping Plan includes refineries, oil and gas facilities, cement and glass manufacturing, and industrial facilities that employ boilers or general combustion engines. The BAU assumptions for refineries are discussed in the transportation section above. Activity in California oil and gas fields are driven by price and availability, and may therefore expand in the future if current price trends continue. Off-shore drilling would most likely hold steady, due to the limited yield and potential for severe environmental impacts. While the demand for cement will grow with population growth, most of the demand is likely to be met through out of state production while the current rate of in-state production holds steady. Overall manufacturing is expected to slightly decline, while the commercial sector increases. Manufacturing will likely remain concentrated in the South Coast and Bay Area, with agricultural and food processing concentrated in the San Joaquin Valley.

Emissions for this sector are forecasted to grow to 91.5 $MMTCO_2E$ by 2020, an increase of approximately five percent from the average emissions level of 2002-2004. BAU-forecasted emissions for this sector are variable, but overall are not expected to grow substantially. Most of the growth from this sector comes from the fuel use and process emissions of three industries: cement plants, oil and gas production, and refining. Emissions from the combustion of natural gas are expected to grow for some industries (e.g., cement plants) and decline for others (e.g., food processors). These assumptions of growth and decline in natural gas demand are based on outputs from energy demand modeling conducted by CEC staff for the 2009 Integrated Energy Policy Report (IEPR).

Recycling and Waste Management

California disposed an estimated 31 million tons of waste in landfills in 2009, which reflects a continuing decline from the state's peak of 42.5 million tons in 2005. Per capita waste disposal has also continued to decrease, most recently measured to be 4.5 pounds/resident/day in 2009, down from 5.1 pounds/resident/day in 2008 (CalRecycle 2010). The reduction in waste disposal reflects the state's high rate of waste diversion from landfills and the recession. Over 55 percent of California's waste is diverted from landfills and recycled or repurposed. Most of the remainder of California's waste is sent to landfills in the state. In the future, the need for new landfills will be determined by both population growth and by how well the state implements its waste management goals. One supporting goal is to halve the volume of organics going to landfills by 2020. These goals will require the development of new facilities for composting to recycle and reuse waste, but will also reduce the need for new landfill capacity.

Forecasted BAU emissions in 2020 for landfills are 8.5 $MMTCO_2E$. This forecast uses a recognized landfill gas emissions model developed by the Intergovernmental Panel on Climate Change (IPCC) and data from Cal Recycle. The forecast reflects assumptions regarding the continued decay of existing waste in landfills and estimates on the amount and character of new waste deposited in landfills through 2020.

Forests

The forest sector is unique to California's GHG inventory because it combines both positive and negative emissions into a current sink of approximately -5 $MMTCO_2E$ (2002-2004 average). This net number is negative because the annual gross emission rate from fires, decomposition, harvesting, land conversion, and wood waste is less than the atmospheric uptake of carbon dioxide from forest growth. In addition to being a GHG sink, forests also provide multiple ecological benefits like habitat, structure, and nutrient cycling, as well as a suite of other human benefits or services such as water storage, soil stability, air and water quality, wood products, and recreation. The BAU inventory shows that forest sector emissions are increasing while forest growth is remaining the same. Two factors addressed in the Proposed Scoping Plan which may cause a decline in forest carbon sinks over time, are land conversion and the increased incidence and intensity of wildfires.

As seen in summer of several recent years, wildfires can significantly impact air quality and threaten public safety. Wildfires in water supply watersheds can also impact drinking water quality for years after they occur. Population growth will increase pressure to develop forest lands and development in close vicinity of forests can further increase risk. Climate change is also likely to increase risks associated with the forest sector through changes to weather patterns which can impact forests, both directly and indirectly, by creating hospitable conditions for pests and catastrophic fires.

High Global Warming Potential Gases

Consumer demand, vehicle use patterns, and increased electrical demand due to population growth will increase the amount of high-GWP gases released to the atmosphere. The rates of increase vary by type of activity.

The forecasted BAU 2020 emissions of high-GWP gases are 37.9 $MMTCO_2E$. High-GWP gases, including sulfur hexafluoride (SF_6) from electric utility applications, substitutes for ozone depleting substances (ODS) (primarily hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs)), and other high-GWP gases used in semiconductor manufacturing and other industrial processes are combined under one sector for purposes of the Scoping Plan. The forecast of BAU emissions of high-GWP gases is derived from the U.S. EPA Vintaging Model, which outputs predicted annual consumption and emissions of all high GWP gases based on end-use equipment, the amount of gas required for manufacture and maintenance, and disposal emissions. Emissions of HFCs and PFCs as ODS-substitutes occur from their use in refrigeration and air conditioning systems, among other commercial and industrial applications. The high BAU forecasted emissions in 2020 comes about as ODS's are rapidly replaced by ODS substitutes, as more ODS's are phased out. In addition, ARB assumes that the effect of an expansion of the electrical transmission system infrastructure, combined with the technical improvements to the equipment in the system, will result in no net change in SF_6 emissions in 2020.

Agriculture

The agriculture sector includes emissions from livestock, i.e., digestive processes and manure management; combustion of liquid and gaseous fuels used for irrigation and crop production; emissions from fertilizer use and application of other soil additives; and emissions from agricultural residue burning. By 2020, there is significant potential for continued conversion of farmlands to urban, commercial, or industrial development or other uses.

Agricultural residue burning and livestock emissions were forecast using ARB’s criteria pollutant forecasting approach. Forecasted emissions from the combustion of natural gas were estimated using outputs from the 2007 IEPR developed by CEC. Other agriculture-related emissions were either held constant or extrapolated using historical trends to obtain a 2020 BAU estimate. BAU emissions from the agriculture sector are forecasted to increase about seven percent from current levels to 29.1 $MMTCO_2E$ in 2020, due exclusively to the assumed increase in livestock population. In spite of current measures to preserve farmlands and open space through Williamson Act contracts, state land purchase, and general plan land use designation or zoning, population increases will continue to pressure the conversion of farmlands to urban, commercial, and industrial development or other uses.

Summary of Alternative 1 Strategy

In summary, recognizing BAU estimates and the continuation of some GHG reduction programs already implemented as part of the Scoping Plan (e.g., pre-existing programs and discrete early action measures) or because of other legislative authorities (e.g., SB 375, SB1X 2), GHG emissions under the No-Project Alternative exceed the 2020 reduction goal in AB 32 by 22 $MMTCO_2E$. With this shortfall, the No-Project Alternative would be inconsistent with the AB 32 statutory mandate.

Alternative 1 Impact Discussion

Objectives

The No-Project Alternative would not meet the fundamental objective of the Scoping Plan and AB 32 to reach 2020 emissions goals, because the GHG emissions reductions of the existing programs and strategies authorized by other statutes would fall short of the mandated goal to of decreasing emissions to 1990 levels by 2020. The expected shortfall would be approximately 22 $MMTCO_2E$, because the Cap-and-Trade regulation and Advanced Clean Car program would not be a part of this alternative.

Environmental Impacts

The No-Project Alternative includes GHG reduction measures that are ongoing, already implemented as part of the Scoping Plan, or developed under authorities additional to AB 32. Direct and indirect environmental effects of these measures would result from implementation of the No-Project Alternative. This would include resource-related environmental effects associated with the development of renewable energy projects in response to the existing 33-percent RPS, including major utility-scale facilities in remote areas, and the construction and operation of the California high speed rail project being pursued by the High-Speed Rail Authority, which are the two existing measures that would result in the most substantial, landscape-altering construction projects. As a result, the No-Project Alternative would incur a substantial portion of the adverse environmental impacts of the Proposed Scoping Plan (which would add the Cap-and-Trade Program, including offset protocols, and the Advanced Clean Car program) without achieving comparable environmental benefits of reduced GHG and co-pollutant emissions. Consequently, the No-Project Alternative would not be environmentally advantageous, compared to the Proposed Scoping Plan.

Aesthetic impacts of the Proposed Scoping Plan, with its Cap-and-Trade Program and advanced clean car program, would be less than significant, because they would not involve substantial construction actions that would alter scenic resources or important views and vistas (ARB 2009, p. J-23). The No-Project Alternative would not avoid any significant aesthetic effects of the proposed programs. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, such as potential scenic resource and aesthetic impacts of developing utility-scale renewable energy projects, the high-speed rail project, or the million solar roofs program.

Agriculture and forest resources impacts of the Proposed Scoping Plan may be significant, because large-scale renewable energy facilities and the high-speed rail project could affect agricultural land (ARB 2009, pp. J-41 – J-42). The sources of potentially significant adverse agricultural and forest resource impacts would not include a Cap-and-Trade Program and Advanced Clean Car program, because compliance responses would not involve use of agricultural lands or conversion of forest land to non-forest uses (ARB 2010b, p. O-15). The No-Project Alternative would not avoid any significant agricultural or forest conversion-related effects of the Proposed Scoping Plan. The effects of other ongoing, implemented, or otherwise authorized measures of the Proposed Scoping Plan would continue to occur, such as potential conversion of important farmland related to developing utility-scale renewable energy projects or the high-speed rail project.

Air quality impacts of the Proposed Scoping Plan were identified as less than significant in the FED (ARB 2009, pp. J-24 – J-40) and included beneficial reduction of co-pollutant emissions on a statewide basis. Subsequently, the potential for significant localized air quality impact was further assessed for the Cap-and-Trade Regulation proposed in October 2008 (ARB 2010b, pp. O-15 – O-16). Localized air quality impacts resulting from compliance responses by covered entities and the development of offset credits related to that proposed Cap-and-Trade Regulation found impacts highly unlikely and the specific locations and impact of any such emission increases uncertain. To address the possibility of unanticipated localized air impacts caused by the Cap-and-Trade Regulation, ARB incorporated an adaptive management approach into the proposed regulation. The adaptive management approach reflects ARB's commitment to monitoring the data on localized air quality impacts and to adjusting a Cap-and-trade Regulation adopted, if warranted. Even with these considerations, ARB has took a conservative approach by concluding that the remote possibility of localized air impacts as potentially significant under CEQA. Therefore, the adoption of the No-Project Alternative would avoid this potentially significant, localized air quality effect of a Cap-and-Trade Program included in the Proposed Scoping Plan. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, such as construction-related or operational criteria pollutant emissions from the development of utility-scale renewable energy projects or the high-speed rail project. Also, environmental benefits related to statewide reduction in GHG emissions from the Cap-and-Trade Program and Advanced Clean Cars program, along with corresponding co-benefits of reductions in criteria air pollutants and TACs, would not be realized with the No-Project Alternative.

Biological impacts of the Proposed Scoping Plan would result from the Cap-and-Trade Program component, including compliance responses by covered entities and the development of offset credits (ARB 2009, pp. J-43 – J-45; ARB 2010b, p. O-16 and O-311 – O-314). These biological impacts would be potentially significant related to facility construction to reduce GHG emissions at existing facilities of cap-covered entities where natural resources could be present. Also, to the extent that new or modified fueling facilities for Advanced Clean Cars required construction on undeveloped land, additional landscape alteration may occur. Therefore, the adoption of the No-Project Alternative could avoid these potentially significant biological effects of the Proposed Scoping Plan. The effects of other ongoing, implemented, or otherwise authorized measures of the Proposed Scoping Plan would continue to occur, such as LCFS and 33-percent RPS, which will require the siting and construction of facilities with potentially substantial alteration of natural landscapes. Substantial landscape alteration from the development of utility-scale renewable energy projects or the high-speed rail project could affect sensitive habitats and special-status species.

Cultural resources impacts of the Proposed Scoping Plan, including the Cap-and-Trade Program and Advanced Clean Car Program, could involve potentially significant effects related to facility construction at existing facilities where archaeological or historic resources could be present (ARB 2009, p. J-46; ARB 2010b, p. O-17). This could include facilities constructed for purposes of reducing GHG at Cap-and-Trade Program covered entity locations and new or modified vehicle fueling stations for advanced clean cars. Therefore, the adoption of the No-Project Alternative would avoid these potentially significant cultural resources effects of the Proposed Scoping Plan. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, however, such as the potential to disturb cultural resources from construction related to the development of utility-scale renewable energy projects or the high-speed rail project.

Energy impacts of the Proposed Scoping Plan with the Cap-and-Trade Program and Advanced Clean Car Program would be less than significant, because the programs would not require substantial net additional energy demand to implement. In addition, considering the energy efficiency improvements expected as a result of compliance responses, the lower GHG emission standards for motor vehicles, the use of renewable transportation fuels, beneficial reduction of energy consumption would occur with the Proposed Scoping Plan (ARB 2009, p. J-47 – J-48; ARB 2010b, p. O-17). Therefore, the adoption of the No-Project Alternative would not avoid any significant energy effects of the Proposed Scoping Plan and certain beneficial energy efficiency effects would not occur. The beneficial energy effects of other ongoing, implemented, or otherwise authorized measures, such as utility-scale renewable energy projects and the high-speed rail project, would not be realized.

Geological, soils, and mineral resources impacts of the Cap-and-Trade Program and Advanced Clean Car Program components of the proposed Scoping Plan could involve potentially significant effects related to facility construction at existing facilities where substantial earthwork would be required (ARB 2009, p. J-49 – J-50; ARB 2010b, p. O-17 – O-18). Therefore, the adoption of the No-Project Alternative would avoid these potentially significant effects of the proposed Scoping Plan to geology, soils, or mineral resources. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, however, such as from the potential for substantial grading and erosion from construction related to the development of utility-scale renewable energy projects or the high-speed rail project.

The GHG-related impacts of the Proposed Scoping Plan, including the Cap-and-Trade Regulation and Advanced Clean Car program, would be beneficial, because GHG reduction is the objective of the plan. Therefore, the adoption of the No-Project Alternative would not avoid any significant GHG effects of the Proposed Scoping Plan;

however, the beneficial GHG reduction effects of the Cap-and-Trade Program and Advanced Clean Car Program would not be realized. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, such as potential GHG benefits resulting from development of utility-scale renewable energy projects or the high-speed rail project.

Hazards and hazardous materials impacts of the Proposed Scoping Plan, including the Cap-and-Trade Program and an Advanced Clean Car Program, would be less than significant, because any waste stream from the programs would be handled by existing regulated handling and disposal requirements and new or more severe hazards would not result from facilities needed to implement the programs (ARB 2009, p. J-50 – J-54; ARB 2010b, p. O-18). The most substantial waste stream from the Scoping Plan programs would be spent batteries from the advanced clean car program. Battery recycling and disposal requirements would be included to minimize and properly handle hazardous materials in the battery waste stream. Therefore, the adoption of the No-Project Alternative would not avoid any potentially significant hazard or hazardous materials effects of the Proposed Scoping Plan. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, however, such as the potential for accidental hazardous materials releases from major construction projects related to the development of utility-scale renewable energy projects or the high-speed rail project.

Hydrology and water quality impacts of the Proposed Scoping Plan, including the Cap-and-Trade Program and Advanced Clean Car Program, could involve potentially significant effects related to construction of facilities for GHG reduction at Cap-and-Trade covered entity sites or related to new or modified fueling stations for advanced clean cars, where water resources are present (ARB 2009, p. J-64 – J-69; ARB 2010b, p. O-19). The effects could include alteration of drainage or accidental contaminant releases during construction. Therefore, the adoption of the No-Project Alternative would avoid these potentially significant effects of the Cap-and-Trade Program and Advanced Clean Car Program components of the Proposed Scoping Plan to hydrology and water quality. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, however, such as the potential for substantial drainage, flood hazard, and water quality effects from major construction projects related to the development of utility-scale renewable energy projects or the high-speed rail project.

Land use and planning impacts of the Proposed Scoping Plan with the Cap-and-Trade Program and Advanced Clean Car Program could involve potentially significant conflict with local plans and policies related to avoided conversion projects under the Forest Protocol of the Cap-and-Trade Program, where actions to protect a forest may conflict with locally adopted land use or development plans (ARB 2009, p. J-54 – J-57; ARB 2010b, p. O-19 – O-20 and O-322 – O-324). Therefore, the adoption of the No- Project Alternative would avoid this potentially significant land use plan conflict effect of the Proposed Scoping Plan. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, such as the potential for substantial land use and planning conflicts related to the development of utility-scale renewable energy projects or the high-speed rail project.

Noise impacts of the Proposed Scoping Plan, including the Cap-and-Trade Program and Advanced Clean Car Program, could involve potentially significant effects related to construction and operational activities occurring as a result of installing livestock digesters under the proposed Cap-and-Trade Regulation offset protocol (ARB 2009, p. J-58 – J-59; ARB 2010b, p. O-20 and O-252 – O-256). Also, construction of new or modified fueling facilities for advanced clean cars could result in temporary, significant noise impacts, if facility locations are near sensitive receptors. Therefore, the adoption of the No-Project Alternative would avoid these potentially significant effects of the Proposed Scoping Plan to noise conditions. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, however, such as the potential for substantial noise generation related to the development of utility-scale renewable energy projects or development and operation of the high-speed rail project.

Employment, population, and housing impacts of the Proposed Scoping Plan, including the Cap-and-Trade Program and Advanced Clean Car Program would be less than significant, because facility or operational changes at Cap-and-Trade covered entities or related to the Advanced Clean Car Program would not change socioeconomic conditions sufficiently to cause substantial physical environmental effects (ARB 2009, p. J-59 – J-60; ARB 2010b, p. O-20). In addition, considering the potential for facility improvements expected as a result of Cap-and-Trade Program, compliance responses, and an Advanced Clean Car Program, beneficial job generation would occur with these proposed programs (although not substantial enough in number to significantly affect local population or housing demands). Therefore, the adoption of the No-Project Alternative would not avoid any significant employment, population, or housing effects of the Proposed Scoping Plan and certain beneficial job formation effects would not occur. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, such as potential job forming benefits resulting from development of utility-scale renewable energy projects or the high-speed rail project.

Public service impacts of the Proposed Scoping Plan, including the Cap-and-Trade Program and Advanced Clean Car Program, would be less than significant, because facility changes resulting from compliance responses would take place in areas already receiving community public services (ARB 2009, p. J-60 – J-61; ARB 2010b, p. O-21). Therefore, the adoption of the No-Project Alternative would not avoid any significant public services effects of the Proposed Scoping Plan. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, such as potential public service demands resulting from development of utility-scale renewable energy projects (including remote-area emergency service demands when energy facilities are located substantially far from existing communities) or the high-speed rail project.

Recreation impacts of the Proposed Scoping Plan with the Cap-and-Trade Program and Advanced Clean Car program would be less than significant, because the location of potential facility changes in response to these programs would not likely be near or in conflict with existing recreation areas or facilities (ARB 2009, p. J-61; ARB 2010b, p. O-21). Therefore, the adoption of the No-Project Alternative would not avoid any significant recreation effects of the Proposed Scoping Plan. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, such as potential conflict with recreation resource lands from developing utility-scale renewable energy projects on public lands.

Transportation and traffic impacts of the Proposed Scoping Plan, including the Cap-and-Trade Program and advanced Clean Car Program, could involve potentially significant temporary effects related to construction activity traffic where substantial facility improvements are implemented as a compliance response (ARB 2009, p. J-63 – J-64; ARB 2010b, p. O-21 – O-22). Therefore, the adoption of the No-Project Alternative would avoid these potentially significant effects of the Proposed Scoping Plan to traffic conditions. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, however, such as the potential for substantial traffic generation during the construction phase of major, utility-scale renewable energy projects or the construction and operation of the high-speed rail project.

Utility and service system impacts of the Proposed Scoping Plan, including the Cap-and-Trade Program and Advanced Clean Car Program, would be less than significant, because facility changes resulting from compliance responses would take place in areas already receiving community utility services (ARB 2009, p. J-64; ARB 2010b, p. O-22). Therefore, the adoption of the No-Project Alternative would not avoid any significant utility and service system effects of the Proposed Scoping Plan. The effects of other ongoing, implemented, or otherwise authorized measures would continue to occur, such as potential utility or service system demands resulting from development of utility-scale renewable energy projects, including in remote areas, or the high-speed rail project.

2.4 Alternative 2: Adopt a Program Based on Cap-and-Trade for the Sectors Included in the Cap

Goal of Alternative 2

The goal of Alternative 2 is to consider an Alternative that focuses on a cap-and-trade program as the primary source of GHG emission reductions for the 22 MMT shortfall identified above. The intended advantage of a cap-and-trade program is that total GHG emissions decrease in compliance with a cap (i.e., allowable emission limit) that declines over time, while covered entities are afforded flexibility to pursue the most cost-effective actions to reduce emissions. In Alternative 2, the Advanced Clean Car Program is not included.

Role of Alternative 2 in the Range of Alternatives

The role of Alternative 2 in the range of alternatives is to assess the effectiveness and potential environmental effects of a GHG reduction approach where compliance relies more heavily on non-prescriptive measures that are adaptable to market and economic factors. A cap-and-trade program can involve many variations in the details of requirements for reporting, meeting surrender obligations, marketing tradable compliance allowances, and providing compliance flexibility with offsets. It is not feasible or meaningful to examine the very wide range of potential details for cap-and-trade programs, because the possible combinations of details are innumerable. However, describing a reasonable and practical approach to illustrate how a cap-and-trade program can reduce GHG emissions will enable an understanding of the relative potential of this market mechanism and its compliance responses to cause environmental impacts.

Precedents or Examples of the Approach in Alternative 2

Several precedents for cap-and-trade approaches have been reviewed while developing California's GHG emissions market-incentive program. Two federal market-incentive programs administered by the U.S. EPA provide a history of performance of cap-and-trade approaches to emissions reductions to consider. The two programs are directed at reducing NO_x emissions and acid rain. The South Coast Air Quality Management District (SCAQMD) has established a RECLAIM program for NO_x and SO_2 reduction. Two early GHG cap-and-trade programs are the Regional Greenhouse Gas Initiative (RGGI) in the Northeast United States and the European Union – Emissions Trading System (EU-ETS).

The Market Advisory Committee (MAC) established to help design the California cap-and-trade program recognized that the prior programs can provide lessons learned in their design and implementation. While not all features of the design of the prior programs worked well, like the absence of allowance banking in the RECLAIM program, the MAC report to ARB indicated that cap-and-trade had a strong potential to achieve GHG reductions in capped sectors at relatively low cost (MAC 2007, pp. 15-17). Independent evaluations of the effectiveness of cap-and-trade systems have identified both advantages and shortcomings from previous and ongoing programs. Some relevant conceptual studies are noted below, followed by a summary of precedential programs. The historic performance, both positive and negative, of market-incentive programs has provided guidance in the design of a California approach.

Conceptual Studies on Emissions Trading vs. Other Options

There is a vast literature that examines the pros and cons of cap-and-trade, and although authors vary in their conclusions, most agree that, if properly designed, cap-and-trade can be an effective tool for reducing emissions. This section presents a brief summary of recent studies on the fundamental considerations when selecting emissions trading as a policy tool.

In 2007, Resources for the Future released a report summarizing work conducted as part of an inter-industry U.S. Climate Policy Forum (RFF 2007). In addition to other topics, this report analyzed three general climate policy options: emissions trading, emissions taxes, and regulatory standards. With respect to carbon pricing policies, this report concludes the following key points:

- There are many similarities between CO_2 taxes and tradable allowances or permits. Both reduce emissions by associating a uniform price with emitting activities at any point in time, leading to efficient, low-cost emission reductions. Both can incorporate offset project opportunities and provide emissions leakage protection (through free allocation in the case of tradable permits or through rebates in the case of the tax).

- A predictable price, as imposed by a carbon tax, tends to have advantages over fixing the level of emissions through emissions trading for a short time horizon of several years. Over longer horizons fixed emissions targets through emissions trading become increasingly advantageous.

- The theoretical differences between a tax and trading policy are easily blurred in a hybrid emissions trading system where some allowances are auctioned to raise government revenue and where banking, borrowing or other flexible cost-containment mechanisms are in place to help stabilize prices.

- Traditional forms of regulation—technology and performance standards—represent an Alternative to emissions trading or CO_2 taxes, but can be much more costly because they do not allow the flexibility to shift efforts toward the cheapest mitigation opportunities. As a complement to emissions trading or CO_2 taxes, however, flexible standards can address possible additional market failures and potentially lower costs.

In February 2008, the U.S. Congressional Budget Office (CBO) released a study on policy options for reducing CO_2 emissions (CBO 2008). In this study, CBO compared three key criteria (i.e., efficiency, implementation, and international consistency considerations) for incentive-based approaches (i.e., CO_2 tax, cap with a ceiling and either banking or a price floor, cap with banking and either a circuit breaker or managed borrowing, and inflexible cap). The study explores ways in which policymakers could preserve the structure of a cap-and-trade program, but still achieve some of the advantages of a tax. These include setting a ceiling or a floor on the price of emission allowances, permitting firms to transfer emission-reduction requirements across time by banking allowances in one year for use in future years (or borrowing future allowances for use in an earlier year), and modifying the stringency of the cap from year to year on the basis of the price of allowances.

According to another study, published in the Oxford Review of Economic Policy in 2008 (Stavins 2008), the most efficient approach for the short to medium term in the U.S. in regards to addressing climate change would be a cap-and-trade system (also, see the study in the Harvard Environmental Law Review (Stavins 2007)). The study identifies that the integrity of a domestic program could be maximized (and its costs and risks minimized) by:

- targeting all fossil-fuel-related CO_2 emissions through an upstream, economy-wide cap;
- setting a trajectory of caps over time that begins modestly and gradually becomes more stringent, establishing a long-run price signal to encourage investment;
- adopting mechanisms to protect against price uncertainty; and
- including linkages with the climate-policy action of other counties.

It is also stated that a well-designed, cap-and-trade system would minimize the costs of achieving any given emissions target through flexibility regarding how much a facility would emit and the ability to trade emission allowances. Also, the cost of achieving significant emission reductions in future years would depend on the availability and cost of low- or non-emitting technologies. A cap-and-trade system that establishes caps extending decades into the future provides important price signals and, hence, incentives for firms to invest in the development and deployment of such technologies, thereby lowering the future costs for achieving emission reductions. However, it is noted that a cap-and-trade system alone may not encourage the socially desirable level of investment in research, development, and deployment of new technologies that could reduce future emission-reduction costs and thus, to achieve this, additional policies may be necessary to provide targeted additional action.

Summary of Existing Emissions Trading Systems

NO_x Reduction Programs

From 1999 to 2002, the Ozone Transport Commission (OTC) NO_x Budget Program was implemented to reduce summertime NO_x emissions, which contribute to ozone formation, in the northeast United States. The program capped summertime NO_x emissions at 219,000 tons in 1999 and 143,000 tons in 2003, less than half of the 1990 baseline emission level of 490,000 tons. The OTC NO_x Budget Program used an allowance trading system that harnessed free market forces to reduce pollution. The NO_x Budget Trading Program (NBTP) replaced the OTC NO_x Budget Program in 2003. It was established as a market-based, cap-and-trade program created to reduce the regional transport of NO_x emissions from power plants and other large combustion sources that contribute to ozone nonattainment in the eastern United States. The program was a central component of the NO_x State Implementation Plan, otherwise known as “NOx SIP Call,” promulgated in 1998. All 20 states covered by the NO_x SIP Call were in the NBTP. In 2009, the Clean Air Interstate Rule’s ozone season program began, effectively replacing the NBTP in the East to achieve further summertime NO_x reductions from the power sector (U.S. EPA 2011b; U. S. EPA 2009, pp. 1-2).

Acid Rain Program

The overall goal of the Acid Rain Program was to achieve substantial environmental and public health benefits through reductions of SO_2 and NOx, which are the primary pollutants that cause acid rain. To achieve this goal at the lowest cost to society, the program employed both traditional and innovative, market-based approaches for controlling air pollution.

For SO_2 reduction, Title IV of the Clean Air Act set a goal of reducing annual emissions by 10 million tons below 1980 levels. To achieve these reductions, the law required a two-phase tightening of the restrictions placed on fossil fuel-fired power plants. Phase I began in 1995 and affected 263 units at 110 mostly coal-burning electric utility plants located in 21 Eastern and Midwestern states. An additional 182 units joined Phase I of the program as substitution or compensating units, bringing the total of Phase I affected units to 445. Emissions data indicate that 1995 SO_2 emissions at these units nationwide were reduced by almost 40 percent below their required level (U.S. EPA 2011).

Phase II of the SO_2 program, which began in the year 2000, lowered the annual emissions limits imposed on these large, higher emitting plants and also set restrictions on smaller, cleaner plants fired by coal, oil, and gas, encompassing over 2,000 units in all. The program affected existing utility units serving generators with an output capacity of greater than 25 megawatts and all new utility units.

The Clean Air Act also called for a 2 million ton reduction in NO_x emissions by the year 2000. A substantial portion of this reduction has been achieved by coal-fired utility boilers that have been required to install low NO_x burner technologies and to meet new emissions standards.

The Acid Rain Program was implemented through an integrated set of rules and guidance designed to accomplish three primary objectives: (1) achieve environmental benefits through reductions in SO_2 and NO_x emissions; (2) facilitate active trading of allowances and use of other compliance options to minimize compliance costs, maximize economic efficiency, and permit strong economic growth; and (3) promote pollution prevention and energy efficiency strategies and technologies. The program consisted of the following components (U.S .EPA 2011):

- The allowance trading system created low-cost rules of exchange that minimize government intrusion and make allowance trading a viable compliance strategy for reducing SO_2.
- The opt-in program allowed non-affected industrial and small utility units to participate in allowance trading.
- The NO_x emissions reduction rule set new NO_x emissions standards for existing coal-fired utility boilers and allowed emissions averaging to reduce costs.

- The permitting process afforded sources maximum flexibility in selecting the most cost-effective approach to reducing emissions.

- The continuous emission monitoring (CEM) requirements provided credible accounting of emissions to ensure the integrity of the market-based allowance system and to verify the achievement of the reduction goals.

- The excess emissions provision provided incentives to ensure self-enforcement, greatly reducing the need for government intervention.

SCAQMD RECLAIM Program

RECLAIM, the Regional Clean Air Incentives Market, is a multi-industry cap-and-trade program adopted by SCAQMD Governing Board in 1993. RECLAIM sets a factory-wide pollution limit for each covered business, and lets businesses decide what equipment, processes and materials they will use to meet their emission limits. Under RECLAIM, these allowable emission limits decline a specific amount each year for each covered factory. Companies are free to choose the most cost-effective, economical ways to reduce pollution. Companies that can reduce emissions more than required can then sell excess emission reductions to other firms. Buyers of the emission reduction credits are companies that need more time to clean up or find the cost of buying credits cheaper than buying and installing new equipment (SCAQMD 2007, pp. EX-1 – EX-2; SCAQMD 2011). The RECLAIM program required industries and businesses to cut their emissions by a specific amount each year, resulting in a 70 percent reduction for nitrogen oxides NO_x and a 60 percent reduction for SO_x by 2003. SO_x annual targets have been met every year. NO_x annual emissions have met the target every year except 2000 and 2001, when California experienced an energy shortage (SCAQMD 2007, p. EX-3; SCAQMD 2011).

On November 5, 2010, the Governing Board of the SCAQMD adopted amendments to its RECLAIM program that will result in cumulative reductions of 5.7 tons per day, or more than 51 percent reduction, of oxides of sulfur (SOx) from all RECLAIM facilities by 2019. The changes are to be implemented in phases: 3 tons per day in 2013, 4 tons per day in each year from 2014 through 2016, 5 tons per day in 2017 and 2018, and 5.7 tons per day in 2019 and beyond.

Regional Greenhouse Gas Initiative

The Regional Greenhouse Gas Initiative (RGGI) is the first market-based, regulatory program in the United States to focus on GHG emissions. Covered entities are limited to electricity generation facilities. Ten Northeastern and Mid-Atlantic states currently participate in the program. The Governor of New Jersey recently announced his intention to withdraw New Jersey from the program at the end of the first control period, December 31, 2011. The RGGI states have capped and committed to reduce CO_2 emissions from the power sector 10 percent by 2018. States sell nearly all emission allowances through auctions and invest proceeds in consumer benefits that include energy efficiency, renewable energy, and other clean energy technologies.

RGGI is composed of individual CO_2 Budget Trading Programs in each of the participating states. Through independent regulations, based on the RGGI Model Rule, each state's CO_2 Budget Trading Program limits emissions of CO_2 from electric power plants, issues CO_2 allowances, and establishes participation in regional CO_2 allowance auctions. Regulated power plants can use a CO_2 allowance issued by any of the participating states to demonstrate compliance with an individual state program. In this manner, the state programs, in aggregate, function as a single regional compliance market for CO_2 emissions (RGGI 2007).

European Union – Emissions Trading System

The European Union – Emissions Trading System (EU-ETS) cap-and-trade program was launched in 2005. Within the cap, companies receive emission allowances that they can sell to or buy from one another, as needed. The limit on the total number of available allowances supports their value. At the end of the trading period, each company must surrender enough allowances to cover all its emissions; otherwise, fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or sell them to another company that is short of allowances. The flexibility of trading promotes cost-effective reduction strategies. The number of allowances is reduced over time so that total emissions decrease. In 2020, emissions are planned to be 21 percent lower than in 2005.

The EU-ETS operates in 30 countries (the 27 EU Member States plus Iceland, Liechtenstein and Norway). It covers CO_2 emissions from installations such as power stations, combustion plants, oil refineries, and iron and steel works, as well as factories making cement, glass, lime, bricks, ceramics, pulp, paper and board. Nitrous oxide emissions from certain processes are also covered. Between them, the installations currently in the scheme account for almost half of the EU's CO_2 emissions and 40 percent of its total GHG emissions.

Airlines are scheduled to join the system in 2012. The EU-ETS will be further expanded to the petrochemicals, ammonia, and aluminum industries and to additional gases in 2013, when the third trading period starts. Also, based on lessons learned during the first two trading periods, a series of system changes will be implemented (European Commission Climate Action 2011).

California Cap on GHG Emissions and Market-Based Compliance Mechanisms

The examples listed above are of existing cap-and-trade programs adopted by other entities. In developing Alternative 2, ARB staff also considered the work it has done in recent months as part of its proposal to the Board to adopt a Cap-and-Trade Regulation in California. As discussed above, the process is currently ongoing, and the Board has made no final decision on whether to adopt a Cap-and-Trade Regulation. Staff's recent work has, however, helped to inform the development and analysis of Alternative 2.

In 2010, ARB staff proposed the adoption of a Cap-and-Trade Regulation with fully developed strategies for defining the declining cap, emissions reporting, establishing marketable emissions allowances, setting the timing for surrendering compliance instruments, formulating protocols for using carbon offsets, and creating an adaptive management approach. This program is described in detail in the FED for the California Cap on GHG Emissions and Market-Based Compliance Mechanisms regulation, released for public review in October 2010 (ARB 2010a, Appendix O). Relevant components of Alternative 2 are summarized from this Cap-and-Trade Regulation FED. Alternative 2, like the proposed Cap-and-Trade Regulation, includes use of offsets to achieve part of its reduction goals and help manage allowance prices. The applicable features of the Cap-and-Trade Regulation presented in that FED serve as the basis for the description in Alternative 2 (including the declining cap, a range of covered entities, requirements to surrender allowances at the end of compliance periods, and a commitment to adaptive management); however, Alternative 2 uses cap-and-trade to meet the entire 22 $MMTCO_2E$ shortfall from the AB 32 emissions goal identified above (rather than the 18 $MMTCO_2E$ target in the proposed regulation). The Cap-and-Trade rulemaking process is still underway and no final action to adopt the rule has been taken by ARB.

Independent Evaluations of Previous and Ongoing Cap-and-Trade Programs

As mentioned above, several trading programs exist in the U.S. and Europe and a broad spectrum of scientific, economic, legal and policy analyses of cap-and-trade programs have found that well designed and implemented programs for certain air pollutants have been effective (Burtraw and Swift 1996, Tietenberg 2006). The U.S. EPA's Acid Rain program is widely viewed as being very successful, bringing about large reductions for lower-than-expected costs. Specifically, the program resulted in cost savings of $1 billion annually, compared with costs under direct regulatory alternatives, and SO_2 emissions from the power sector decreased from 15.7 MT in 1990 to 10.2 MT in 2005 (Carlsom et al. 2000). Banking provisions contributed to the program's cost-effectiveness (Ellerman et al. 2000). Analyses of the program indicate that it did not produce unintended consequences of concentrating SO_2 emissions in minority communities, and improved air quality for minority and low-income populations (Ringquist, 2011: and U.S. EPA, 2005).

In the NO_x program, compliance cost savings of 40-47 percent have been estimated for the period 1999-2003, compared to a base case of continued command-and-control regulatory alternatives without trading or banking (Farrell et all 1999, as cited in Stavins 2008).

RECLAIM does not allow banking because of concerns that unacceptably high emissions would occur in a future year. The lack of banking is thought to have contributed to a substantial price spike for NO_x emission rights in 2000. Specifically, a heat wave caused an increase in demand for electricity, while the availability of imported power from other states declined. This increased demand was met by operating old-gas fired generating facilities in California that resulted in a significant rise in cost (i.e., tenfold) of RECLAIM trading credits and contributed to high wholesale electricity prices during that period (CBO 2008). Overall, trading under the RECLAIM program was restricted in several ways, with some negative consequences, but despite these problems, NO_x and SO_x emissions in the regulated area were reduced significantly. The program reduced compliance costs for regulated facilities (i.e., 42 percent cost savings) (Anderson 1997).

The EU-ETS is a real-world example of a cap-and-trade system working in tandem with other complimentary climate policies (IIDRI, 2011). Creation of the EU-ETS was challenging (Convery, 2009); once the program was in place, several issues arose during implementation of the initial phase that involved member states relying on emission estimates rather than actual emissions as a result of insufficient historic data. This led to less stringent caps than anticipated, and the market price for allowances dropped significantly when the over-allocation became apparent (Grubb et al., 2011). The system overcame these start-up issues, and the EU-ETS now represents an example of a functioning CO_2 market achieving emissions reductions from sources covered by the program (Ellerman et al. 2010).

Attributes of Alternative 2

Alternative 2, like any cap-and-trade program, would need to undergo rigorous review during development of the regulation. For the purposes of this analysis, however, this Supplement will make certain assumptions about Alternative 2's attributes. Alternative 2 would cover the major sources of GHG emissions in the state, including refineries and power plants, industrial facilities and transportation fuels, which would include up to 85 percent of California's emissions. The program would impose an enforceable emissions cap that would steadily decline over time. The state would distribute allowances, which are tradable permits, equal to the cap. Sources under the cap would need to turn in allowances equal to their emissions at the end of each compliance period. Sources with more allowances than emissions can trade (i.e., sell) their surplus allowances to firms who find it more expensive to reduce their emissions than to purchase allowances from others. Alternative 2 would include a number of cost-containment strategies for smoothing the transition into the program, such as disturbing allowances for free in the early stages of the program, allowing those covered by the program to focus on investing in emission reductions and cleaner technologies, and limiting any concerns about competitiveness and emissions leakage.

Under the Alternative 2 cap-and-trade program, offset credits can be used by covered entities to meet a small portion of their compliance obligation. An offset is a credit that represents a reduction of GHGs resulting from an activity that can be measured, quantified, and verified. Each offset credit represents a metric ton of emission reductions from a source not directly covered by the cap-and-trade program.

The regulation would include strict rules for reporting emissions and trades, with substantial penalties for violations. Transparency in the trading process is important to avoid market manipulation.

Each design element is discussed in more detail later in this chapter.

Cap-and-Trade

In this Alternative 2 program, a cap that declines over time is placed on emissions from all covered sectors. The total number of allowances created would be equal to the cap set for cumulative emissions from all the covered sectors. In addition to allowances, a limited amount of offsets could be used for compliance. The use of offsets would allow emissions in the capped sectors to slightly exceed the allowances issued, though these additional emissions from capped sectors would be matched by emission reductions that result from offset projects. The term *compliance instrument* covers both allowances and offsets. Both types of compliance instruments may be traded among entities. At the end of each three year compliance period, covered entities are required to turn in, or *surrender*, enough compliance instruments to match their emissions during this time period. These compliance instruments are permanently retired, thereby reducing the allowable emissions under the cap over time. Each allowance equals one metric ton of carbon dioxide equivalent. Since the program includes some GHGs (e.g., methane) that are more effective at trapping heat than carbon dioxide, all emissions are measured in units relative to the heat trapping potential of carbon dioxide or CO_2E, the “E” standing for “equivalent”.

Because a cap-and-trade program allows compliance instruments to be traded, the price for those instruments becomes a price on emitting carbon. This price provides incentives for GHG emission reductions and innovation. It can stimulate reductions for all covered sectors without requiring individual regulations for all GHG emissions. Pricing carbon in this way ultimately creates a market for finding the most cost-effective emission reductions. Providing entities the flexibility to find the most cost-effective reductions lowers the overall cost of the program. Creating a market provides more flexibility than direct regulation can and provides incentives for investment and deployment of low carbon technologies.

Fundamental Elements of the Cap-and-Trade Program

The following discussion highlights the basic elements of the Alternative 2 Cap-and-Trade Program. These elements closely follow the elements of the proposed Cap-and-Trade Program presented in the Proposed Scoping Plan. For Alternative 2, the targeted emissions reductions are 22 $MMTCO_2E$, instead of the 18 $MMTCO_2E$ target for the Proposed Scoping Plan.

Scope

The Cap-and-Trade Program phases sectors into the program. Under this phased approach, entities in the following sectors would be covered in the program according to the following timelines:

Starting in the first compliance period:

- Electricity generation, including electricity imported from outside California; and
- Large industrial sources with GHG emissions at or above 25,000 metric tons of carbon dioxide equivalent ($MTCO_2E$).

Starting in the second compliance period, the program expands to include fuel distributors in order to cover emissions associated with:

- Combustion of gasoline, diesel, natural gas, and propane from sources with emissions below 25,000 $MTCO_2E$, including all commercial, residential, and small industrial sources; and
- Fuels used for transportation.

All sectors listed above would be covered through 2020.

The Cap

The limit on GHG emissions, i.e., the cap, is a critical part of a Cap-and-Trade Program design because it determines the number of total allowances ARB would issue. The cap is set in the regulation and consists of annual cap numbers, also referred to as “budgets.”

Based on the 2010 proposed program, the initial cap level would be set at the level of emissions expected from covered sources for that year, which, based on current projections would be 165.8 million $MTCO_2E$ ($MMTCO_2E$). The cap would decline starting in 2013 until 2015. In 2015 the cap would then be expanded to include GHG emissions from fuel suppliers. This expansion is based on the level of GHG emissions expected from the covered fuels for the year 2015, resulting in a cap for 2015 of 394.4 $MMTCO_2E$. The cap would then continue to decline from 2015 to 2020, to a level of about 334 $MMTCO_2E$.

The level of the cap is critical to the environmental effectiveness of a cap-and-trade program. If the cap is not set at a stringent enough level to drive GHG emission reduction activities, the environmental goals of the program may not be met even if all sources comply with program requirements. The intended design of such a program would be sufficiently stringent to motivate GHG emission reductions to achieve AB 32 goals. As discussed above, the cap in the Proposed Scoping Plan Cap-and-Trade Program would be about 334 $MMTCO_2E$ for 2020, which is designed to allow California to achieve the AB 32 target.

The cap is also an important element of the entire program design as it serves as a backstop for ensuring that the 2020 target is met. As the program covers about 85 percent of the emissions, any failure of the other measures will be addressed through compliance with this cap. This ability to serve as a flexible backstop to other policies is one of the most fundamental strengths of a cap-and-trade program.

Allowances

As discussed previously, an allowance is equal to one metric ton of CO_2E. ARB would issue a total of approximately 2.7 billion allowances for the Cap-and-Trade Regulation through the year 2020. This amount of allowances is about the same as the originally proposed Cap-and-Trade Regulation. Annual allowance budgets for calendar years 2012–2020 are established by regulation, so that the total number of allowances issued in each year through 2020 are known. At the end of a compliance period, each covered entity is required to surrender allowances (and if it elects, a limited amount of offsets) equal to its total GHG emissions during that compliance period. ARB would also require entities to surrender compliance instruments to match a portion of their reported emissions each year during the three-year compliance period to reduce the risk of non-compliance at the end of the three year period. When compliance instruments are surrendered, ARB would permanently retire them.

Covered entities are not the only entities that may hold and trade allowances in the program. Entities in covered sectors with emissions less than 25,000 $MTCO_2E$ may voluntarily elect to become covered entities. Other non-covered entities may be eligible to participate voluntarily. Some examples of these non-covered entities include financial institutions or brokers, offset project developers, and those who may want to obtain and voluntarily retire allowances. Once an entity holds an allowance, it can: 1) surrender it to comply with an obligation under the regulation: 2) bank it for future use; 3) trade it to another entity; or 4) ask ARB to retire it.

A gradual transition into the program would occur through the design of the allocation system. As with the program identified in the Proposed Scoping Plan, ARB would rely primarily on free allocation at the start of the program to minimize near-term costs to California consumers and businesses and to minimize emissions leakage. The allocation design would reward those who have invested in energy efficiency and GHG emission reductions and would encourage continued investment in clean and efficient technologies in the future.

The outset of the program would include an auction that includes a consignment feature for allowances allocated to electricity distribution utilities. The auction would allow for broad participation by diverse market players and minimize the chances for manipulation. The auction is set up in a way to ensure that allowances go to those market participants that place the highest value on them.

Cost Containment Mechanisms

The Cap-and-Trade Regulation includes a number of mechanisms designed to minimize the costs of reducing GHGs without compromising the environmental integrity of the program. Some of the mechanisms in the proposed Cap-and-Trade Regulation are three-year compliance periods, banking, the Allowance Price Containment Reserve, offsets and linkage to other trading systems.

A number of major sources of California emissions are subject to significant year-to-year variations – for example, electricity sector emissions increase in low water years as lower hydropower production is replaced with natural gas generation. For this reason, the Alternative 2 program has been designed with a three-year compliance cycle to help smooth out these annual variations, and to provide sources with greater flexibility to reduce emissions.

In a cap-and-trade program, banking allows participants to hold spare allowances and use them for compliance in a later period. The ability to bank allowances provides an incentive for covered entities to make early reductions since the declining cap could push allowance prices higher over time. Staff proposes to allow banking of allowances without restriction.

Alternative 2 would include an Allowance Price Containment Reserve (the Reserve). The Reserve would be an account that is filled with a specified number of allowances removed from the overall cap at the beginning of the program. Covered entities may purchase reserve allowances at specified prices during direct quarterly sales. Covered entities gain flexibility through access to the Reserve if prices are high or entities expect prices to be high in the future.

Under the Alternative 2 program, covered entities may use offset credits to satisfy a small portion of their compliance obligation. In addition to providing compliance flexibility, the inclusion of offsets in the program would support the development of innovative projects and technologies from sources outside capped sectors that can play a key role in reducing emissions both inside and outside California.

Offsets must meet rigorous criteria that demonstrate that the emissions reductions are real, permanent, verifiable, enforceable, and quantifiable. To be credited as an offset, the action or project must also be additional to what is required by law or regulation or would otherwise have occurred. Under the Cap-and-Trade Program in Alternative 2, ARB would issue or recognize an offset credit that could be used by a covered entity instead of turning in an allowance for the equivalent amount of CO_2E emitted.

The Alternative 2 program imposes a limit on the amount of offsets that an individual covered entity can use for compliance. Allowing a limited number of offsets into the program provides benefits and ensures that some GHG emission reductions occur within the sectors covered by the Cap-and-Trade Program. The Alternative 2 Cap-and-Trade Program includes provisions that would allow a maximum of 232 million $MTCO_2E$ of offsets through the year 2020. This limit would be enforced through a limit on the use of offsets by an individual entity equal to eight percent of its compliance obligation. Combined with the Allowance Price Containment Reserve (described above), this limit ensures that a majority of reductions from the program come from sources covered by the program at expected allowance prices, while use of the reserve would relax that constraint if prices rise.

Linkage is the reciprocal acceptance of compliance instruments issued by another system. California could decide to link its Cap-and-Trade Program to other emissions trading systems of similar scope and rigor, and has been working with our WCI partners to create the framework for a regional system of linked programs. Linkage can expand the coverage of the Cap-and-Trade Program to include emission reduction opportunities for sources covered in another program. The proposed Cap-and-Trade Regulation establishes a framework for linkage. Each program considered for linkage would be subject to Board action, and would undergo a case-by-case analysis by staff as part of a formal rulemaking process.

Although linkage to any programs is not included in this alternative, three programs are candidates for future linkage. Currently three other WCI partners are working to implement cap-and-trade programs consistent with the Design for the WCI Regional Program by 2012 or 2013: British Columbia, Quebec, and Ontario. Linking to WCI partners would have several advantages for California. The reduction of GHG emissions that can be achieved collectively by the WCI partner jurisdictions are larger than what can be achieved through a California-only program. The broad scope of a WCI-wide market would provide additional opportunities for reduction of emissions, therefore providing greater market liquidity and more stable carbon prices within the program.

Compliance and Enforcement

A robust enforcement program would play a vital role in the success of a cap-and-trade program by discouraging gaming of the system and deter and punish fraudulent activities. One allowance is needed to cover one metric ton of a covered entity's emissions, if they are turned in by the compliance deadline. If an entity does not meet the compliance deadline it would need to surrender additional allowances. The Alternative 2 program would need to be designed to remove, to the extent possible, financial incentives for noncompliance and to make sure that every ton of GHG emitted is covered by a valid compliance instrument.

To develop an enforcement program for a cap-and-trade program, ARB staff could consult with legal and enforcement staffs from state and federal agencies to gain insight in this area. These agencies may include the California Environmental Protection Agency, California Attorney General's Office, the California Energy Commission, the California Public Utilities Commission, the Department of Water Resources, the United States Department of Justice, the United States Securities and Exchange Commission, and the United States Commodities and Futures Trading Commission. In addition, staff could consult with academic institutions, such as University of California Berkeley's Center for Law, Energy, and the Environment and legal and market expert scholars from other universities.

Adaptive Management

A cap-and-trade program would be made up of many elements and would serve a large number of important objectives at the same time. Accordingly, unanticipated effects and results could occur over the life of the Alternative 2 program. ARB, therefore, would be committed to using an adaptive management process to review and revise policies, protocols, and procedures as more information becomes available. Among other purposes, the adaptive management commitment would be useful in monitoring whether environmental impacts were arising and defining how a program could be modified to avoid or reduce them.

Summary of Alternative Strategy

Implementation of Alternative 2 would involve a strategy that is similar to the emphasis on a Cap-and-Trade Program in the Proposed Scoping Plan, except that the emissions reduction would need to account for 22 $MMTCO_2E$ to make up for the amount allocated in the Scoping Plan for both Cap-and-Trade and Advanced Clean Cars. It would be expected to enable the state to reach its AB 32 goal by 2020, although the absence of the advanced clean car measure from this Alternative would place more GHG reduction burden on the market mechanisms of the Cap-and-Trade Program. As a result, allowance prices may be higher.

Alternative 2 Impact Discussion

Objectives

Alternative 2 would be expected to meet the fundamental objective of reaching the 2020 emissions reduction goal. The Proposed Scoping Plan Cap-and-Trade Program was designed to reduce GHG emissions by 18 $MMTCO_2E$. This Alternative is required to further reduce GHG emissions by 4 $MMTCO_2E$, because it must also account for the reduction assigned in implementation of the Proposed Scoping Plan to Advanced Clean Cars (4 $MMTCO_2E$). It would be reasonable to expect that the additional reduction could be achieved by more aggressive reductions within the existing covered entities and/or addition of other covered entities, because the cap establishes a firm emissions limit that must be met. Because reductions are not mandated for Advanced Clean Cars under this alternative, there would be less economic incentives for technological changes in that sector since emissions reduction may occur in any of the capped sectors.

The achievement of other objectives of the Proposed Scoping Plan would also be expected by Alternative 2, because a market-driven GHG reduction program has the characteristics sought by the objectives. For instance, it would reduce fossil fuel use through fuel switching compliance responses. Emissions reductions would be ensured by the establishment of the mandatory, declining cap. Reductions would be expected to occur in the most cost-effective manner, because the cost of reductions or the cost of allowances that can be purchased are determined by the market. Leakage would be minimized by the market-driven pricing of carbon and the availability of lower cost offsets for a portion of the reductions to help manage allowance prices. The allocation strategy would also include free allowances for trade-exposed industries. Many co-benefits would occur with an effective market-driven GHG reduction program, such as energy conservation and efficiency, reduced fossil fuels use, reduction of regional co-pollutants, and job-forming economic opportunities related to facility modifications and development of energy efficiency technologies.

Environmental Impacts

As described above, Alternative 2 focuses on a Cap-and-Trade Regulation and program designed to reduce GHG emissions sufficiently to achieve 22 $MMTCO_2E$ reductions by 2020, including compliance responses by covered entities and use of offsets according to specified protocols. Under this alternative, compliance responses by covered entities could include upgrading equipment, switching to lower intensity carbon fuels, implementing maintenance and process changes at existing facilities, and reducing operations of carbon-intense facilities in favor of increased operations of more carbon-efficient facilities. Implementation of carbon offset programs under specified protocols could also occur. The four offset protocols proposed as part of the Proposed Scoping Plan's Cap-and-Trade Program would also be applicable for this alternative: Ozone Depleting Substances (ODS), Livestock, Urban Forest, and Forest. Construction-related activities associated with these compliance responses could occur. The general approach, covered entities, and offset protocols of a Cap-and-Trade Program under Alternative 2 would be reasonably expected to be similar to the Proposed Scoping Plan's Cap-and-Trade Program, except that the reduction target would be increased from 18 to 22 $MMTCO_2E$, because the reductions allocated in the Proposed Scoping Plan to the Advanced Clean Car program (4 $MMTCO_2E$ would also need to be covered) (ARB 2010b).

Aesthetic impacts of the Alternative 2 compliance responses of this Alternative would be less than significant, because they would not change the character of the facility sites. The ODS Offset Protocol would not introduce activities that would disrupt aesthetic or visual settings. The Livestock Offset Protocol would include the construction of digesters in agricultural settings. Digesters are consistent with agricultural uses and would not represent an adverse change to the visual character of the vicinity. The Urban Forest Offset Protocol would improve the quality of the urban visual environment and would be considered aesthetically beneficial. The Forest Offset Protocol would not increase the amount of forest activities, but could shift activities to projects that increase carbon sequestration. This shift could change the visual character of offset project sites over time, but would not pose an adverse visual impact. Managing forests to increase cover and remove dead and diseased trees may be a visually beneficial effect.

Agricultural and forest resources effects of Alternative 2's compliance responses would not be expected to affect agriculture or forest resources, because they would occur at existing facilities of the covered entities. The ODS Offset Protocol would not include activities that affect agriculture or forest resources. The Livestock Offset Protocol would include the construction of digesters in agricultural settings. Digesters are consistent with agricultural uses and would not represent an adverse change to agriculture or forest resources. The Urban Forest Offset Protocol would not affect agriculture or forest resources. The Forest Offset Protocol would not increase the amount of forest activities, but could shift activities to projects that increase carbon sequestration. Managing forests to increase cover and remove dead and diseased trees may be considered a beneficial impact to forests. The Forest Offset Protocol includes all existing mechanisms under current state law to limit clear cutting. Further, the Forest Offset Protocol does not include actions that would encourage the conversion of agricultural land to forest.

Air quality impacts of Alternative 2 would be mostly less than significant and would also include beneficial reduction of co-pollutant emissions on a statewide basis. However, a remote potential for significant localized air quality impact exists, as discussed below. This Alternative focuses on a cap-and-trade program designed to reduce GHG emissions sufficiently to achieve a 22 $MMTCO_2E$ reduction by 2020, including compliance responses by covered entities and use of offsets according to specified protocols. In general, measures that reduce GHG emissions also provide co-benefits in terms of reductions in regional criteria air pollutant and TACs on a statewide basis, because of their similarities in source types. Thus, implementation of this Alternative would reduce statewide levels of criteria air pollutants and TACs resulting in a beneficial effect. Under this alternative, compliance responses by covered entities could include upgrading equipment, switching to lower intensity carbon fuels, implementing maintenance and process changes at existing facilities, and reducing operations of carbon-intense facilities in favor of increased operations of more carbon-efficient facilities

The combination of placing a price on carbon and setting a declining cap on emissions is expected to incentivize investment in more efficient processes and equipment, reducing criteria pollutant emissions and TACs. ARB staff evaluated the potential for criteria pollutant emissions increases under the proposed Cap-and-Trade Regulation in the Co-Pollutant Emissions Assessment (ARB, 2010a). The Assessment examined some hypothetical possibilities for potential increases in criteria pollutant emissions from certain facility types in four community-specific case studies and determined that any increase in co-pollutants is highly unlikely (ARB, 2010a).

Construction-related activities associated with these responses could adversely impact air quality due to the temporary generation of criteria air pollutants and TACs (e.g., use of diesel-fueled heavy-duty equipment and fugitive particulate matter dust emissions). Construction-related best management practices exist (e.g., watering) to reduce this potentially significant air quality impact. In addition, increasing operations of more carbon-efficient equipment could result in localized increases in emissions. For both of these potential impacts, the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. In addition, project-specific mitigation details are not available at the programmatic stage of analysis, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts.

Although localized air quality impacts resulting from compliance responses by covered entities and the development of offset credits related to Alternative 2 are highly unlikely, they cannot be entirely ruled out. For example, the use of compliance instruments (allowances and offsets) may result in an increase in actual emissions up to the permitted level of a facility. Also, the specific locations and impact of any such emission increases are uncertain. To address the possibility of unanticipated localized air impacts caused by the cap-and-trade program, ARB would incorporate an adaptive management program into the alternative. This means that ARB would be committed to monitoring the data on localized air quality impacts and to adjusting the program, if warranted. Even with these considerations, ARB has taken a conservative approach by concluding that the remote possibility of localized air impacts for Alternative 2 would be considered potentially significant and unavoidable under CEQA.

Biological resources may be affected by the compliance responses in Alternative 2. The upgrading of equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at covered facilities could affect natural habitats and sensitive species, if they are present around existing facilities. Construction, grading and trenching have the potential to adversely affect any protected biological resources that might exist at those locations. Recognized measures exist to reduce this potentially significant impact, but the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, this FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant impact may be unavoidable.

Biological effects of the offset protocols in Alternative 2 would vary, depending on the offset. The ODS Offset Protocol would not include activities that potentially affect biological resources. The Livestock Offset Protocol would include the construction of digesters at or adjacent to existing livestock operations where natural habitats are expected to be absent or limited. As such, the Livestock Offset Protocol would result in less than significant impacts to biological resources. The Urban Forest Offset Protocol recognizes tree improvement projects in urban settings, and as such would not be expected to significantly affect biological resources. The Forest Offset Protocol would not increase total forest activities, but could shift activities to projects that increase carbon sequestration. Reforestation projects conducted under the Forest Offset Protocol could change existing habitat and disrupt wildlife. Alternative 2 would include adaptive management to monitor and, where feasible, reduce this impact. The authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, it is premature to be able to define project-level mitigation at the stage of programmatic analysis, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, the FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that Alternative 2 may result in this potentially significant impact and it may be unavoidable.

Cultural resources may be adversely affected by construction related to the compliance responses under Alternative 2. The covered entity compliance responses consist of upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. Construction, grading and trenching have the potential to adversely impact any cultural resources that might exist at those locations. Recognized measures exist to reduce this potentially significant impact, but the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, the FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant impact may be unavoidable.

Cultural resources effects of the offset protocols in the Alternative would vary, depending on the offset. The ODS Offset Protocol would not include activities that potentially impact cultural resources. The Livestock Offset Protocol would include the construction of digesters at or adjacent to existing livestock operations where cultural or historic features could exist. Similarly, the Urban Forest Offset Protocol includes projects in urban settings where cultural and historic resources could exist. Although recognized mitigation measures exist to reduce these potential impacts, the authority to require project-specific mitigation lies with local permitting agencies and not ARB. Consequently, these impacts are conservatively identified as significant and unavoidable for purposes of CEQA compliance. The Forest Offset Protocol could change the type of forest projects that are undertaken, but would not alter the overall level of forest activities, and as such would not increase potential impacts to cultural resources. This impact of the Forest Offset Protocol would be less than significant.

Energy-related effects of Alternative 2 would be beneficial, because the GHG reduction strategy of cap-and-trade also results in improved energy efficiency and reductions in fossil fuel use. The covered entity compliance responses consist of upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes, all of which would be expected to improve energy efficiency. These actions would reduce overall energy demand and are considered beneficial effects. Projects implemented under the compliance offset protocols would not increase energy demand and, as such, pose no impacts or less than significant impacts to energy demand and use.

Geology, soils, and mineral resource effects could occur as a result of Alternative 2. The covered entity compliance responses consist of upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities, which could require construction of new facilities. Construction, grading and trenching have the potential to result in adverse soil erosion, dust generation, and sedimentation of local waterways. Recognized measures exist to reduce this potentially significant impact, but the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, the FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant impact may be unavoidable.

Geology, soils, and mineral resources impacts of the offset protocols in Alternative 2 would vary depending on the offset. The ODS Offset Protocol would pose no significant impacts on geology, soils and mineral resources. The Livestock Offset Protocol would include the construction of digesters that would be subject to regulations considered sufficient to mitigate potential impact to geology, soils and mineral resources to a less than significant level. The Urban Forest Offset Protocol would result in only minor soil disturbance and would not be expected to adversely impact geology, soils or mineral resources. This impact would be less than significant. The Forest Offset Protocol would not increase total forest activities, but could shift activities to projects that increase carbon sequestration. Because the overall level of forest activities would not change, this impact would be less than significant.

GHG emission reduction is the goal of the Cap-and-Trade Program of Alternative 2, so its implementation would continue to improve GHG emissions conditions in the state. The existing condition of emissions (without GHG reduction measures) projected to 2020 is estimated to be 507 $MMTCO_2E$. The AB 32 emissions reduction target is 427 $MMTCO_2E$. Alternative 2 would need to reduce emissions by 22 $MMTCO_2E$ to contribute to reaching the target, i.e., the balance needed to reach the target if all of the other Proposed Scoping Plan measures achieve their expected reductions (except the advanced clean car program, which would not be included in the Alternative). Thus, GHG-related impacts of this Alternative would be beneficial because of the fundamental objective of this program to reduce GHGs. The potential for leakage is a consideration, but can be addressed in the design of cap-and-trade programs by incorporating offsets as well as through the fee allocation of allowances for sectors with a high risk of leakage.

Hazard and hazardous materials-related environmental impacts of Alternative 2 would be less than significant. The covered entity compliance responses consist of upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. The use of hazardous materials is common practice in industrial settings. Implementation of compliance responses could include the use of hazardous materials, but this would be considered simply a continuation of existing business practices for the covered entities, controlled by existing practices and regulations, and, thus, considered less than significant. Offset projects implemented under the proposed offset protocols may result in the use or transport of hazardous materials that require special handling and disposal. All projects would be required to comply with established local, state, and federal laws pertaining to the use, storage, and transportation of these materials. Assuming compliance with applicable laws and regulations, the impacts would be less than significant.

Hydrology and water quality effects could occur as a result of Alternative 2. The covered entity compliance responses consist of upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. Construction, grading and trenching have the potential to result in adverse soil erosion resulting in sedimentation and degradation of local waterways. Recognized measures exist to reduce this potentially significant impact, but the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, the FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant impact may be unavoidable.

Hydrology and water quality effects of the offset protocols in Alternative 2 would vary depending on the offset. The ODS Offset Protocol would have no adverse impacts on hydrology and water quality. The Livestock Offset Protocol would include the construction of digesters that would be subject to regulations which are considered sufficient to mitigate potential impacts to hydrology and water quality to a less than significant level. The Urban Forest Offset Protocol would result in only minor soil disturbance resulting in less than significant impacts to hydrology or water quality. The Forest Offset Protocol would not increase total forest activities, but could shift activities to projects that increase carbon sequestration. Because the overall level of forest activities would not change, the potential to adversely impact hydrology and water quality would not change.

Land use impacts of the Alternative 2 compliance responses of this Alternative would be less than significant, because they would not change the fundamental use of facility sites. The covered entity compliance responses consist of upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities and, as such, would be consistent with the existing land use and would pose a less than significant land use and planning impact. The ODS Offset Protocol would use existing facilities, representing a less than significant impact to land use and planning. The Livestock Offset Protocol would allow the construction of digesters in agricultural settings. Digesters are an allowed use in agricultural areas. As such, their construction would not conflict with existing land use plans, and thus would be a less than significant impact. Projects implemented under the Urban Forest Offset Protocol would not conflict with land use plans, resulting in a less than significant impact.

Land use effects of the Forest Offset Protocol could occur as a result of avoided conversion projects that may conflict with local land use plans envisioning development or other uses of forested areas. The authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, the FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that the potentially significant impact described as possible conflicts between the “avoided conversion” element of the Forest Offset Protocol and land use plans may be unavoidable.

Noise impacts of the compliance responses of the Alternative 2 covered entities and use of offsets would vary depending on the activity. Under this alternative, compliance responses by covered entities could include upgrading equipment, switching to lower intensity carbon fuels, implementing maintenance and process changes at existing facilities, and reducing operations of carbon-intense facilities in favor of increased operations of more carbon-efficient facilities. Construction-related activities associated with these responses could adversely affect noise due to the generation of short-term levels that exceed acceptable ambient conditions (e.g., use of heavy-duty equipment). Construction-related best management practices currently exist (e.g., limiting activities to the less noise-sensitive daytime hours and maintaining equipment in proper working condition) to reduce this potentially significant noise impact. In addition, construction generated noise levels would be intermittent and temporary in nature and similar to the types of noise sources and associated levels that currently exist within these industrial settings.

With respect to potential operational increases, noise levels associated with increased carbon-efficient activities would likely be similar (in type and level) to those from existing carbon-intense and other activities that currently exist within these industrial settings. Thus, these impacts would be considered less than significant. However, under this alternative, the use of offsets according to specified protocols could result in both construction- and operational-related impacts due to the generation of noise levels that exceed ambient conditions at existing sensitive receptors. For example, a particular protocol could allow the construction of noise sources in non-industrial areas near sensitive receptors where sources of this nature do not currently exist. Best management practices currently exist (e.g., limiting construction activities to the less noise-sensitive daytime hours and obstructing the line of sight between sources and receptors for operational activities) to reduce this potentially significant noise impact.

The authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. In addition, project-specific mitigation details are not available at the programmatic stage of analysis, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Also, the specific locations and impact of any such noise increases are uncertain from protocols. Thus, the FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this noise impact would be considered potentially significant and unavoidable.

Adverse population, employment, and housing effects of Alternative 2, including the compliance responses and associated offset projects would not occur, because the compliance activities would not substantially change socioeconomic conditions. All impacts to population, employment, and housing would be less than significant.

Public services impacts of the Alternative 2 compliance responses of this Alternative would be less than significant, because these activities would occur at existing facility sites where public services are already provided. The Alternative 2 Cap-and-Trade Program, including the proposed compliance offset protocols and associated offset projects would not result in increased demands for public services. All potential impacts to public services would be less than significant. The covered entity compliance responses consist of upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes. These projects would not substantially increase the level of public services beyond that already provided to existing facilities. The ODS Offset Protocol, the Livestock Offset Protocol, and the Urban Forest Protocol and associated projects would not result in a need for an increased level of public services beyond that already provided to existing facilities. The Forest Offset Protocol would not alter the extent of forest activities, but would shift some activities to projects that sequester carbon. Because the level of overall forest activities would not change, the consequential need for public services would not change. Thus, this public services impact is less than significant.

Recreation impacts of the Alternative 2 compliance responses of this Alternative would be less than significant, because these activities would occur at existing facility sites. The Alternative 2 Cap-and-Trade Program's expected compliance responses and associated offset projects would not result in increased demand for or adverse impacts to recreation resources. The covered entity compliance responses consist of upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes. These actions would have a less than significant impact on recreation resources. The ODS Offset Protocol, the Livestock Offset Protocol, the Urban Forest Offset Protocol, and associated offset projects would result in a less than significant impact on recreation resources. Forest management activities could disrupt opportunities for forest recreation, but such disruptions exist under current conditions. Offset projects developed under the proposed offset protocol would include the construction of roads, temporary closures for tree installation and periodic increases in truck or construction equipment traffic that could disrupt recreational activities, but forest projects developed under the Forest Offset Protocol would occur on land that was historically forested or currently forested, and consequently, the overall impact to recreational resources would be less than significant.

Transportation or traffic impacts from implementation of compliance responses under Alternative 2 would not be significant. Under this alternative, compliance responses by covered entities would not adversely impact transportation or traffic because any increases due to construction traffic would be temporary and mitigated through ingress and egress controls, traffic controls, and reduced speed zones to ensure safety; and operational traffic levels would be similar to existing conditions. Thus, these impacts would be considered less than significant. However, under this alternative, the use of offsets according to specified protocols could result in both construction- and operational-related impacts due the use of heavy-duty equipment on rural roads, potentially creating unsafe conditions, such as for construction of livestock digesters in rural areas. Best management practices exist to reduce this potentially significant impact. However, the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. In addition, project-specific mitigation details are not available at the programmatic stage of analysis, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, the FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant traffic impact may be unavoidable.

Utility and service system impacts of the Alternative 2 compliance responses of this Alternative would be less than significant, because these activities would occur at existing facility sites where utility systems are already provided. The covered entity compliance responses consist of upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes. These projects would not increase the level of utilities beyond that already provided to existing facilities. The availability and extension of utilities is subject to approval of the local utility provider, and readily implemented in a manner that would be less than significant. The ODS, Livestock, and Urban Forest offset protocols would not result in a demand for a significant increase in the level of utilities or service systems that may serve existing sites. Construction of new facilities could require the incidental extension of utilities and services. The availability and extension of utilities is subject to approval of the local utility provider, and thus mitigated to less than significant. The Forest Offset Protocol would not alter the extent of forest activities, but could increase forest projects to sequester carbon. Because the level of overall forest activities would not change, the consequential need for utility service systems associated with those activities would not change. Thus, this impact is considered less than significant.

2.5 Alternative 3: Adopt a Program Based on Source-Specific Regulatory Requirements with No Cap-and-Trade Component

Goal of Alternative 3

Instead of pursuing a cap-and-trade program or a carbon fee or other alternatives, ARB could pursue source-specific emissions limits by regulation to make up the emissions reductions that the Proposed Scoping Plan identifies as coming from Cap-and-Trade and Advanced Clean Car regulations (i.e., 22 $MMTCO_2E$). The goal of Alternative 3 is to evaluate this direct regulatory approach.

Role of Alternative 3 in the Range of Alternatives

Direct regulations typically establish performance-based limits on emissions, activities, or outputs at specified sources that are designed to achieve emission reductions in a cost-effective and technologically feasible manner. In some cases, a specific pollution abatement technology is required to achieve the emission reductions. In establishing source-specific limits, flexibility is often provided by using performance standards and allowing for such actions as averaging among individual units at different operations in complex facilities to improve the cost-effectiveness of the measure.

Direct regulations can be applied to a wide range of sources in different sectors. Example sectors include many types of industrial production operations, oil production and refining, agriculture, electricity generation, ports, railyards, and transportation fuels, among others. For Alternative 3, sources have been selected to present a reasonable scenario for a potentially feasible strategy to help reach the 2020 reduction target. Different combinations of sources could also be defined; however, the definition of the Alternative below provides a reasoned analysis of the potential environmental effects of a direct, source-specific regulatory approach.

Precedents or Examples of the Approach in Alternative 3

California has a long history of developing, adopting, and successfully implementing source-specific air quality regulations. These regulations provide a broad range of potential approaches to consider in formulating Alternative 3. Both ARB and local air districts in California have extensive experience with regulating the wide variety of sources that emit smog-forming and toxic air emissions including cars, trucks, fuels, consumer products, agricultural sources, electricity generating facilities, and many types of industrial sources. Many of these sources also emit GHGs. Most of these regulations have been in the form of rules that focus on a specific sector such as automobiles, refineries, power plants, cement plants, gasoline, or consumer products, such as paint, deodorants, or hairspray.

Source-specific regulations have been widely used to regulate air emissions in the United States since the 1960's. Much of the progress in reducing levels of urban smog can be attributed to strong requirements to achieve specified emission reductions through the use of control equipment on cars, trucks, and industrial sources. ARB has largely pursued performance-based standards. These regulations specify a level of allowable emissions, but provide flexibility to regulated entities to choose the solutions that work best for their operations. ARB and the local air districts have most often pursued "intensity-based" regulations that require regulated entities to reduce the emissions associated with a given unit of output (e.g., the grams of pollution per mile for an automobile or pounds of emissions per KWh for electricity generation) instead of absolute limits on total emissions or activity. In some situations, limits are placed on the amount of emissions or other surrogates (e.g., hours of operation) to ensure there are no localized adverse effects.

Although intensity-based regulations do not provide a hard cap on emissions from a sector, they have been effective in reducing overall emissions despite growth in activity and, thus, improving air quality, even during periods of high economic growth. For example, although the number of miles driven by cars in California increased by 137 percent between 1980 and 2010, the smog-forming emissions from cars decreased by about 80 percent. In limited cases, ARB has adopted regulations that prescribe specific practices. For example, a measure to reduce hexavalent chromium for hard-chrome plating facilities has specific housekeeping measures to limit fugitive dust emissions.

Air agencies have also developed and implemented regulations to achieve reductions of emissions for complex sources that provide some degree of flexibility as to how those reductions are achieved. These regulations generally apply to a specific sector or groups of larger sources, and incorporate an emission-related performance standard and, in some cases, an averaging and/or emission trading component. For example, the ARB's Low-Emission Vehicle regulations – designed to lower tailpipe emissions of smog-forming and other pollutants -- set a performance standard not for individual vehicles models, but for each manufacturer's fleet of cars. Manufacturers who outperformed the standard could bank the extra emission reductions for use in future years or sell to other manufacturers. Electric utilities have had to meet regional performance standards for NOx, but were provided with the flexibility to have different control levels at individual units so long as the regional standards were met. Other examples of flexible compliance mechanisms include the U.S. EPA acid rain trading program and SCAQMD RECLAIM program. See Alternative 2 for a discussion of these market-based programs.

The emissions of CO_2, the most common GHG, are somewhat unlike pollution that California has controlled successfully with direct regulation. Technology is available to control many other pollutants, but there is no device that can be placed at the top of a smokestack or converter that can be attached to a combustion engine to reduce or permanently capture the most common GHG – carbon dioxide. Carbon capture and storage is developing as a technology, but it has yet to be proven as a cost-effective, viable GHG reduction technology (IPCC 2005, p. 8). Most of the potential GHG emission reductions available from direct regulation of existing industrial sources are based on approaches that, in one way or another, result in reduced combustion of fossil fuels, such as energy efficiency improvements or building new renewable generation (thus reducing overall electricity demand including fossil-fueled generation); switching fuel supplies (e.g., from coal, a much more carbon-intensive fuel, to natural gas or from using oil to biofuels); or reducing fugitive or process emissions, for example, from natural gas extraction processes or pipelines.

Attributes of Alternative 3

Because a very wide range of potential direct regulations could be adopted to reduce GHG emissions in regulated sectors, it would not be feasible to consider all the possible combinations. The description that follows presents the process for identifying regulatory measures and a reasonable scenario for a potential direct regulatory approach to GHG emissions reduction in California.

Regulatory Development, Implementation and Enforcement

Regulatory development typically begins with staff researching potential control technologies at all stages of development – from systems that have been deployed in the field to technologies that are still in the research phase. Regulatory staff evaluates the industries that are candidates for regulation to understand their operations. This helps them determine how control technologies or methods could be integrated and gain a better understanding of potential barriers to implementation. For example, if a packinghouse uses loading equipment around the clock, battery-operated equipment that requires extended recharging time each day may not be feasible. Staff must also consider how regulations would affect other essential systems. For example, requiring the least efficient power plants to cease operation could reduce the reliability of the electricity grid.

If ARB pursues direct regulations to implement AB 32, each regulation would go through the rigorous Administrative Procedure Act (APA) process. The APA provides very specific rules for adopting new regulations. This process must be completed within one year of the notice date (see below), pursuant to Government Code section 11346.4(b). Information about the APA process is presented in Section 2.2 above. In addition, any GHG measure adopted under the authority of AB 32 has additional, specific statutory requirements that must be met.

The ultimate staff regulatory proposal depends upon an extensive knowledge of where emissions come from, the potential means to reduce emissions, the feasibility and cost of these technologies, environmental impacts of compliance responses, and how each industry operates to assess whether the proposal is workable. Staff proposals are vetted in public workshops to provide opportunities for the public and the potential affected industry to both provide additional information, identify alternatives and to comment on the staff's proposal. Proposed regulations also undergo environmental review consistent with ARB's certified regulatory program under CEQA. For ARB, regulations are proposed to the Board for consideration and adoption. Following Board adoption, regulations are transmitted to the Office of Administrative Law for entry into the California Code of Regulations, at which time they become law.

Once regulations are adopted and become law, ARB transitions to implementation and enforcement. The approach to implementation and enforcement depends upon both the type of regulation and the sources affected. Regulations that apply to a small number of vehicle or engine manufacturers can usually be implemented and enforced with fewer resources than regulations that apply to thousands of equipment owners and operators.

Description of Alternative 3

Alternative 3 has been designed to identify additional measures that use direct regulations that could achieve another 22 $MMTCO_2E$ reductions by 2020 to cover the shortfall necessary to meet the emission target required by AB 32. To develop Alternative 3, ARB assessed the sources of remaining GHG emissions in 2020 and considered potential source-specific reduction opportunities in the major sectors. It should be noted that the measures needed for Alternative 3 are in addition to many performance-based approaches that are already included in the No-Project Alternative. ARB based this evaluation on a number of studies including the compliance pathway analysis in the Initial Statement of Reasons for the Cap-and-Trade Regulation (ARB 2010a), the draft Scoping Plan (ARB 2008) which outlined a number of potential source-specific measures that were not ultimately included in the 2008 Scoping Plan (ARB 2009), suggestions from the public, and ARB staff's knowledge about emission sources and current and emerging control technologies. The potential reductions estimated in this analysis are generally based on those typically found in the United

States. These estimates should be considered a conservatively high estimate, because California sources are typically more efficient than national counterparts.

To identify sources for a direct regulation, an analysis of candidate sectors was undertaken to identify the potentially feasible sources that could be subject to direct regulation. Based on the analysis of the multiple sectors presented below, three specific sectors were chosen as the focus of Alternative 3. These sectors are: coal-fired electricity generation, three industrial sectors (refineries, cement, and oil and gas extraction), and advanced clean cars in the transportation sector. These sectors were also generally chosen based on their potential for reductions in criteria pollutants and TACs, along with local benefits. The analysis below shows that direct regulation of these sectors may be technologically feasible, but substantial additional analysis would need to be done to ensure that the APA and AB 32 requirements could be met.

Transportation

Transportation is the largest source of GHG emissions in California. This sector includes the GHG emitted when transportation fuels, predominantly gasoline and diesel fuel, are burned in car, truck and off-road engines to move both people and freight. This sector is estimated to emit 184 MMTs of GHGs in 2020 in the revised baseline forecast, which includes the clean car standards already adopted by ARB. The current estimate is that, excluding reductions that might occur with a Cap-and-Trade Program in place, this sector's emissions will be reduced by about 24 $MMTCO_2E$, to approximately 160 $MMTCO_2E$ by 2020 through programs such as Low Carbon Fuel Standard (LCFS), GHG emission reductions targets under SB 375 (Chap. 728, Statutes of 2008) and strengthening of the clean cars standards for new vehicles produced between 2017 and 2020.

GHG emissions in the transportation sector can be reduced in three primary ways: by reducing the GHG emissions emitted by vehicles and off-road engines; by reducing the carbon intensity of the fuel burned in these vehicles and engines; and by reducing the need to use these vehicles and off-road engines. As stated above, ARB has already adopted source-specific regulations or is pursuing programs in all three of these arenas. ARB has adopted limits on the GHG emissions from passenger vehicles. Similar limits have also been adopted by the federal government and the California and federal programs are aligned through 2016. ARB has also adopted and is implementing the LCFS to reduce the carbon intensity of transportation fuel by 10 percent by 2020. In addition, under SB 375, ARB has set GHG emission reduction targets for passenger vehicles for 2020 and 2035. These targets mark the first step toward a statewide program to integrate long-range land use, housing, and transportation planning at the regional level, which is designed to reduce travel by cars and light trucks.

The compliance pathway analysis prepared in 2010 notes that the transportation sector offers the potential for low-cost emission reductions (ARB 2010a). However, it is unlikely that substantial additional emission reductions could be realized from the transportation sector by 2020 by adopting additional traditional regulations other than those already in the Proposed Scoping Plan. Under the Advanced Clean Car Program, ARB is already pursuing additional rulemaking to further reduce GHG emissions from passenger vehicles produced in the 2017 to 2020 period. The Advanced Clean Car Program is currently under development, with the Board anticipated to consider the regulation in late 2011. Based on adjustment of the estimate in the Proposed Scoping Plan, ARB has estimated 3.8 $MMTCO_2E$ of "foreseeable" emission reductions from this measure. The Advanced Clean Car Program is also expected to achieve significant reductions in criteria pollutants and TACs. For all of these reasons, the Advanced Clean Car Program is included in Alternative 3.

As discussed above, the LCFS requires fuel providers to achieve a 10 percent reduction in the carbon intensity of transportation fuels by 2020. This is an ambitious target and the rule itself calls for periodic reviews to determine if adjustments in the emission reduction targets are needed. The first comprehensive review is now underway, but will not be completed until the end of 2011. It is possible that sufficient low carbon fuels will be available by 2020 to enable additional reductions to be achieved, but it is uncertain at this time. Thus, it is not feasible at this time to target additional emission reductions from this source category.

Electricity

Electricity generation, both within California and from sources that import electricity into the state, are a significant source of GHG emissions. The current estimate is that, excluding reductions that might occur under a Cap-and-Trade Program, this sector's emissions will be reduced by about 20 MMTs by 2020 through programs such as the 33-percent RPS (authorized by SB1X 2, Statutes of 2011) and expansion of energy efficiency efforts. The remaining emissions, would be expected to come from a combination of in- and out-of-state natural gas fired generation and out-of-state coal fired generation (approximately 90 MMTs).

There are four primary methods to reduce emissions from the electricity sector: (1) expanding the use of renewable generation and cogeneration technologies, (2) improving the efficiency of existing electricity generating facilities, (3) using electricity more efficiently, and (4) switching to lower-carbon fuels in those sources that use higher-carbon, fossil fuels to generate electricity.

Relative to expanded use of low GHG emitting renewable technologies, the No-Project Alternative already relies upon the further reduction of the electricity sector's carbon footprint with a requirement that by 2020, 33 percent of the electricity delivered to retail customers come from renewable sources, such as wind, geothermal, biomass, and solar. This measure, which was originally approved as an ARB rule in 2010, has recently been enacted into law (SB1X 2, Statutes of 2011). Requirements for a higher percentage of renewable generation could be estimated. For example, a requirement could be established that 40 percent of the delivered electricity should come from renewable sources. This higher requirement could potentially result in an additional reduction of 6 $MMTCO_2E$ by 2020. However, this requirement was not recommended for inclusion in Alternative 3. The underlying basis and rationale for such a standard would need to be considered as part of an overall policy strategy on energy and would not likely be cost-effective from simply a GHG-reduction perspective.

Existing electricity generating facilities in California vary in age and efficiency. The primary methods to significantly reduce GHG emissions from older, inefficient existing facilities are to “re-power” them with a new unit at the existing site, or to retire them and replace their generation with a new facility at another location. Grid reliability is a critical issue that must be thoroughly evaluated in determining which facilities can be retired or re-powered.

Existing programs and regulations, as described in the No-Project Alternative, include substantial GHG reductions from increasing efficiency in the use of electricity and natural gas. The No-Project Alternative assumes that all cost-effective energy efficiency measures are implemented by 2020, although the specific methods are not identified. California law and existing policy require that energy efficiency codes and standards must be cost-effective. Achieving additional GHG emission reductions through energy efficiency beyond those already assumed in the No-Project Alternative is highly unlikely.

Fuel switching to reduce GHG emissions often refers to replacing high carbon fuels, such as coal, with lower carbon fuels, such as natural gas. In California, the vast majority of electricity generating facilities already operate on natural gas. The major opportunity for lower emissions from fuel switching is with in-state and out-of-state, coal-fired units. California’s existing Emissions Performance Standard (EPS) (Senate Bill 1368, Perata, Chapter 598, Statutes of 2006) prevents the state’s electric utilities from entering into new or extending existing long-term contracts with high-emissions intensity sources, such as coal.

Because electricity from existing coal-fired power plants is very inexpensive to produce, regulations to directly reduce use of coal-generated electricity in California could result in significant leakage, with the out-of-state electricity now used by California being sold in other markets. This switch from coal to gas-fired generation would be effective in reducing greenhouse gas emissions only if existing coal generation is retired as California consumed less of their production, or if the operation was curtailed though some other means. However, despite the potential drawbacks, a regulation to further curtail dependence on coal-fired generation is technically feasible and, of the available options, the most likely measure to gain significant reductions from the electricity sector in California’s GHG emission inventory via source-specific regulation. Estimates of these potential emission reductions are provided in the section titled, Summary of Alternative 3 Strategy.

Industrial Sources

Industrial sources account for almost 20 percent of GHG emissions in California. This sector is estimated to emit approximately 92 MMTs of GHGs in 2020 in the revised baseline forecast. Based on the analysis presented below, there are three industrial source categories where direct regulation is feasible. These are refineries, oil and gas extraction, and cement. Consequently, Alternative 3 would entail development of direct regulations to obtain GHG emission reductions from these three specified industrial sources. Estimates of the potential emission reductions from the direct regulation of these sectors are presented in the section titled, Summary of Alternative 3 Strategy.

The industrial sector is composed of four large discrete sectors and one additional general sector. The largest discrete sectors, in terms of emissions in the 2020 baseline, include refining (35 MMTs), oil and gas extraction (16 MMTs), cogeneration related sources (10 MMTs) and cement production (9 MMTs), each with its own unique operating characteristics. Within some sectors, there may be significant variation in the types and size of sources. For example, refineries are individually designed to process specific types of crude oil into the desired transportation fuels. The last large sector, industrial combustion (15 MMTs), is composed of smaller sub-sectors, many with unique needs and operating characteristics.

Generally, there are no devices that can be placed at the top of a smokestack to reduce or permanently capture the most common GHG, i.e., carbon dioxide, from industrial sources. Most of the potential reductions available from industrial sources with combustion emissions are based improving energy efficiency, switching fuel supplies, or limiting the output of the units to maintain a specified emission level.

The compliance pathway analysis estimated approximately 5 MMTs of potential emission reductions from the industrial sector ranging in price from savings of $100 per metric ton to costs of greater than $200 per metric ton (ARB 2010a, Figure V-5). For boilers and other heat sources, low-cost or cost-saving strategies included maintenance strategies such as steam leak and steam trap maintenance generated cost savings, and high-cost strategies included process heater and boiler replacement. Developing a regulation to require certain types or schedules for maintenance would be administratively challenging. Because operating characteristics and requirements vary significantly across (and within) industries, ARB would likely be unable to prescribe a uniform maintenance schedule, but could develop specific maintenance practices for a multitude of applications. Implementation and enforcement of such a regulation would be extremely resource-intensive requiring site visits to hundreds of industrial facilities. Although there is substantial variation in boiler age, size and operating conditions, it would also be feasible to develop a regulation to mandate improved efficiency from existing industrial boilers, for example a boiler performance standard. The results from ARB's Energy Efficiency and Co-Benefits Assessment will be available in mid-2012, and would allow ARB staff to better evaluate the feasibility, cost, and cost-effectiveness of industrial boiler regulations.

A discussion of specific subsectors follows:

Refineries

A number of refinery-specific measures to reduce GHG emissions are possible. Such measures include process level or industry-wide performance standards, adding gas recovery at refinery flares, removing the methane exemption from determining if a leak is significant and needs to be addressed, and capping GHG emissions from refineries. Though most large California refineries make similar products and have many common processes, the age, efficiency, state of upgrade, crude oil mix and potential cost and cost-effectiveness of modifications vary widely. While this presents potentially significant challenges for the development of process-level or industry-wide performance standards, such regulations may be feasible. Enhancing gas recovery capacity at flares and removal of the methane exemption in refinery leak-detection and repair regulations were included as Scoping Plan measures. However, ARB's preliminary evaluation indicates that emissions from flaring are lower than originally estimated, there are existing and effective measures in place at each of the three local air districts where major refineries are located, and the potential for reductions from these measures appear to be very small. ARB could establish a cap on GHG emissions for individual refineries. This approach would likely afford each source the greatest flexibility to meet its emission obligation relative to other direct regulation approaches. In addition, a refinery cap would likely provide co-benefits of reducing criteria pollutants and TACs. However, if a cap is set too low, some refineries may be induced to curtail output rather than invest in energy efficiency modifications. While this would reduce in-state GHG emissions, it might also reduce in-state production of transportation fuels, and result in out-of-state refineries needing to increase production to meet demand.

Cement Plants

The strategies to reduce GHG emissions from cement plants address the two sources of GHG emissions from cement facilities – coal combustion and the process emissions associated with calcinating the limestone to make cement. Blending of cement with supplementary cementitious materials (SCMs) would "stretch" the cement supply, reducing the need for imported cement. However, requiring the use of SCMs is unlikely to reduce direct GHG emissions from cement manufacturing within California since it occurs downstream from the production facility. ARB has explored the idea of a cement carbon intensity factor (CIF) which would assign a CIF performance standard that accounts for the fuel used to produce a given amount of cement. In order to meet the performance standard, cement plants would need to replace a portion of their coal with Alternative fuels such as natural gas or biomass. Each of these Alternative fuels presents implementation challenges from cost and fuel infrastructure (natural gas) to supply and availability (biomass).

Additional costs from the Alternative are likely to result in increased emissions leakage (such as from increased production in China). The cement industry is highly capital intensive and because of high fixed costs, facilities must operate at high capacity levels to maximize return on investment. If they cannot do so, an increase in imports from other countries is the most likely outcome. California's plants are among the lowest GHG-emitting facilities in the world. Any leakage would result in an increase in GHG emissions.

However, as with refineries, a cap on GHG emissions could be set for each individual cement facility. Such an approach would afford each facility the greatest flexibility to meet its emission obligation; however, if set too low, such a cap could induce some facilities to curtail output, rather than invest in energy efficiency modifications or make fuel changes. As with refineries, a cap would likely provide co-benefits of reducing criteria pollutants and TACs. While a cap would reduce in-state GHG emissions, it would also reduce in-state production of cement, and could result in an increase of out-of-state facilities' output to meet California demand, causing substantial leakage.

Cogeneration

Cogeneration systems produce both electricity and useful heat for industrial or heating purposes. Cogeneration is widely used in California, but has the potential to significantly expand. Sometimes referred to as combined heat and power (CHP), cogeneration can reduce GHG emissions by displacing emissions from power plants. It often improves grid reliability, reduces dependence on transmission lines, and reduces electrical transmission and distribution energy loss. However, barriers have limited the recent growth of cogeneration, such as the reluctance of utilities to accept power from sources they do not control, the charging of fees even though electricity is not consumed (i.e., standby charges or interconnection fees), and the lack of a sufficient market price for electricity generated onsite. Because of actions taken by the CPUC, the expansion of CHP for investor-owned utilities (IOUs) is anticipated in the No-Project Alternative. Additional CHP may be an option for publicly owned utilities (POUs), but requires considerable analysis to determine if reductions are feasible.

Progress has been made recently to encourage the development and installation of efficient CHP. The CPUC has approved a settlement that establishes a CHP Program designed to preserve resource diversity, fuel efficiency, GHG emission reductions, and other benefits and contributions of CHP. However, the settlement is not yet final. Through July 17, 2015, a large portion of the GHG emission reduction benefits of the existing CHP fleet will be retained through the procurement of approximately 3,000 MW of existing CHP. Consistent with the 2008 Scoping Plan, the CHP Program also establishes an incremental GHG emission reduction target of 4.8 MMTCO2E for the IOUs, ESPs, and CCAs that will require the installation of approximately 3,000 MW of new CHP by 2020. The Settlement assumes the remainder of the Scoping Plan's CHP emission reductions will come from the installation of new CHP systems at POUs to achieve the Scoping Plan's 6.7 MMTCO2E of emission reductions due to the installation of 4,000 MW of new CHP.

Oil and Gas Extraction

The oil and gas extraction sector has emissions that result from combustion and venting operations, as well as fugitive emissions. Over 80 percent of the emissions are associated with combustion, with the vast majority using natural gas as the fuel.

The 2008 Scoping Plan included a measure to reduce GHG emissions that are either vented or are fugitive emissions from oil and gas extraction operations. ARB evaluation of this measure found that the emissions from this category were underestimated in the 2008 Scoping Plan. Staff now estimates that emission reductions of about 1 MMT could be feasibly achieved from this measure; however, the cost-effectiveness and feasibility of a potential regulation have not yet been fully evaluated.

Given the large emissions from this category and the fact that there are a significant number of large operations, there is also potential to apply facility-level emission caps. Such an approach would afford each facility the greatest flexibility to meet its emission obligation; although, if set too low, such a cap could induce some facilities to curtail production, rather than invest in energy efficiency modifications or improving operations in other ways. Presumably lost production would be replaced by greater imports of crude oil and natural gas, and GHG emissions would increase in the area where these supplies were extracted (i.e., emissions leakage). Consequently, while additional GHG reductions from direct regulation of oil and gas extraction facilities may occur, leakage risk could be high.

Commercial and Residential Fuel Combustion

This category accounts for about 9 percent of GHG emissions in California, and is estimated to emit approximately 45 MMTs of GHGs in 2020 in the revised baseline forecast. Emissions occur when fuel is combusted in millions of individual homes, business or institutions and when the fuel is conveyed to the source. The fuel of choice is overwhelmingly natural gas. The vast majority of emissions in this sector are attributed to combustion. The No-Project Alternative includes slightly more than 4 MMTs of reductions from increased energy efficiency efforts targeting users of natural gas.

The Proposed Scoping Plan did include a measure to reduce GHG emissions from natural gas transmission and distribution, but not from the combustion of the fuel itself, which was proposed to be addressed in the Cap-and-Trade Regulation. ARB evaluation of this transmission and distribution measure found that the emissions from this category were overestimated in the 2008 Scoping Plan. ARB staff now estimates potential emission reductions of 0.5 MMT, down from a previously estimated 0.9 MMT. However, the cost, cost-effectiveness, and feasibility of a potential regulation have not yet been fully evaluated. Staff is continuing to evaluate this measure due to the potential co-benefits of reducing smog-forming, volatile organic compounds. ARB staff review of this category concluded that there is little additional potential to gain significant reductions from direct regulation of individual sources and, as with many other regulations affecting potentially millions of sources, would be challenging to administer if applied at the end-user level, i.e., the individual home or small- or medium-sized business.

High Global Warming Potential Gases

High GWP Gases are powerful global warming substances that pose unique challenges. Just a few pounds of high GWP gases can have the equivalent effect on global warming as several tons of carbon dioxide. Based on the warming potential and the persistence in the atmosphere, the impact of high GWP gases is normalized to the impact of carbon dioxide, and is represented by "CO_2 equivalents." This sector is estimated to emit approximately 38 MMTs of GHGs in 2020 in the revised baseline forecast.

ARB has adopted several measures to reduce GHG emissions from high GWP gases including standards for semiconductor manufacturing, restrictions on the use of sulfur hexafluoride (SF_6) in both electrical and non-electrical uses, limits on the use of refrigerant recharge canisters for automobiles (typically used by do-it-yourselfers), and a refrigerant management program for systems that use more than 50 pounds of high-GWP refrigerant. ARB is also considering additional measures to address installed high GWP gases in vehicles as part of the Advanced Clean Car regulatory development.

The 2008 Scoping Plan included a measure to reduce GHG emissions from high GWP gases via a fee. ARB staff evaluation indicates that, at this time, a regulation to levy a fee on purchases of high-GWP gases to reduce emissions and incentivize conservation and recovery from high GWP gases is not feasible. To address equity, competitiveness, and nexus issues – that is, to ensure that the fee raised is used directly to address a problem or issue related to the material on which it is levied -- a high-GWP fee would likely need to be levied on over 1,500 fee payers, many of which have not been subject to air quality requirements. The lack of an obvious regulated party for imported high-GWP gases presents a significant concern of leakage (i.e., high-GWP gases that are imported and circumvent the fee). As a result, this measure has significant enforcement issues. ARB staff also evaluated the potential of a regulatory phase-down or phase-out of high GWP gases. ARB believes that, although this option may have potential in the future, such a regulation is also not feasible at this time because there are not, at present, sufficient alternatives to replace high GWP gases.

Agricultural Sources

Agricultural sources of GHG are generally diffuse sources of emissions, such as enteric fermentation from livestock (a product of the digestion of ruminants such as cows), decomposition of manure from livestock, emissions from soil, and energy use in on-farm operations, such as agricultural pumps. No specific direct regulatory activities are proposed for these sources for a variety of reasons, including technical feasibility, animal welfare concerns, lack of technical data, and cost and cost-effectiveness issues.

Post-harvest activities, such as food processing, are generally considered industrial activities and potential emission reduction strategies are discussed in the general residential and commercial combustion portion of the industrial section. This sector is estimated to emit approximately 29 MMTs of GHGs in 2020 in the revised baseline forecast.

A discussion of specific subsectors follows:

Manure Management

The Proposed Scoping Plan identifies manure management through the use of digesters as a voluntary measure. After additional evaluation, ARB continues to believe that a voluntary approach is the appropriate path for manure digesters. In California, most dairies are located in the San Joaquin Valley, which requires that new emission sources (such as energy generation using methane as the fuel source from dairy digesters) meet strict smog standards. The quality of manure biogas generated in digesters makes it difficult and costly to meet those smog standards. Costs associated with gas clean-up systems, add-on emission controls, and ultra-clean technologies (fuel cells) make it cost prohibitive for many projects to proceed. A voluntary approach, supported by a voluntary offset program, allows the opportunity for technology testing to demonstrate a clean pathway to larger scale deployment of digesters.

Enteric Fermentation

Suggestions to reduce GHG emissions from enteric fermentation from livestock have included changes to feed or containment of livestock in barns with methane control technology. ARB does not believe that a direct regulatory approach is feasible for either of these approaches. In sectors that affect livestock, ARB must be particularly careful that potential regulations do not negatively impact animal health or welfare. For example, wholesale changes to livestock feed to reduce enteric fermentation emissions may jeopardize animal health and welfare. In addition, shifting from low-energy feed to the higher-energy feed that could reduce enteric fermentation may not reduce overall GHG emissions on a lifecycle basis. Requiring barn enclosures to trap enteric methane would rely on un-demonstrated technology to separate methane from barn air. If methane were collected, the issues associated with consuming or combusting the biogas would mirror the challenges currently facing manure digesters. In addition to potential animal welfare issues and cost, enclosed barns would also require cooling in the summer, potentially outweighing the GHG benefits of capturing the methane.

Soil Emissions

The Proposed Scoping Plan described a research program to evaluate nitrous dioxide (N_2O) emissions from soils as a result of fertilizer application. Some limited and localized research in California has found that decreases in fertilizer use may reduce N_2O emissions. However, generalizing those results statewide is difficult and highly uncertain due to differences in crop types, climate, soil type, soil moisture, soil pH, soil microbial activity, and individual farm management practices such as irrigation method, irrigation timing, tilling practices, crop rotation, fertilizer type, fertilizer application method and the timing of fertilizer application. ARB is continuing to fund research into N_2O emissions, and believes that given the number of outstanding questions, regulations are not feasible at this time.

Summary of Alternative 3 Strategy

The Alternative summarized below describes a technically feasible approach that allows as much flexibility as possible while still delivering the needed reductions, i.e., an additional 22 MMTs of GHG in 2020. This is the minimum quantity of emission reductions needed, and assumes that all other adopted and foreseeable measures achieve the estimated emission reductions. The strategy would consist of three major elements affecting automobiles and the largest emissions sources with reduction potential in the electricity or industrial sectors. These measures are summarized below.

The Advanced Clean Car standards included in Alternative 3 are based on the proposal being developed by ARB. This measure would reduce emissions of GHG, as well as criteria pollutants and TACs. The standards would update and link several existing programs that reduce pollution from vehicles into a single regulatory framework. This framework includes the Low-Emission Vehicle program (LEV III), the Zero-Emission Vehicle (ZEV) program and the GHG reduction program (often called Pavley standards). A Clean Fuels Outlet component (principally directed at the deployment of hydrogen fueling stations) would also be considered for inclusion in the alternative. All four elements are critical to reduce the level of criteria pollutants and GHG emissions that new passenger vehicles sold in California will generate through model year 2025. The numbers of plug-in hybrids and zero-emission vehicles in California would be accelerated and supported, as well.

New performance standards in LEV III would provide auto manufacturers a clear target for meeting environmental standards over the next 15 years, and identify a pathway to even lower emissions by mid-century. To achieve this longer term goal, ARB also plans to integrate its ZEV requirements into this new effort. ZEVs include battery electric, fuel cell, and plug hybrid electric vehicles. These vehicles are just beginning to enter the marketplace, and are expected to be fully commercial by the end of this decade. Most vehicle manufacturers agree a portfolio of these technologies would be necessary to meet climate targets by 2050.

Alternative 3 includes a requirement that electric utilities displace at least 50 percent of their coal-based generation with generation that has no higher emissions than the emission rate set by CPUC and CEC for new, long term energy contracts pursuant to SB 1368, Statutes of 2006. In effect, this results in about a 26-percent reduction in emissions. The likely response to such a regulation would be construction of new, and expanded use of existing, combined-cycle natural gas plants. Because of the difficulties in getting new plants constructed and permitted, particularly in California, such construction may take considerable time, and most new and expanded plants would be outside of California. The most likely location for new plants would be where existing natural gas lines and transmission lines are in close proximity. Extension of natural gas and/or transmission lines any considerable distance is a costly undertaking. An important consideration, though, is that the 2020 target leaves only nine years to site, build and permit plants.

To provide the balance of emission reductions needed to achieve the 22 MMT, three industrial categories have been identified. In each of these source categories, a GHG emission cap would be applied that, on average, reduces GHG emissions by 20 percent from the levels projected in the 2020 baseline forecast. The cap would be applied to the following source categories:

- Large refineries
- Cement production facilities
- Large oil and gas extraction facilities

Table 2.5-1 presents the baseline 2020 emissions, the reductions and the remaining emissions if the percentages used above were applied uniformly to each sector.

Table 2.5-1 Summary of Emission Reductions in Alternative 3

Major Emission Category	2020 GHG Emissions (MMT)	Reduction Target	GHG Reductions (MMT – 2020)
Electricity Generation			
Coal Fired	23.4	26%	6.2
Industrial Sector			
Refineries	35.0	20%	7.0
Oil & Gas Extraction	15.8	20%	3.2
Cement Production	9.2	20%	1.8
Advanced Clean Cars	--		3.8
Total			22.0

Source: ARB data, 2010a–f

The combined impact of these measures would produce the 22 $MMTCO_2E$ of reductions needed to replace reductions associated with the Cap-and-Trade and Advanced Clean Car measures. The percentages presented above are not meant to be definitive, but do illustrate the magnitude of the minimum reductions needed to replace a cap-and-trade program. An extensive rulemaking process would be needed to determine the precise percent reductions and actual caps that would be applied to each sector, and then to each facility. This effort would also need to evaluate the best split of reduction burden between sources in the electricity sector and those in the industrial sector. A phase-in of facility caps and phase down of coal generated electricity would begin around 2015 with caps set at close to the expected BAU levels. To maintain as much flexibility as possible, facility caps could be applied on a biennial basis, and early reductions could be banked for later use. This approach could result in high control costs, due either to the need for expensive measures to reduce emissions, or to lost revenue due to curtailment of production to levels allowed by facility caps.

Alternative 3 Impact Discussion

Objectives

Alternative 3 could potentially meet the fundamental objective of reaching the 2020 emissions reduction target; however, the substantial risk of leakage to other unregulated states could undermine the benefits of this achievement and would be inconsistent with AB 32, because it could jeopardize grid reliability and increase consumer cost with reduced cost-effectiveness. This Alternative would seek to reduce GHG emissions by 22 $MMTCO_2E$ through the use of source-specific performance standards for the Advanced Clean Car Program, electricity generation, and the industrial sources of refineries, cement production, and oil and gas extraction. Based on evaluations of current emissions, the availability of feasible reduction measures, and the enforceability of a direct regulation approach, it is expected that the necessary level of reduction would be achievable from the four source types.

The achievement of other basic objectives of the Scoping Plan would be variable for Alternative 3. For instance, it would reduce fossil fuel use through reduction of operations and create an enforceable program that would ensure in-state emission reductions. The co-benefits of reduced criteria pollutants and TACs would be expected within the facilities of the four sources and where disadvantaged communities are located. However, it is uncertain that Alternative 3 would result in the most cost-effective GHG emissions approach, because performance standards would be set administratively and not based on the market. Most importantly, the effectiveness of the approach would likely be hindered by substantial leakage, which would not be consistent with the Scoping Plan objectives and may not ultimately meet the environmental objectives or other substantive requirements of AB 32.

Environmental Impacts

This Alternative focuses on source-specific emission limitations by regulation to reduce GHG emissions sufficiently to achieve a 22 $MMTCO_2E$ reduction by 2020. Specifically, the strategy for this Alternative would affect automobiles and the electricity generation and industrial sectors (i.e., refineries, cement production, and oil and gas extraction), which are the largest emission sources with reduction potential. As shown in Table 2.5-1, the strategy would consist of: requirements for various types of advanced clean cars; for electric utilities to displace at least 50 percent of their coal-based generation with lower-carbon fuel-based generation; and for application of a cap to large refineries, cement production facilities, and large oil and gas extraction facilities, which on average would reduce GHG emissions by 20 percent.

This approach would afford each facility the flexibility to meet emission obligations. Compliance responses for electricity and industrial sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and other operational improvements. The likely response to the coal-displacement regulation would be construction of new, and expansion of existing, combined-cycle natural gas plants. Because of the difficulties in getting new plants constructed and permitted, particularly in California, such construction may take considerable time and most new and expanded plants would be outside of California. Compliance responses to the Advanced Clean Car Program would involve improved engine and transmission technologies, vehicle technologies, mass reduction, electrification and accessory technologies, and electric drive technologies including hybrid technologies. The improvements in vehicle technology would result in greater use of electricity and fuel cells for powering vehicles and construction of alternative fueling stations to serve plug-in hybrid, battery electric vehicles, and fuel-cell vehicles.

Aesthetic impacts resulting from Alternative 3 would be less than significant, because compliance responses are focused on small fueling facilities for Advanced Clean Car and modification of existing industrial facilities and uses. Under this alternative, in-state compliance responses for the industrial sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and other operational improvements. Implementation of this Alternative would not be anticipated to result in adverse aesthetic impacts because any construction- or operational-related activities would likely occur within existing industrial facilities, where the aesthetic character is already established and would not be substantially changed. An exception may be if new combined-cycle natural gas power plants are constructed (likely outside California), which would be of sufficient size to potentially cause significant adverse aesthetic impacts. Fueling stations for advanced clean cars would be expected where existing fuel stations are located or where local zoning allows such a use. Leakage issues for industrial sources could result in both construction and operational impacts out-of-state; however, these changes would again generally be expected to occur within existing industrial areas. Consequently, aesthetic impacts resulting from compliance responses to source-specific performance standard regulations would be less than significant, with the exception of potential new combined-cycle, natural gas power plants built in response to a regulation to reduce coal-fired electricity generation.

Agricultural and forest impacts resulting from Alternative 3 would be less than significant, because compliance responses are focused on modification of existing industrial facilities and uses. Under this alternative, in-state compliance responses for industrial sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and other operational improvements. Small Advanced Clean Car fueling stations would be near highways and in communities, rather than in important agricultural or forest resource areas. If a new fueling station is built next to a highway interchange, it may occupy the edge of some agricultural or forest area, but the encroachment would be minimal and would not be expected to substantially affect the overall resource. If new combined-cycle, natural gas power plants are built in response to a regulation to reduce coal-fired electricity generation, they would likely be located near existing transmission lines (probably outside California). While it is conceivable that a new electricity generation facility could affect agricultural or forest land, facilities would be expected to locate at or near existing electricity generation and transmission infrastructure, where adverse impacts to agricultural land and forests could be avoided. Implementation of this Alternative would not be anticipated to result in adverse agricultural or forest impacts because any construction- or operational-related activities would likely occur within existing industrial areas or where important agricultural or forest resources would not be located. Leakage issues could result in both construction- and operational-related impacts out-of-state; however, these changes would again generally be expected to occur within existing industrial areas (for industrial sources), within existing communities (for Advanced Clean Car fueling stations), or near existing electricity generation and transmission infrastructure (for repowered or new electricity generation facilities to displace coal-fired generation). Consequently, agricultural and forest impacts resulting from compliance responses to source-specific performance standard regulations would be less than significant.

Air quality impacts of Alternative 3, in general, would be regionally beneficial within the state because measures that reduce GHG emissions also provide co-benefits in terms of reductions in regional criteria air pollutant and TAC emissions because of their similarities in source types. Thus, implementation of this Alternative would reduce statewide levels of criteria air pollutants and TACs resulting in a beneficial effect. However, implementation of this Alternative could result in substantial leakage for industrial sources and electricity generation, because the performance standards placed on the covered sectors are not defined by market conditions. For example, replacing high carbon fuels (e.g., coal) with lower carbon fuels (e.g., natural gas) could result in out-of-state electricity now being used by California being sold in other markets. Additional natural gas power plants could be built outside the state to meet the performance standard (if generators are seeking to avoid the regulatory restrictions in California), which could shift the location of pollutant emissions. Also, if the performance standard limit applied to refineries, cement production, and oil and gas extraction were set too stringently, such facilities could decide it is more cost-effective to curtail in-state output and shift operations out-of-state, rather than invest in energy efficiency or other modifications in California. If this occurred, it would reduce in-state GHG and co-pollutant emissions, but also increase out-of-state production and importation/transportation potentially resulting in increased out-of-state and transportation emissions. Consequently, implementation of this Alternative could result in adverse regional and local air quality impacts out-of-state associated with construction (e.g., use of heavy-duty equipment) and operational (e.g., higher facility production levels) increases in criteria air pollutants and TACs. Best management practices exist to reduce these potentially significant impacts. However, the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects and out-of-state environmental regulations are often not as protective as California's regulatory framework. In addition, project-specific mitigation details are not available at the programmatic stage of analysis, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Also, the specific locations and impact of any such emission increases are uncertain. Thus, this FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that these air quality impacts would be potentially significant and unavoidable.

Adverse biological impacts resulting from Alternative 3 could occur, if compliance responses require modification of existing industrial facilities, construction of new fueling stations for Advanced Clean Cars, or development of new lower-carbon fuel electricity generation facilities where biological resources are present. Under this alternative, in-state compliance responses for industrial and electricity sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and other operational improvements. The construction related to upgrading of equipment, switching to lower intensity carbon fuels, and implementing operational changes at covered facilities could affect natural habitats and sensitive species, if they are present around existing facilities or at construction sites for new facilities. Construction, grading and trenching have the potential to adversely affect any protected biological resources that might exist at those locations. Recognized measures are available to reduce this potentially significant impact, but the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, this FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant biology impact may be unavoidable.

Adverse cultural resources impacts resulting from Alternative 3 could occur, if compliance responses require modification of existing industrial facilities, construction of new fueling stations for Advanced Clean Cars, or development of new lower-carbon fuel electricity generation facilities where archaeological or historic resources are present. Under this alternative, in-state compliance responses for industrial and electricity sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and other operational improvements. The construction related to upgrading of equipment, switching to lower intensity carbon fuels, and implementing operational changes at covered facilities could disturb cultural resources, if they are present around existing facilities or at construction sites for new facilities. Construction, grading and trenching have the potential to adversely affect any potentially important cultural resources that might exist at those locations. Recognized measures are available to reduce this potentially significant impact, but the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, this FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant cultural resources impact may be unavoidable.

Energy-related effects of Alternative 3 would be beneficial, because the GHG reduction strategy of direct, source-specific performance standards also results in improved energy efficiency and reductions in fossil fuel use. Under this alternative, in-state compliance responses for industrial and electricity sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and other operational improvements. For Advanced Clean Cars, the use of batteries and other Alternative fuels would conserve fossil fuels. These actions would reduce overall energy demand in-state, particularly related to curtailed operations, and are considered beneficial effects. However, implementation of this Alternative could result in increased energy demand out-of-state associated with leakage (e.g., shifting production out-of-state resulting in greater operational emissions), because siting, permitting, and construction of new power plants in California may be difficult to accomplish within the time frame. The authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects in other states. Consequently, while the net change would still be beneficial (i.e., less total energy demand), the potential level of benefit would be diminished because of the potential for substantial leakage.

Adverse geology, soils, and mineral resources impacts resulting from Alternative 3 could occur, if compliance responses require modification of existing industrial facilities, construction of new fueling stations for Advanced Clean Cars, or development of new lower-carbon fuel electricity generation facilities where new ground disturbance and landscape alteration are needed. Under this alternative, in-state compliance responses for industrial and electricity sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and other operational improvements. The construction related to upgrading of equipment, switching to lower intensity carbon fuels, and implementing operational changes at covered facilities could affect local geology and soils. Construction, grading and trenching have the potential to cause soil erosion, dust generation, and sedimentation of local waterways at those locations. Recognized measures are available to reduce this potentially significant impact, but the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, this FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant geology and soils impact may be unavoidable.

GHG emissions would be expected to decrease in California with the imposition of source specific regulations. This Alternative focuses on a performance-standard limitation by regulation on key emission sources to decrease GHG emissions sufficiently to achieve a 22 $MMTCO_2E$ reduction by 2020. As described above, the strategy would consist of requiring and promoting Advanced Clean Car technologies, requiring electric utilities to displace at least 50 percent of their coal-based generation with lower-carbon fuel-based generation, and applying a cap to large refineries, cement production facilities, and large oil and gas extraction facilities. Thus, GHG-related impacts of this Alternative would be beneficial because of the fundamental objective of this program to reduce in-state GHGs. However, implementation of this Alternative could result in adverse GHG impacts out-of-state associated with increases in GHGs from leakage (e.g., shifting production out-of-state resulting in greater operational emissions). The authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects in other states. Consequently, while the net change would still be beneficial (i.e., less GHG emission than current conditions), the level of emissions would likely not achieve the 2020 target because of the potential for substantial leakage.

Hazard and hazardous materials-related environmental impacts of Alternative 3 would be less than significant. Under this alternative, in-state compliance responses for industrial and electricity sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and implementing other operational improvements. The use of hazardous materials is common practice in industrial settings. Implementation of compliance responses could include the use of hazardous materials, but this would be considered simply a continuation of existing business practices for the covered entities, controlled by existing practices and regulations, and, thus, considered less than significant. All projects would be required to comply with established local, state, and federal laws pertaining to the use, storage, and transportation of these materials. The greater use of vehicle batteries and fuel cells would increase their production, storage, recycling, and ultimately disposal. An increase of batteries and fuel cells in the waste stream could result in potential hazardous materials and water quality effects; however, regulations exist for handling of hazardous materials and protection of water quality from waste disposal facilities and ARB is also considering specific regulatory requirements for further protection in the Advanced Clean Car Program design. Assuming compliance with applicable laws and regulations, the impacts would be less than significant.

Adverse hydrology and water quality impacts resulting from Alternative 3 could occur, if compliance responses require modification of existing industrial facilities, construction of new fueling stations for Advanced Clean Cars, or development of new lower-carbon fuel electricity generation facilities near local water features. Under this alternative, in-state compliance responses for industrial and electricity sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and other operational improvements. The construction related to upgrading of equipment, switching to lower intensity carbon fuels, and implementing operational changes at covered facilities could affect local drainage and discharge of contaminants to local waterways. Construction, grading and trenching have the potential to cause soil erosion and sedimentation of local surface water resources at those locations. Recognized measures are available to reduce this potentially significant impact, but the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, this FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant hydrology and water quality impact may be unavoidable.

Land use impacts of the compliance responses of Alternative 3 would be less than significant, because they would not change the fundamental use of facility sites and new facilities would be located where local planning and zoning allow them. Under this alternative, in-state compliance responses for industrial and electricity sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and other operational improvements and, as such, would be consistent with the existing land use and would pose a less than significant land use and planning impact. Leakage issues could result in both construction- and operational-related impacts out-of-state; however, these changes would again generally be expected to occur within existing industrial areas or at or near existing electricity generation and transmission infrastructure. Consequently, land use impacts resulting from compliance responses to source-specific performance standard regulations would be less than significant.

Adverse noise impacts could result from Alternative 3, because of the potential for substantial leakage of operations in covered sectors to other states. Under this alternative, in-state compliance responses for industrial and electricity sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and other operational improvements. Implementation of this Alternative would not be anticipated to result in adverse noise impacts at the facilities of existing in-state sources, because no major noise-generating construction- or operational-related activities would likely occur. If such were to transpire associated with onsite modification or improvements, they would be minor, intermittent and temporary in nature, and similar (or less) to the levels from sources that currently exist within these industrial settings. Construction of Advanced Clean Car fueling stations may result in temporary, construction noise within existing communities; however, local noise ordinances would be expected to maintain impacts at less-than-significant levels. Thus, these impacts would be considered less than significant. However, leakage issues could result in both construction and operational impacts out-of-state because of the generation of noise levels that exceed ambient conditions at existing sensitive receptors. For example, an out-of-state cement facility could expand current operations to increase production resulting in increased on-site noise levels from construction and operation, and offsite noise levels from increased truck travel associated with material transport. Best management practices currently exist (e.g., limiting construction activities to the less noise-sensitive daytime hours and obstructing the line of sight between sources and receptors for operational activities) to reduce these potentially significant noise impacts. However, the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. In addition, project-specific mitigation details are not available at the programmatic stage of analysis, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Also, the specific locations and impact of any such noise increases are uncertain. Thus, this FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that these noise impacts would be potentially significant and unavoidable.

Adverse population, employment, and housing effects would not occur from the source-specific regulations in Alternative 3, including from the operational and facility-modification compliance response projects, because the compliance activities would not substantially change socioeconomic conditions. All impacts to population, employment, and housing would be less than significant.

Public services impacts of Alternative 3 would be less than significant, because direct regulation compliance response activities would occur at existing facility sites where public services are already provided. Under this alternative, in-state compliance responses for industrial or electricity sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and other operational improvements. All potential impacts to public services would be less than significant. These projects would not substantially increase the level of public services beyond that already provided to existing facilities. Leakage issues could result in both construction- and operational-related impacts out-of-state; however, these changes would again generally be expected to occur within existing industrial areas or at or near existing electricity generation and transmission infrastructure. Consequently, public services impacts resulting from compliance responses to source-specific performance standard regulations would be less than significant.

Recreation impacts of Alternative 3 would be less than significant, because direct regulation compliance response activities would occur at existing facility sites or within communities at locations allowed by local zoning codes. The source-specific regulations, including the expected compliance responses, would not result in increased demand for or adverse impacts to recreation resources. The covered entity compliance responses consist of upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities in the state. Leakage issues could result in both construction- and operational-related impacts out-of-state; however, these changes would again generally be expected to occur within existing industrial areas. Consequently, recreation impacts resulting from compliance responses to source-specific performance standard regulations would be less than significant.

Adverse transportation impacts could result from Alternative 3, because of the potential for substantial leakage of operations in covered sectors to other states and the resulting need for additional transportation of affected products. Under this alternative, in-state compliance responses for industrial and electricity sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and implementing other operational improvements. Implementation of this Alternative would not be anticipated to result in adverse transportation or traffic impacts, because no major traffic-generating construction or operational activities would likely occur. If such were to occur, any construction traffic increases would be temporary and mitigated through ingress and egress controls, traffic controls, and reduced speed zones to ensure safety, and operational traffic levels would be similar to existing conditions. Thus, these impacts would be considered less than significant. However, leakage issues could result in both construction and operational impacts out-of-state because of the generation of traffic. For example, an out-of-state cement facility could expand current operations to increase production resulting in increased traffic on the local roadway network from additional employees and material transport. Also, new combined-cycle, natural gas power plants may be built in response to the requirement to displace coal-fueled electricity generation, resulting in substantial construction traffic. Increased interstate transport of products into California could also be required. Best management practices exist to reduce these potentially significant impacts. However, the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. In addition, project-specific mitigation details are not available at the programmatic stage of analysis, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Thus, this FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that these transportation impacts would be potentially significant and unavoidable.

Utility and service system impacts of Alternative 3 would be less than significant, because these activities would occur at existing facility sites where utility systems are already provided. Under this alternative, in-state compliance responses for industrial and electricity sources could include curtailing production, implementing energy efficiency modifications, making fuel changes, and other operational improvements. These projects would not increase the level of utilities beyond that already provided to existing facilities. The availability and extension of utilities is subject to approval of the local utility provider, and readily implemented in a manner that would be less than significant. Leakage issues could result in both construction and operational impacts out-of-state; however, these changes would again generally be expected to occur within existing industrial areas or at or near electricity generation and transmission infrastructure. Consequently, utility and service system impacts resulting from compliance responses to source-specific performance standard regulations would be less than significant.

2.6 Alternative 4: Adopt a Program Based on a Carbon Fee or Tax

Goal of Alternative 4

The goal of Alternative 4 is to evaluate a reasonable approach to GHG emissions reduction relying on a carbon fee or tax program to achieve the remaining reductions (i.e., approximately 22 $MMTCO_2E$) needed to make up for the amounts intended to come from Cap-and-Trade and an Advanced Clean Car Program to meet the 2020 GHG reduction target. It is intended to help decision-makers consider whether a strategy based on carbon pricing assigned by ARB to regulated sources, instead of relying on an emissions cap would reduce or otherwise substantially change potential effects on the environment.

Role of Alternative 4 in the Range of Alternatives

Within the range of alternatives, a carbon fee represents an approach where pricing is set by the state. The carbon fee or tax is an example of a charge levied on an economic activity that causes a negative cost (i.e., costs incurred by the public and the state resulting from global warming risks, in this case) that would otherwise not be taken into account in the market price of the activity; these costs are sometimes called “externalities.” The primary purpose of a carbon fee is to reflect the externalities in the market price, thereby raising the cost of processes and products that generate the emissions and providing incentives to switch to lower emitting activity. The carbon fee or tax provides a clear signal of the price that parties will face for their GHG emissions. Setting the cost of carbon emissions on covered entities through a fee or tax does not guarantee a specific emissions outcome because there is neither a regulated cap (as in Cap-and-Trade) nor a defined performance standard (as in a direct, source-specific regulation). Defined administratively by statute and/or regulation, the carbon fee or tax would not typically adjust with changing market conditions (unless special provisions were included in legislation or regulations for automatic adjustments).

Precedents or Examples of the Approach in Alternative 4

A carbon fee or tax is a charge levied on the carbon content of a fuel or the equivalent emissions produced when the fuel is used. Many carbon fees (or taxes) have been enacted at national and state/province levels around the world, as summarized in Table 2.6-1. There is fairly wide variation in the rates imposed and the sources of carbon covered. In some jurisdictions, such as in Europe, the carbon fee is complementary to a comprehensive cap-and-trade program (EU-ETS). In other cases, such as Boulder, Colorado, the fee is a (perhaps temporary) substitute for a broader comprehensive program. In Canada, provincial taxes in Quebec, Alberta, and British Columbia provide a means to help achieve the emission reductions that Canada has agreed to under the UN Framework Convention on Climate Change's Kyoto Protocol, in light of the fact that Canada's federal government has not implemented a cap on emissions at the national level. Several countries other than those in Table 2.6-3 are either now considering a carbon fee or tax (United Kingdom, South Korea, Taiwan, South Africa) or recently deliberated on and decided against one (France, Slovenia, Japan, and New Zealand). Australia recently announced plans to implement a carbon tax in 2012 as a transitional strategy to a cap-and-trade program (Daley 2011).

The examples above suggest that carbon fees and taxes have been taken seriously by a number of other jurisdictions as a means to address GHG emissions. Several Scandinavian countries experimented with carbon-related taxes in the early 1990s, but they were often assigned to parts of the energy mix, not comprehensively, and have changed over time as climate and energy policy has evolved. The Kyoto Protocol agreement is structured around national caps, but individual countries can implement their own national strategies, including a fee or tax, if they choose. The existence of carbon fees or taxes in some European countries – which have also adopted national caps on emissions -- suggests that some governments there feel the need to supplement the cap-and-trade program, especially recognizing that not all sectors are covered by the EU-ETS.

Because many countries have just recently implemented a tax and the tax is often mixed with other strategies, it is not yet feasible to assess the program's success nor to segregate the success of the tax component from the overall program. For example, British Columbia uses a revenue-neutral approach to reduce personal and corporate income taxes. In terms of revenue, the carbon tax between 2008 and 2009 collected $846 million and reportedly resulted in $230 million net reductions to taxpayers there. Modeling anticipates that the British Columbia system will reduce emissions by five percent (Plumer 2010).

Table 2.6-1 Current Examples of Carbon Fees or Taxes

Location	Fee or Tax Rate	Comments
Denmark	$17.47 (90 DKK/MT)	As of 2008[1,2]
Norway	$5-70 (25-380 NOK/MT)	As of 2011. Varies by emission level; some can be covered with emissions trading scheme.
Sweden	$164.18 (€103/MT) for households and services $31.88 (€22/MT) for sectors subjected to leakage and outside EU ETS $21.73 (€15/MT) CO_2 for sectors subjected to leakage and inside EU ETS	As of 2010[3]. Much higher prices for general level compared to industry level. Various exemptions[4].
Finland	$43.47 - 72.45 (€30 -50/MT)	As of 2010; only traffic and heating fuels[5]
Switzerland	$40.43 (36 Swiss franc/MT)	As of 2010. Companies participating in cap-and-trade can be exempt.[6]
France		Plan for $24.62/MT (€17/MT) tax abandoned[7].
Ireland	$21.72 (€15/MT)	As of 2010. Relief for electricity generation, chemical reduction, and electrolytic/metallurgical processes.[8]
Quebec, Canada	$3.11 (C$3/MT)	As of 2009[9, 10]
British Columbia, Canada	$20.79 (C$20/MT)	As of 2011; will rise to $31.19/MT (C$30/MT) July 2012[11, 12].
Alberta, Canada	$15.60 (C$15/MT)	As of 2008[13]
Costa Rica	3.5% on fossil fuels market price	Steady percent rate since 1997[14, 15]
India	$3.19 (50 rupees/MT of coal (1 short ton of coal = 2.86 short ton of CO_2[16]))	As of 2010, only for coal, both produced and imported to India.

Table 2.6-1 Current Examples of Carbon Fees or Taxes

Location	Fee or Tax Rate	Comments
California, USA	4.8 cents/MT	As of 2008, applies only to Bay Area Air Quality Management District[17].
Colorado, USA	$7.71/MT	As of 2008, on electricity consumption in the City of Boulder, CO[18] and expires by March 2013[19].
Maryland, USA	$5 .51/MT	As of 2010, from any stationary source in Montgomery County, MD[20]

MT = metric ton

1 http://www.ees.uni.opole.pl/content/03_10/ees_10_3_fulltext_01.pdf
2 http://www.nrel.gov/docs/fy10osti/47312.pdf
3 http://www.norway.or.jp/Global/SiteFolders/webtok/PDF/20_Years_of_CO2_Taxation_in_Sweden.pdf
4 http://www.iea.org/textbase/nppdf/free/2008/Sweden2008.pdf
5 http://www.environment.fi/default.asp?contentid=147208&lan=en
6 http://www.bafu.admin.ch/co2-abgabe/05179/05314/index.html?lang=de
7 http://www.telegraph.co.uk/finance/newsbysector/energy/7507015/France-ditches-carbon-tax-as-social-protests-mount.html
8 http://www.taxireland.ie/TaxFind/ContentHTML/ParsedHTML/AITIManuals_HTMLFILES%5CITM_HTMLFILES%5Cc33.t2.st3.html
9 http://www.cdhowe.org/pdf/backgrounder%20118_English.pdf
10 http://www.torys.com/Publications/Documents/Publication%20PDFs/CCB2007-6.pdf
11 http://www.nytimes.com/cwire/2011/03/22/22climatewire-british-columbia-survives-3-years-and-848-mi-40489.html?pagewanted=2
12 http://www.sbr.gov.bc.ca/documents_library/notices/British_Columbia_Carbon_Tax.pdf
13 http://www.cbc.ca/news/business/story/2008/01/08/renner-carbon.html
14 http://www.policyarchive.org/handle/10207/bitstreams/20176.pdf
15 http://www.nytimes.com/2009/04/12/opinion/12friedman.html
16 http://www.indiaenvironmentportal.org.in/files/India%20Taking%20on%20Climate%20Change.pdf
17 http://articles.sfgate.com/2008-05-22/news/17155215_1_carbon-dioxide-greenhouse-gas-emissions
18 http://nexus.umn.edu/Courses/Cases/CE5212/F2008/CS7/CS7PPT.pdf
19 http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=7698&Itemid=2844
20 http://solveclimate.com/news/20100525/maryland-county-carbon-tax-law-could-set-example-rest-country

The Table is generally taken from the following source: Murray, Mazurek, and Profeta 2011.

Attributes of Alternative 4

Key Carbon Fee or Tax Alternative Design Decisions

If a carbon fee or tax was implemented in California, four key design issues must be addressed, as outlined below. (The terms, "fee" and "tax," are generally used interchangeably in the section that follows, because they both levy a price on carbon emissions, with the exception of the discussion of the administrative differences between implementation of a fee or a tax in California.)

Covered Sectors

The covered sectors must be identified. In California, the sectors potentially subject to the carbon fee or tax would be those that were slated to be covered under the proposed Cap-and-Trade Regulation (ARB 2010a). These would include electricity, transportation fuels, natural gas and large industrial sources of 25,000 metric tons or more.

Fee or Tax Level

The level of the fee or tax would need to be decided. The state must determine the carbon fee or tax level and whether and how to change it over time. Table 2.6-2 lists several criteria used by other jurisdictions for setting the carbon fee or tax level. A wide range of fees or taxes can result from consideration of the various criteria. The federal Interagency Work Group on the Social Cost of Carbon conducted a comprehensive exercise to estimate the social cost of carbon, which is one of the potential criteria. Mean values for 2010 ranged from about \$5 to \$35 per ton CO_2, depending on time discount rates (varying between 2.5 and 5 percent). The value that includes 95 percent of the range of fees or taxes, using a 4 percent discount rate, would be about \$65 per ton (IWGSCC 2010).

Table 2.6-2 Representative Criteria for Setting the Carbon Fee or Tax Level

Criterion	Description	Advantages	Disadvantages
Social cost of carbon (SCC)	Economic value of the damages caused by an additional ton of CO_2 equivalent	Consistent with the underlying Pigovian concept that the fee or tax causes the product to reflect its true cost to society	Wide range of estimates depending on studies of varying methodologies and scope
"Pain threshold"	Level above which the economic costs of the fee or tax are deemed too burdensome for affected parties	Pragmatic, recognizing need to reduce shocks especially in early years. Can be combined with strategy to start fee low and phase-in increases over time.	Difficult to determine which single level meets this criterion. Easy to manipulate politically.

Table 2.6-2 Representative Criteria for Setting the Carbon Fee or Tax Level

Criterion	Description	Advantages	Disadvantages
Technology goal	Set at level sufficient to stimulate investment in key technologies deemed critical to achieving long-term reductions (e.g., renewable power, electric vehicles)	Clear rationale to avoid weak or stranded investment. May be easier to estimate initially than alternatives above.	Involves government picking "winner" technologies and may be difficult to match dynamics of technology and cost changes over time.
Comparable prices elsewhere	Set within range of carbon fees, taxes, or prices found in other systems (fee-based or cap-and-trade)	Easy to determine.	Other systems will reflect particular scope and criteria that may be at variance with values and objectives of California program
Environmental objective	Effectiveness in reducing emissions	Stable carbon price over the long term also means consistent, ongoing incentive to reduce emissions.	Indirect influence on emission level with absence of cap. Risk of leakage, if fee or tax does not reflect market price well.

Emissions Basis

The next decision is the exact quantity of emissions subject to the fee or tax. A standard approach would be for all emissions in the covered sector to be subject to the fee or tax. An Alternative would be to assess a *marginal fee or tax* only on emissions above a set level . To compare these approaches, consider a plant planning to generate one million tons of CO_2 emissions in a given year. If the carbon fee or tax is set at $15 per ton, under the full-fee system, the plant would pay $15 million in fees or taxes for the year. If the fee or tax is assigned on all emissions in excess of 900,000 tons, the plant would pay $1.5 million in fees or taxes for the year. In both cases, the firm's monetary incentive to reduce emissions from 1 million to 900,000 tons is the same (save $1.5 million) but the total amount the government receives in revenue would be quite different. Importantly, however, there would be no incentive to reduce emissions below 900,000 tons under the marginal fee or tax approach but there would be a continued incentive to do so under the total fee or tax approach since all tons incur a cost.

If a marginal fee or tax were selected, the state would need to determine the threshold (baseline) level for each covered entity, below which no fee or tax would be assessed. This could be determined based on a range of factors, such as a fixed percentage of historic emissions, a sectoral threshold standard or benchmark (e.g., emissions per unit output), or customized for each individual plant's condition. The marginal fee or tax approach would minimize cost impacts to businesses and discourage leakage, so it is assumed for purposes of the alternatives analysis in the FED Supplement.

Point of Regulation

The point of regulation for the fee or tax is the next critical question. The appropriate point of regulation varies based on the sector. A carbon fee or tax could target the same points of regulation or any point within the state from fuel extraction to combustion to end use. This is often referred to as the point of regulation or point of fee assignment. Options for the point of regulation and their relative advantages are included in Table 2.6-3.

Cost-effectiveness would vary depending on the point of regulation, primarily related to administrative costs. The direct cost of a fee or tax to emitters would not change whether the point of regulation is set upstream, midstream, or downstream. As long as it coincides with the carbon (CO_2, GHG) contained or emitted and can be passed through, the amount charged would be the same no matter where the fee or tax is levied. However, the most substantial cost variations that arise with different points of regulation likely are administrative in nature. The monitoring and transaction costs associated with a fee or tax would generally be smaller on a per ton basis, if imposed at a point where there are relatively few entities responsible for relatively much carbon in an easy-to-monitor form. As suggested in Table 2.6-3, this is typically more likely with upstream regulation. For example, imposing a fee or tax on transportation carbon may be more easily (less costly) accomplished at the refinery or fuel supplier level, with relatively few suppliers transacting in fuel, rather than on emissions at the tailpipe level assessed downstream on millions of drivers. Midstream may involve assessment at thousands of gas pumps across the state. Therefore, in principle, there may be a reduction in administrative and monitoring costs, if assessed upstream. As suggested in Table 2.6-3, the most administratively advantageous point varies. For example, imposing a fee or tax on transportation carbon may be more easily (less costly) accomplished at the refinery or fuel supplier level, with relatively few suppliers transacting in fuel, rather than on emissions at the tailpipe level assessed downstream on millions of drivers. Implementing the fee or tax further downstream may involve assessment at thousands of gas pumps across the state. Therefore, in principle, there may be a reduction in administrative and monitoring costs, if assessed midstream.

Table 2.6-3 Potential Points of Regulation for Fee or Tax Assignment

Fee or Tax Assignment Point	Point of Regulation	Example	Advantages and Disadvantages
Upstream	On fuel content	Assign fee or tax on carbon content of all natural gas, coal, transportation fuels used in California	Relatively easy to administer, as number of fuel producers is small relative to number of users Difficult for “imported” emissions such as electric power generated in another state and transmitted to California Not easily imposed on non-fossil fuel sources (e.g., methane emissions from landfills)
Downstream	Assign fee or tax to final consumer of goods that are responsible for emission	Imposed at gas pump or in electric power bill, for all Californians, based on, consumption of the carbon-emitting product.	May have greater impact on use/efficiency if directly levied on final consumer. With upstream or midstream, cost may ultimately fall on final user anyway through market price adjustments. May have higher transaction costs if levied on millions of consumers directly
Midstream	At point of large stationary sources of combustion	Charged to power plants and factories based on actual GHG emissions there	Lower transaction costs since imposed on few, relatively large emitters. Direct incentives for emission reduction activities, emission leaks.

Source: Murray, Mazurek, and Profeta 2011.

It is important to note that a downstream system may have some indirect cost savings advantages, in terms of spurring efficiency improvements. The potential for savings turns on the assumption that those who most directly bear the price impact have a comparably large incentive to save energy and the attendant emissions reductions that efficiency improvements will bring. Under a system that imposes the fee or tax further upstream, such pricing effects may not be as apparent to the downstream energy user (Niemeier et al 2008) because the charge is imbedded in the cost of the input, rather than directly assessed based on the activity of the downstream party. ARB’s economic modeling of the Cap-and-Trade Regulation showed that savings from efficiency improvements significantly lowered the total compliance costs of the Cap-and-Trade Program.

One other possible advantage of downstream assessment is that it may be easier to target relief for low-income households if that is the point of regulation. Certain households could be exempted from the fee or tax. This would be more difficult, if the fee or tax is assessed further upstream and flows down to all households, although it could be addressed by uses of the revenue.

Despite the potential advantages of downstream regulation, from an implementation perspective, a more upstream point of regulation would be the most administratively cost effective approach. The points of regulation assumed in Alternative 4 are as follows. For purposes of this analysis, the point of regulation of electrical generation and industrial sources would be the facility operator (i.e., the generation or industrial facility). For electricity imports, the point of regulation would be the importer. For natural gas, the point of regulation would be the user or distributor of the gas. For transportation fuels, the point of regulation would be the first holder or supplier of refined gasoline or distillate fuel oil.

Administrative Features of a Potential Carbon Fee or Tax

The discussion above addresses four factors to consider in designing a carbon fee or tax program. The administrative steps to creating a fee or tax include: sectoral coverage, fee or tax level, emissions basis, and point of regulation (fee or tax assignment). In theory, a carbon fee or tax may be more straightforward to design and to administer, compared to the other regulatory alternatives. However, in practice, a levy of this nature may be more challenging to design and administer in California owing to legal distinctions between what constitutes a tax and a fee. The following discussion examines what administrative issues California would need to face in practice.

Data Collection and Monitoring

Once the decisions are made about the sectors to be covered, the level of the fee or tax, the emissions basis and the point of regulation, the next step would be to develop data to track the GHG emissions on which the fee or tax is assessed. The amount of data collection and analysis required depends on the point of regulation. An upstream system requires only data on carbon content in fuels and data on fuel quantities. A midstream fuels-based system requires data on carbon content in fuels and data on fuel quantities. A system designed to mimic sources targeted under the proposed Cap-and-Trade Regulation would require emissions data at the regulated source or emissions estimates in the production and use of the final product.

How the environmental effectiveness of a fee or tax would be monitored also depends, in part, on the point of regulation. Fuel use data would be necessary to monitor a fuel based system, whereas emissions estimates or product use would be necessary to monitor the environmental effectiveness of an emission based system.

Collection and Enforcement

In theory, a key administrative advantage to taxes is that they may be levied and enforced through established tax collection methods, rather than developed from the ground up through agencies charged with environmental regulation, which could be the case for a fee. For example, a federal carbon tax, similar to a fuel excise tax, could be levied and collected by the U.S. Department of the Treasury instead of the U. S. EPA. Under a fuel based system, fuel suppliers would account and pay in a manner much like other taxes to which they are accustomed. California corollary to administer Treasury's functions would be the State Board of Equalization or Franchise Tax Board. In British Columbia, a Western Climate Initiative partner to California, retail gasoline establishments collect the carbon tax and remit revenues along with other monies to the provincial revenue collection authority. Because the tax may be based on transaction records (e.g., fuel purchase) and not measurement of emissions, non-compliance could be achieved through financial cheating or evasion. Accordingly, enforcement against a transaction based tax would take place in large part through established tax auditing systems.

Revenue Uses

Depending on the emissions basis (e.g., marginal emissions or total emissions), a fee or tax holds the potential to generate a greater or lesser amount of revenue per year. As in the case of an allowance auction, a state with a carbon fee or tax must then decide how to use those revenues. ARB's Economic and Allocation Advisory Committee (EAAC 2010, p. 33-34) identified four potential uses of allowance revenues including reducing the disproportionate impact of higher fuel prices caused by a fee or tax on low income households; financing government expenditures; reducing income or sales taxes; or providing public dividends in such forms as direct payment or a trust fund for education. The Alaska Permanent Fund, which recycles oil-extraction royalties to Alaskans, is one example of a dividend model. Varying degrees of flexibility in revenue use apply in California, based on the different legal restrictions of fees versus taxes, as discussed below.

Avoiding Leakage

Because a fee or tax, like a cap-and-trade approach, would place a price on carbon emissions by in-state industrial sources, both systems are prone to leakage of economic activity and attendant emissions to jurisdictions without carbon regulation and pricing. Here, "leakage" refers to the incentive for regulated entities with high GHG emissions or energy costs to shift or to relocate activity to states without carbon regulation, fees, or taxes to avoid the added cost, which then could erase the emission reductions achieved in-state. A cap-and-trade program addresses leakage through the use of free allocation of allowances to trade-exposed, energy-intensive industries. For this alternative, implementation could result in leakage if not accounted for in the design of the alternative. For a fee or tax, administrative mechanisms may be necessary to address leakage, such as something called a border adjustment (which are import fees levied by a carbon-taxing jurisdiction on goods coming in from non-carbon-taxing jurisdiction to eliminate the cost avoidance advantage of relocation) or other mechanisms such as the use of rebates. For purposes of this analysis, the design of this Alternative is assumed to include appropriate mechanisms that minimize the potential for leakage.

Administrative Issues Specific to California

"Fee" and "tax" have been used interchangeably in this discussion so far, because they both have the effect of pricing carbon and in some jurisdictions the terms are interchangeable in operation. In California, a fee and a tax have distinct legal characteristics, which bring different legal requirements and restrictions to bear. As a result, in practice a carbon tax could operate differently from a carbon fee in California. Both are discussed below.

Under California's Constitution, as of 2006 – when AB 32 was enacted into law – a tax requires a legislative supermajority (two-thirds) vote, whereas a fee traditionally only requires a simple majority vote of the Legislature. For purposes of this analysis, ARB would adopt the carbon fee regulation under the authority of AB 32. If new legislation were required for ARB to adopt a carbon fee, the requirements of Proposition 26 (approved in 2010) – which expanded the definition of a "tax" – would determine whether a legislative majority or supermajority vote is required.

In general, with a tax, there are no restrictions on the level of the tax or how the money is appropriated for use. The tax levy and appropriation for use are defined by the Legislature. For example, the revenue from a tax may go into the state's "general fund," from which a wide variety of public services and programs are funded. By contrast, with a fee, the amount collected and the uses for which the money may be appropriated are subject to limitations based on a complex legal test. The purpose of this alternatives analysis is not to provide a legal opinion, but rather to discuss the limitations on fees in laypersons' terms.

Generally speaking, the total amount collected via the fee must not exceed the reasonable cost of the government program, and the fee must be allocated reasonably among fee payers based on their responsibility for causing the burden that made the program necessary or the benefits they directly or indirectly receive from the program. Thus, subject to those restrictions, at the time AB 32 was enacted, the Legislature could, by a simple majority vote, authorize agencies to establish fees to pay for environmental damages and the costs to administer programs to address those damages. The revenues from a carbon tax could, however, be used to offset lower income or sales taxes or to create a trust fund for public education, or other legislatively authorized purposes; such use of revenue would not be available under a fee.

With these distinctions between a tax and a fee in California in mind, whether and how such programs might operate and who would operate them could look very different in practice. To implement a carbon tax in California, the Legislature would need to approve the tax by two-thirds supermajority. Such a scenario is extremely unlikely for the foreseeable future. Alternatively, a carbon tax could be placed on the ballot with sufficient signatures, but this scenario would require significant outside resources to pass such a measure. The challenges surrounding approval of a carbon tax could make this approach infeasible as a practical matter.

Assuming hypothetically that such a tax would pass by legislative vote or by popular vote, the administrative steps to implementation would be consistent with those outlined above. Legislators or voters could set the tax and decide whether to return revenues to the general fund, return revenues to taxpayers, or use the value for other goals as outlined by the EAAC (2010). Under this statutory authority, ARB could establish the point of regulation, based on carbon content or emissions data. ARB could administer the program and monitor progress towards emissions reductions. However, an existing taxing agency, such as the State Board of Equalization or Franchise Tax Board, theoretically could levy, collect, and monitor the tax, as well as administer personal tax reductions, if the state were to implement such an approach. Because the primary goal of this tax would be to achieve targeted reductions in GHG emissions, it would be necessary to return to the Legislature or to voters to raise additional taxes, for example if monitoring shows that the program is failing to achieve GHG emission reduction targets (although the initial tax authorization could include an automatic adjustment).

In contrast to a tax, additional legal and administrative considerations would need to be brought to bear under a California carbon fee program. Here, the legal requirements for a fee would make such decisions as on what basis to levy a fee and where to apply to the point of regulation more complicated. As discussed above, the California Constitution and court decisions interpreting the Constitution also would likely constrain how ARB could charge and use revenues from a carbon fee.

Summary of Alternative 4 Strategy

Carbon fees or taxes assign a price to carbon and apply it administratively to a specific point of regulation, with the goal of encouraging emissions reduction to avoid the added cost. A fee or tax may be relatively straightforward to set and to administer, although it would be more challenging to ensure that the fee or tax achieves the required emission reductions. Moreover, taxes in theory may be levied and collected by tax authorities, rather than environmental regulatory agencies. In the case of a carbon fee, the uses of the revenues are restricted by state law, while a carbon tax approved by voters or the Legislature, revenues can be redirected to any number of potential uses, including offsetting income taxes, dividends or reducing comparably higher fuel bills to low income households that a carbon fee or tax would bring.

The most challenging constraint for a tax approach in California owes to the requirement that taxes must be approved either by legislative supermajority or voter initiative. Such measures would require time and potentially substantial resources to pass, and may be politically infeasible. Successful passage and creation turns in large part on confidence that government will use revenues wisely and return value to taxpayers or households. Importantly, while a fee or tax may be simple to administer, a central drawback is that a fee or tax addresses environmental goals or emissions limits indirectly (i.e., increasing the price of carbon, but without a specified emissions cap). Thus, there is uncertainty about whether the emission reduction target would be met. If evidence shows that a tax is failing to sufficiently reduce emissions, it may be politically difficult to return to the Legislature or to voters to levy a higher tax to reduce more emissions (although an automatic adjustment could be included in the original authorization).

Alternative 4 Impact Discussion

Objectives

Alternative 4 would seek to reduce GHG emissions by 22 $MMTCO_2E$ through the use of a carbon fee or tax on emissions from electricity, transportation fuels, natural gas and large industrial sources. The Alternative could potentially meet the fundamental objective of reaching the 2020 emissions reduction target; however, the absence of a firm cap or performance standard creates a substantial risk of either falling short of the target or over-complying, which may involve unnecessary additional costs. Also, if the carbon fee or tax does not reflect market conditions well, either leakage to other unregulated states could occur (if the levy is too high compared to the market) or actual reductions could fall short of what is needed to meet the state's target (if the levy is too low compared to costs of changes to reduce GHG).

The achievement of other basic objectives of the Proposed Scoping Plan would be variable for Alternative 4. For instance, Alternative 4 would reduce fossil fuel use through the potential compliance responses to the fee or tax, such as reduction of operations or enhancement of energy efficiency. The co-benefits of reduced criteria pollutants and TACs would be expected within the facilities of the affected sectors. However, it is uncertain that Alternative 4 would result in the most cost-effective GHG emissions approach, because the level of the fee or tax would be set legislatively or administratively, rather than being easily adjusted to the market. Disadvantaged communities would experience benefits of reduced co-pollutants where facilities cut back on operations or achieved more energy efficiency. Most importantly, the effectiveness of the approach has substantial risk of being hindered, because of the potential for the charge to be inconsistent with marketplace conditions, either resulting in substantial leakage, which would not be consistent with the Proposed Scoping Plan objectives, or falling short of the contribution needed to the state's 2020 reduction target. If pursued, this Alternative would need to be designed to include administrative mechanisms to minimize the potential for leakage.

Environmental Impacts

Alternative 4 relies on a carbon fee or tax program that would identify affected sectors, fee or tax level, emissions basis, and point of regulation to meet the 2020 GHG emissions reduction target. The sectors affected by this Alternative would be the same as those included as covered entities in the proposed Cap-and-Trade Regulation (i.e., electricity, transportation fuels, natural gas and large industrial sources). Under this alternative, compliance responses by affected entities could include fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. For purposes of this analysis, the point of regulation of electrical generation and industrial sources would be the facility operator (i.e., the generation or industrial facility). For electricity imports, the point of regulation would be the importer. For natural gas, the point of regulation would be the user or distributor of the gas. For transportation fuels, the point of regulation would be the first holder or supplier of refined gasoline or distillate fuel oil. Setting the cost of carbon emissions on covered entities through a fee or tax provides an indirect influence on emitters to reduce their GHG emissions sufficiently to meet the 2020 target, because there is neither a regulated cap (as in Cap-and-Trade) nor a defined performance standard (as in a direct, source-specific regulation). Defined administratively by statute and/or regulation, the carbon fee or tax would not adjust with changing market conditions (unless special provisions are included in authorizing statute or regulation for adjustment). The carbon fee or tax provides a clear, long-term signal of the price that parties will face for their GHG emissions, which allows for long-term operational planning.

Aesthetic impacts resulting from Alternative 4 would be less than significant, because compliance responses are focused on modification of existing industrial facilities and uses. Under this alternative, compliance responses to the fee or tax by affected entities could include the fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. Implementation of this Alternative would not be anticipated to result in adverse aesthetic impacts because any construction- or operational-related activities would likely occur within existing facilities, where the aesthetic character is already established and would not be substantially changed. Leakage issues could result in both construction- and operational-related impacts out-of-state; however, these changes would again generally be expected to occur within existing industrial areas. Consequently, aesthetic impacts resulting from compliance responses to a carbon fee or tax would be less than significant.

Agricultural and forest impacts resulting from Alternative 4 would be less than significant, because compliance responses are focused on modification of existing industrial facilities and uses. Under this alternative, compliance responses to the fee or tax by affected entities could include the fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. Implementation of this Alternative would not be anticipated to result in adverse agricultural or forest impacts because any construction- or operational-related activities would likely occur within existing industrial areas, where important agricultural or forest resources would not be located. Leakage issues could result in both construction- and operational-related impacts out-of-state; however, these changes would again generally be expected to occur within existing industrial areas. Consequently, agricultural and forest impacts resulting from compliance responses to a carbon fee or tax would be less than significant.

Air quality impacts of Alternative 4, in general, would be regionally beneficial, because measures that reduce GHG emissions also provide co-benefits in terms of reductions in regional criteria air pollutant and TAC emissions because of their similarities in source types. Thus, implementation of this Alternative would reduce statewide levels of criteria air pollutants and TACs resulting in a beneficial effect. However, implementation of this Alternative could result in substantial leakage because the cost of carbon in a fee or tax program would be set administratively, rather than by the market, resulting in the potential to be inconsistent with marketplace conditions. Unless administrative mechanisms are in place to minimize the potential for leakage, implementation of this Alternative could result in adverse regional and local air quality impacts out-of-state associated with construction- (e.g., use of heavy-duty equipment) and operational-related (e.g., relocated facilities) increases in criteria air pollutants and TACs. However, with such mechanisms in the design of the alternative, impacts to air quality would be reduced to a level of insignificance.

Adverse biological impacts resulting from Alternative 4 could occur, if compliance responses to the fee or tax require modification of existing industrial facilities and uses where biological resources are present. Under this alternative, compliance responses to the fee or tax by affected entities could include the fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. The construction related to upgrading of equipment, switching to lower intensity carbon fuels, and implementing operational changes at covered facilities could affect natural habitats and sensitive species, if they are present around existing facilities. Construction, grading and trenching have the potential to adversely affect any protected biological resources that might exist at those locations. Recognized measures are available to reduce this potentially significant impact, but the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, this FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant biology impact may be unavoidable.

Adverse cultural resources impacts resulting from Alternative 4 could occur, if compliance responses to the fee or tax require modification of existing industrial facilities and uses where archaeological or historic resources are present. Under this alternative, compliance responses to the fee or tax by affected entities could include the fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. The construction related to upgrading of equipment, switching to lower intensity carbon fuels, and implementing operational changes at covered facilities could disturb cultural resources, if they are present around existing facilities. Construction, grading and trenching have the potential to adversely affect any potentially important cultural resources that might exist at those locations. Recognized measures are available to reduce this potentially significant impact, but the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, this FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant cultural resources impact may be unavoidable.

Energy-related effects of Alternative 4 would be beneficial, because the GHG reduction strategy of the carbon fee or tax also results in improved energy efficiency and reductions in fossil fuel use. Under this alternative, compliance responses to the fee or tax by affected entities could include the fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. These actions would reduce overall energy demand in-state, particularly related to curtailed operations, and are considered beneficial effects. However, implementation of this Alternative could result in increased energy demand out-of-state associated with leakage (e.g., shifting production out-of-state resulting in greater operational emissions). The authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects in other states. Consequently, while the net change would still be beneficial (i.e., less total energy demand), the potential level of benefit would be diminished because of the potential for substantial leakage.

Adverse geology, soils, and mineral resources impacts resulting from Alternative 4 could occur, if compliance responses to the fee or tax require modification of existing industrial facilities and uses where new ground disturbance and landscape alteration are needed. Under this alternative, compliance responses to the fee or tax by affected entities could include the fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. The construction related to upgrading of equipment, switching to lower intensity carbon fuels, and implementing operational changes at covered facilities could affect local geology and soils. Construction, grading and trenching have the potential to cause soil erosion, dust generation, and sedimentation of local waterways at those locations. Recognized measures are available to reduce this potentially significant impact, but the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, this FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant geology and soils impact may be unavoidable.

GHG emissions would be expected to decrease in California with the imposition of a carbon fee or tax. This Alternative relies primarily on a carbon fee or tax program that would identify covered sectors, fee or tax level, emissions basis, and point of regulation to meet the 2020 GHG emissions reduction target. Thus, GHG-related impacts of this Alternative would be beneficial because of the fundamental objective of this program to reduce in-state GHGs. However, although implementation of this Alternative would reduce GHGs, it is important to note that a central drawback of this type of program is that the fee or tax addresses environmental goals or emission limits indirectly (i.e., without a defined emissions cap) resulting in less certainty that such are being met (i.e., AB 32 2020 GHG emissions reduction target). In addition, implementation of this Alternative could result in adverse GHG impacts out-of-state associated with increases in GHGs from leakage (e.g., operational emissions from relocated facilities). Unless administrative mechanisms are in place to minimize the potential for leakage, implementation of this Alternative could result in adverse GHG impacts. However, with such mechanisms in the design of the alternative, impacts related to GHGs would be reduced to a level of insignificance.

Hazard and hazardous materials-related environmental impacts of Alternative 4 would be less than significant. Under this alternative, compliance responses to the fee or tax by affected entities could include the fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. The use of hazardous materials is common practice in industrial settings. Implementation of compliance responses could include the use of hazardous materials, but this would be considered simply a continuation of existing business practices for the covered entities, controlled by existing practices and regulations, and, thus, considered less than significant. All projects would be required to comply with established local, state, and federal laws pertaining to the use, storage, and transportation of these materials. Assuming compliance with applicable laws and regulations, the impacts would be less than significant.

Adverse hydrology and water quality impacts resulting from Alternative 4 could occur, if compliance responses to the fee or tax require modification of existing industrial facilities and uses near local water features. Under this alternative, compliance responses to the fee or tax by affected entities could include the fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. The construction related to upgrading of equipment, switching to lower intensity carbon fuels, and implementing operational changes at covered facilities could affect local drainage and discharge of contaminants to local waterways. Construction, grading and trenching have the potential to cause soil erosion and sedimentation of local surface water resources at those locations. Recognized measures are available to reduce this potentially significant impact, but the authority to determine project-level impacts and require project-level mitigation lies with the permitting agency for individual projects. Further, the programmatic analysis does not allow project-specific details of mitigation, resulting in an inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts. Consequently, this FED Supplement takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that this potentially significant hydrology and water quality impact may be unavoidable.

Land use impacts of the compliance responses of Alternative 4 would be less than significant, because they would not change the fundamental use of facility sites. Under this alternative, compliance responses to the fee or tax by affected entities could include the fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities and, as such, would be consistent with the existing land use and would pose a less than significant land use and planning impact. Leakage issues could result in both construction- and operational-related impacts out-of-state; however, these changes would again generally be expected to occur within existing industrial areas. Consequently, land use impacts resulting from compliance responses to a carbon fee or tax would be less than significant.

Adverse noise impacts could result from Alternative 4, because of the potential for substantial leakage of operations to other states for sectors subject to the fee or tax. Under this alternative, compliance responses by covered entities could include fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. Implementation of this Alternative would not be anticipated to result in adverse noise impacts because no major noise-generating construction- or operational-related activities would likely occur. If such were to transpire associated with onsite upgrades or process changes, they would be minor, intermittent and temporary in nature, and similar (or less) to the levels from sources that currently exist within these industrial settings. Thus, these impacts would be considered less than significant. However, under this alternative, leakage issues could result in both construction- and operational-related impacts out-of-state due to the generation of noise levels that exceed ambient conditions at existing sensitive receptors. Unless administrative mechanisms are in place to minimize the potential for leakage, implementation of this Alternative could result in adverse noise impacts out-of-state associated with construction- (e.g., use of heavy-duty equipment) and operational-related (e.g., relocated facilities.). However, with such mechanisms in the design of the alternative, impacts to noise would be reduced to a level of insignificance.

Adverse population, employment, and housing effects would not occur from the carbon fee or tax in Alternative 4, including from the operational and facility-modification compliance response projects, because the compliance activities would not substantially change socioeconomic conditions. All impacts to population, employment, and housing would be less than significant.

Public services impacts of Alternative 4 would be less than significant, because compliance responses to the fee or tax would occur at existing facility sites where public services are already provided. Under this alternative, compliance responses to the fee or tax by affected entities could include the fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. All potential impacts to public services would be less than significant. These projects would not substantially increase the level of public services beyond that already provided to existing facilities. Leakage issues could result in both construction- and operational-related impacts out-of-state; however, these changes would again generally be expected to occur within existing industrial areas. Consequently, public services impacts resulting from compliance responses to a carbon fee or tax would be less than significant.

Recreation impacts of Alternative 4 would be less than significant, because compliance responses to the fee or tax would occur at existing facility sites. The carbon fee or tax, including the expected compliance responses, would not result in increased demand for or adverse impacts to recreation resources. The affected entity compliance responses consist of upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities in the state. Leakage issues could result in both construction- and operational-related impacts out-of-state; however, these changes would again generally be expected to occur within existing industrial areas. Consequently, recreation impacts resulting from compliance responses to a carbon fee or tax would be less than significant.

Adverse transportation impacts could occur from Alternative 4, because of the potential for substantial leakage of operations to other states for sectors subject to the fee or tax, resulting in the potential need for additional transportation of affected products. Under this alternative, compliance responses by covered entities could include fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, curtailing operations because of increased cost, and implementing maintenance and process changes at existing facilities. Implementation of this Alternative would not be anticipated to result in adverse transportation or traffic impacts because no major traffic-generating construction- or operational-related activities would likely occur. If such were to transpire, any increases due to construction traffic would be temporary and mitigated through ingress and egress controls, traffic controls, and reduced speed zones to ensure safety; and operational traffic levels would be similar to existing conditions. Thus, these impacts would be considered less than significant. However, under this alternative, leakage issues could result in both construction- and operational-related impacts out-of-state due to the generation of traffic. Unless administrative mechanisms are in place to minimize the potential for leakage, implementation of this Alternative could result in adverse transportation impacts out-of-state associated with construction- (e.g., use of heavy-duty equipment) and operational-related (e.g., relocated facilities). However, with such mechanisms in the design of the alternative, impacts to transportation would be reduced to a level of insignificance.

Utility and service system impacts of Alternative 4 would be less than significant, because compliance responses to the fee or tax would occur at existing facility sites where utility systems are already provided. Under this alternative, compliance responses to the fee or tax by affected entities could include the fee or tax payment, but also upgrading equipment, switching to lower intensity carbon fuels, and implementing maintenance and process changes at existing facilities. These projects would not increase the level of utilities beyond that already provided to existing facilities. The availability and extension of utilities is subject to approval of the local utility provider, and readily implemented in a manner that would be less than significant. Leakage issues could result in both construction- and operational-related impacts out-of-state; however, these changes would again generally be expected to occur within existing industrial areas. Consequently, utility and service system impacts resulting from compliance responses to a carbon fee or tax would be less than significant.

2.7 Alternative 5: Adopt a Variation of the Combined Strategies or Measures

Goal of Alternative 5

The goal of Alternative 5 is to describe a reasonable variation of the components of the Proposed Scoping Plan reduction measures. It is intended to help decision-makers consider whether modifying the mix of reduction strategies would reduce or otherwise substantially change potential effects on the environment.

Role of Alternative 5 in the Range of Alternatives

The role of Alternative 5 in the range of alternatives is to assess whether the number and magnitude of environmental effects would be sensitive to varying the mix of reduction measures. Instead of adopting all the reduction measures in the Proposed Scoping Plan or a set of measures oriented to a specific, primary strategy (e.g., Cap-and-Trade, source-specific regulation, or carbon fee or tax, as described in other action alternatives), ARB could adopt some of the measures or a different mix of them. Numerous variations could be implemented when considering different subsets and/or combinations of the measures identified in the Proposed Scoping Plan. It is not feasible or meaningful to examine the numerous potential Alternative combinations in detail; too many different permutations exist. However, identifying a reasonable, Alternative combination of measures would illustrate whether the number and magnitude of environmental effects would be influenced substantially by altering the combination of measures.

Precedents or Examples of the Approach in Alternative 5

British Columbia

British Columbia has prepared a Climate Plan and is developing a multi-faceted climate program that includes comprehensive strategies and initiatives that will substantially reduce GHG emissions by 33 percent by 2020. The Climate Plan program includes some measures that are in the Proposed Scoping Plan, but differs in other substantial ways. British Columbia’s Climate Plan includes a carbon tax, which has been in place since 2008, and a proposed cap-and-trade program that will be voted on in the near future. Incentive programs for energy efficiency are already being implemented. The carbon tax is applied to all fuels, except for bunker, aviation and marine vessel fuels. The cap-and-trade program would cover industrial sources and electricity. In-province electricity is generated largely from hydro and biomass facilities. Similar to California’s proposed Cap-and-Trade Regulation, biomass emissions are exempted.

The Climate Plan positions British Columbia to benefit from growth in demand for high technology and clean energy products and services while addressing climate action in four key areas:

- Entrenching GHG reduction targets in law.
- Taking targeted action in all sectors of British Columbia's economy.
- Taking steps to help British Columbians adapt to the realities of climate change.
- Educating and engaging British Columbians on climate action.

The Plan highlights the revenue-neutral tax on pollution as a significant piece of climate action legislation which requires industry and individuals alike to pay the same rate on the purchase and use of fossil fuels. As a result of the Carbon Tax, individual British Columbians will see their personal income taxes reduced by two percent in 2008, rising to five percent in 2009 on taxable income up to $70,000. This will mean British Columbians pay the lowest provincial income tax on earnings up to $111,000. Every dollar raised by the revenue-neutral carbon tax will be returned to individuals and businesses through tax reductions. Failure to do so will result in a financial penalty for the Minister of Finance.

The Plan describes the three-year, $60 million LiveSmart BC Efficiency Incentive Program, and lays out strategies specific to seven sectors:

- Transportation – Improved vehicle efficiency, vehicle scrapping, less tax on efficient vehicles, cleaner buses and trucks, reduced fuel carbon and expanded transit and cycling.
- Buildings – A Green Building Code, Energy Efficient Buildings Strategy, encouraging compact, green communities, and solar roofs on 100,000 BC buildings.
- Waste – Turning waste into energy, cleaning up landfills, increased composting, and making manufacturers more responsible for waste created by their products.
- Agriculture – Digesters to capture methane from manure, improved fertilizer application, community biomass projects, research on biomass fuels and green city farms.
- Industry – A carbon emissions cap-and-trade system to provide an incentive for large emitters to reduce their emissions, often by implementing made-in-BC solutions.

- Energy – PowerSmart incentives, a First Nations and remote community clean energy, Alternative energy development, solar energy, smart meters, BC Bioenergy Strategy.

- Forestry –Forests for Tomorrow, Trees for Tomorrow, accelerated forest growth and net-zero deforestation, bio-mass energy and cellulosic ethanol production (British Columbia 2008).

Stakeholder Contributions

During the Proposed Scoping Plan development, several committees and stakeholder groups offered recommendations for different approaches, including a "three-faceted approach", which involved a combination of regulations and standards, incentives, and a price on carbon (i.e., a carbon fee or tax). Also proposed was a mix of approaches that includes performance standards, a price on carbon, and targeted incentives. Although the attributes of Alternative 5 are not the same as the committees' recommendations, they serve as an example of a variation in the mix of strategies to consider when defining the reasonable set of measures included in Alternative 5.

Attributes of Alternative 5

Alternative 5 represents a suite of strategies rather than a single alternative. Instead of adopting all the measures identified in the Proposed Scoping Plan, ARB could adopt some of them or a different mix of them. Numerous alternatives exist to adopt various subsets and mixes of the measures identified in the Proposed Scoping Plan, and for the purposes of this analysis, ARB considered taking a three-faceted approach to reducing GHGs: a cap-and-trade system, a combination of regulation and standards, and putting a price on carbon via a carbon fee or tax. Further, for purposes of comparison, ARB examined a mix of traditional regulations, such as a direct regulation for light duty vehicles; a Cap-and-Trade Program for large sources that covers large stationary sources, electricity, refineries, and cement; and a fee on emissions from fuels not under Cap-and-Trade that includes transportation fuels and commercial and residential combustion.

Attributes of each component of this Alternative are individually described in Alternatives 2, 3, and 4.

Alternative 5 builds upon the No-Project Alternative (Alternative 1) by adding:

- a direct regulation that has been defined as technologically feasible and is expected to be cost-effective;

- a cap-and-trade approach for large industrial sources and electricity generation; and

- carbon fees on the transportation, commercial, and residential fuel sectors.

The application of a set of regulations, fees, and a Cap-and-Trade Program to other combinations of source categories is possible. The approach was selected based on the following reasoning:

- Direct regulations are preferred in cases where there is a high likelihood that cost-effective emission reduction technologies can be applied in a relatively uniform manner across the spectrum of sources affected.

- A cap-and-trade approach is most appropriate for those sources that are not good candidates for direct regulation, but can exercise a substantial degree of control over their emissions and/or usage in response to a cap-and-trade system. Under this approach facility operators have the flexibility to weigh the cost of reductions versus the cost of obtaining emission allocations and chose the less costly compliance option.

- A carbon fee approach is most appropriate for the remaining fuel combustion-related categories. In these categories, the regulated entity, such as a supplier of transportation fuels, has limited influence over the amount of fuel consumed. Under these conditions the principal impact of a cap-and-trade approach would be to gain reductions because as fuel prices increase to reflect the cost of carbon allowances. As described in Alternative 4, a fee approach would incentivize reductions in GHG levels, but the level of that reduction is less than certain than a cap.

Because most of the sources that could be best governed by direct regulations and meet the criteria described above are already included in Alternative 1, the new direct regulation element of Alternative 5 is limited to one major regulation, the ARB's advanced clean cars program. This program consists of strengthening clean cars standards for new vehicles produced between 2017 to 2020 to achieve an additional 3.8 $MMTCO_2E$ of reductions by 2020.

The second element of Alternative 5 would be the application of a cap on the large source emission sector which consists of larger industrial sources and electricity generation facilities. (See Alternative 2 for more detail on the cap-and-trade approach) Collectively these sources are projected to emit about 192 $MMTCO_2E$ in 2020 in ARB's most recent baseline forecast (ARB 2010e). Measures included in Alternative 1 are estimated to reduce emissions in 2020 to about 172 $MMTCO_2E$. The cap for the sources covered by the second element would be set at about 157 $MMTCO_2E$ in order to meet the 2020 emissions limit (427 $MMTCO_2E$) established pursuant to AB 32. The derivation of the level of the cap is predicated on obtaining 7.2 MMTs from other elements of Alternative 5 (see Table 2.7-1 for more detail).

The final element of Alternative 5 would be the application of an emissions fee on transportation fuels, residential and commercial fuels and on fuels used by smaller industrial sources not subject to the cap. (See Alternative 4 for more detail on the emission fee approach.) Collectively, these sources are projected to emit about

229 $MMTCO_2E$ in 2020 in ARB's most recent baseline forecast. Measures included in Alternative 1 and from an advanced clean cars program are estimated to reduce emissions in 2020 to about 204 $MMTCO_2E$. Under these elements, an emissions fee of $50 per MT would be assumed, and is estimated to produce reductions on the order of 1.7 percent – about 3.4 $MMTCO_2E$ in 2020. Table F-12 in Appendix F of the Cap-and-Trade Regulation statement of reasons estimated that a $60 per MT allowance price would produce a 2 percent decrease in gasoline use (ARB 2010a). Based on this information, an estimated reduction of 1.7 percent was made for a $50 per MT fee. A similar percent reduction was assumed for all transportation fuels and for natural gas usage, as well.

The emission reductions and remaining emissions estimated from implementing Alternative 5 are shown below in Table 2.7-1.

Table 2.7-1 Summary of Emission Effects from Alternative 5

Strategy Category	2020 Emissions MMTs(1)	Emission Reductions MMTs - 2020	Remaining Emissions in 2020
Direct Regulation (Advanced Clean Cars)		3.8	N/A
Sources in Cap & Trade	182	15	167
Fuels Subject to Fees	204	3.4	197(2)
Remaining Sources(3)	63	None	63
Totals	449	22.2	427

Notes:
[1] After measures included in Alternative 1 are accounted for and rounded to no more than three significant figures.
[2]Includes reductions from direct regulations, Advanced Clean Car Program.
[3] Includes high GWP gases, Agriculture and Forestry.

Collectively, the elements in Alternative 5 are designed to achieve the 2020 emission target set by AB 32.

Alternative 5 Impact Discussion

Objectives

Alternative 5 would be expected to be able to meet the fundamental objective of reaching the 2020 emissions reduction target. The Proposed Scoping Plan Cap-and-Trade Program was designed to reduce GHG emissions by 18 $MMTCO_2E$, so achieving a contribution of 15 $MMTCO_2E$ in this Alternative would also be feasible. The advanced clean car program has received initial evaluation by ARB sufficient to support the feasibility of a 3.8 $MMTCO_2E$ contribution. The application of a carbon fee to transportation fuels is estimated to secure a 3.4 $MMTCO_2E$ contribution, which is only 1.5 percent of the current emissions from that sector. It would be reasonable to expect that this combination of measures could achieve the 2020 GHG reduction target.

The achievement of other objectives of the Proposed Scoping Plan would also be generally expected by Alternative 5, because it uses a combination of market-driven GHG reduction strategies and direct regulations. For instance, it would reduce fossil fuel use through encouragement of decreased fuel consumption resulting from the advanced clean car program and fuel fee and from fuel switching in compliance responses to the Cap-and-Trade Program. Emissions reductions would be generally ensured by the establishment of the mandatory, declining cap for the majority of the reductions. Reductions would be expected to occur in the most cost-effective manner, because the cost of reductions or the cost of allowances that can be purchased are determined by the market under the Cap-and-Trade component, and the advanced clean car program uses performance standards that allow flexibility in specific strategies to achieve them. Leakage would be minimized by the market-driven pricing of carbon and the availability of lower cost offsets for a portion of the reductions to help manage allowance prices from the Cap-and-Trade Program. Limiting the carbon fee to transportation fuel would minimize leakage, as well, compared to levying a fee or tax on industrial sectors. However, with a pass-through of a transportation fuel fee, fuel costs for consumers would increase, which could increase cost burden on disadvantaged communities. Many co-benefits would occur with an effective market-driven GHG reduction program and advanced clean car program, such as energy conservation and efficiency, reduced fossil fuels use, reduction of regional co-pollutants, and job-forming economic opportunities related to facility modifications and development of energy efficiency and vehicle technologies.

Environmental Impacts

Alternative 5 focuses on a combination approach to meeting the 2020 GHG reduction target, by drawing elements of the strategy from Alternatives 2, 3, and 4. The Cap-and-Trade Program drawn from Alternative 2 is designed to reduce GHG emissions sufficiently to achieve a 15 $MMTCO_2E$ reduction by 2020, including compliance responses by covered entities and use of offsets according to specified protocols. For this component of the alternative, compliance responses by covered entities could include upgrading equipment, switching to lower intensity carbon fuels, implementing maintenance and process changes at existing facilities, and reducing operations of carbon-intense facilities in favor of increased operations of more carbon-efficient facilities. Implementation of carbon offset programs under specified protocols could also occur. The four offset protocols proposed as part of the Scoping Plan's Cap-and-Trade Program would also be applicable for this alternative: Ozone Depleting Substances (ODS), Livestock, Urban Forest, and Forest. Construction-related activities associated with these compliance responses could occur. The general approach, covered entities, and offset protocols of a Cap-and-Trade Program under Alternative 5 would be reasonably expected to be similar to the Proposed Scoping Plan's Cap-and-Trade Program, except that the reduction target would be decreased from 18 to 15 $MMTCO_2E$.

This Alternative includes a source-specific emissions regulation through the adoption of the advanced clean car program currently being evaluated by ARB. An assessment of the program has been developed to evaluate its feasibility and emissions reduction expectations (U.S. EPA, U.S. DOT, and ARB 2010). By regulation, ARB would seek to reduce GHG emissions by 3.8 $MMTCO_2E$. The program would establish more stringent tailpipe and GHG emission standards for new passenger vehicles. Combining the control of criteria pollutants and GHG emissions into a single coordinated package of standards is a new approach to ARB's motor vehicle standards. The new approach also includes efforts to support and accelerate the numbers of plug-in hybrids and zero-emission vehicles in California. Compliance responses to the program would involve improved engine and transmission technologies, vehicle technologies, mass reduction, electrification and accessory technologies, and electric drive technologies including hybrid technologies. The improvements in vehicle technology would result in greater use of electricity and fuel cells for powering vehicles and construction of Alternative fueling stations to serve plug-in hybrid, battery electric vehicles, and fuel-cell vehicles.

The third component of Alternative 5 would be a carbon fee levied on transportation fuels. The compliance responses to this measure would be expected to include reduced consumption of fossil fuels and fuel switching away from the affected transportation fuels.

The environmental impacts of this combination of strategies would be similar to the conclusions presented in Alternatives 2, 3, and 4 for the analogous components in Alternative 5. Rather than repeat the previously presented impact discussions for the Cap-and-Trade Program (please refer to Alternative 2), direct regulation strategies (please refer to Alternative 3), and carbon fee measure (please refer to Alternative 4), a summary discussion will be provided for the environmental impacts of the specific features of this Alternative not emphasized in the earlier.

The environmental effects of Alternative 5 would primarily involve a combination of the potential impacts of compliances responses to a Cap-and-Trade Program and the impacts of the Advanced Clean Car Program. The fee on transportation fuels in this Alternative would not be expected to result in significant environmental impacts, because the compliance response would consist of fuel switching, probably using facilities and infrastructure that are already in place or would need relatively minor modification. The environmental effects of a Cap-and-Trade Program are related primarily to compliance responses that involve potential construction-related impacts to sensitive resources, if they are present at construction sites, along with the remote possibility of localized air quality impacts, if covered entities shifted production to more carbon-efficient units, or of land use plan conflict of avoided forest conversion where local plans call for development (see discussion under Alternative 2). The potential environmental effects of the advanced clean car program component of Alternative 5 relate primarily to how to serve the changes in fuel sources for vehicles and the greater use of batteries and fuel cells. Construction of new or modified fueling stations could result in environmental impacts to resource-related issues, such as biological resources, cultural resources, geology and soils, hazardous materials, and hydrology and water quality, if sensitive resources are present on or near the construction locations. If these resources were present and adversely affected, the impact may be potentially significant, similar to the construction-related conclusions for facility modifications expected in response to other GHG reduction measures. Land use related impacts would likely be less than significant, because the location and design of fueling stations would need to comply with local land use plans and zoning. Therefore, less-than-significant aesthetic, agriculture and forest resource, noise, socioeconomics, traffic/transportation, public services, utilities, recreation, and land use and planning effects would be expected.

Air quality, GHG, and energy demand impacts of the advanced clean car program would be beneficial, because the program seeks to combine strategies that control and reduce criteria pollutants and GHG together, which would also lead to reduced fossil fuel use and reduced energy demand for the affected motor vehicles. Propulsion would rely more on power from the electricity grid, which would be a beneficial fuel switch for air quality and GHG emissions as the renewable portfolio of electricity generation continues to transition toward the 33-percent RPS. The increased use of vehicle batteries and fuel cells would increase their production, storage, recycling, and ultimately disposal. An increase of batteries and fuel cells in the waste stream could result in potential hazardous materials and water quality effects; however, regulations exist for handling of hazardous materials and protection of water quality from waste disposal facilities and ARB is also considering specific regulatory requirements for further protection in the advanced clean car program design.

2.8 Comparison of the Proposed Scoping Plan, Project Alternatives, and their Environmental Tradeoffs

Each of the alternatives discussed in Section 2.0 of the FED Supplement possess environmental advantages and disadvantages. These advantages and disadvantages were discussed in more detail in the subsections devoted to each alternative. A summary of the preceding discussions is presented below to help the reader understand the most important differences among the alternatives, in terms of achievement of environmental objectives or potential for significant environmental impacts.

With the exception of Alternative 1, No-Project, all of the project alternatives are designed to cover the 22 $MMTCO_2E$ reduction shortfall needed to achieve the AB 32-mandated GHG reduction target of 1990 levels by 2020 that would occur if the Proposed Scoping Plan was not implemented. The likelihood of reaching this target would be high for Alternative 2, Cap-and-Trade, and Alternative 5, Combined Strategy, because they include a market-based approach for covered sectors shown to have technologically feasible ways to reduce GHG and the opportunity to use offsets or purchase allowances from others to enhance cost-effectiveness through flexibility and choice of reduction strategies. Because of the potential for substantial leakage, there is a reduced likelihood that Alternative 3, Direct Source-Specific Regulation, or

Alternative 4, Carbon Fee or Tax, would achieve the target. Both strategies could be effective in reducing in-state GHG emissions, but could cause adverse GHG emissions impacts elsewhere in unregulated states, if substantial shifting of operations out-of-state occurred. All the action alternatives would create at least some benefits related to reduced GHG emissions, reduced regional criteria co-pollutants and TACs, and energy demand, compared to existing conditions.

Because Alternative 1, No-Project Alternative, does not reach the reduction target mandated by AB 32, it would not be environmentally advantageous compared to the Proposed Scoping Plan or the other action alternatives. Already implemented or ongoing measures in Alternative 1 include the sources of a major proportion of the potential significant environmental impacts of the full Proposed Scoping Plan, specifically utility-scale renewable energy projects and the high-speed rail project. Therefore, Alternative 1 would incur the majority of the environmental impacts of the Proposed Scoping Plan, but would not achieve the GHG reduction benefit needed to comply with AB 32.

Alternative 2, which uses a Cap-and-Trade Program to achieve the 22 $MMTCO_2E$ reduction shortfall, would result in environmental impacts similar to the Proposed Scoping Plan, where Cap-and-Trade is also a central feature, and also somewhat similar to Alternative 5, Combined Approach (including Cap-and-Trade). The Cap-and-Trade Program offers an effective approach for achieving the AB 32 goals, so GHG-reduction benefits of Alternative 2 would be similar to the Proposed Scoping Plan. Potential significant environmental impacts are identified for Alternative 2, including the remote potential for localized air quality impacts, construction-related impacts of covered entities' compliance responses, and environmental effects of certain elements of the offset protocols (such as construction impacts related to livestock digesters and possible local land use planning conflicts from avoided forest conversion where local plans call for development). Compared to other action alternatives, the Proposed Scoping Plan and Alternative 2 present environmental trade-offs, because the Cap-and-Trade Program compliance responses and offset protocols could result in certain significant environmental impacts that other alternatives would not cause, while the Proposed Scoping Plan's and Alternative 2's effectiveness in reducing GHG and creating attendant air quality co-benefits would be stronger than Alternative 3 (Direct Regulation) or 4 (Carbon Fee or Tax), because of the lesser risk of leakage. Also, the smaller risk of leakage means that Proposed Scoping Plan and Alternative 2 would not have the potential for out-of-state environmental impacts, as either Alternative 3 or 4 would have.

Alternative 3, the source-specific regulatory approach, would result in some environmental impacts similar to the Proposed Scoping Plan, such as the construction- related environmental effects where compliance responses by industrial and electricity sources include changes or additions to facilities where sensitive resources may be present. Alternative 3 could result in significant additional environmental impacts from the potential for construction of electricity generation facilities using less carbon-intensive fuels than coal (such as combined-cycle, natural gas power plants). If new power plants were built, the impacts would likely take place outside California, because the siting, permitting, and construction of new electricity generation facilities in the state would be challenging in time to help achieve the 2020 target. Also, the advanced clean car program could result in environmental impacts related to construction of fueling stations and the increased use and ultimately disposal of batteries and fuel cells. The direct-regulation approach offers an effective strategy for reducing in-state GHG emissions, but may not achieve the AB 32 reduction target, because of the potential for substantial leakage. Compared to the Proposed Scoping Plan and other action alternatives, Alternative 3 presents environmental trade-offs, because the substantial leakage risk could cause out-of-state impacts not expected from the Proposed Scoping Plan or Alternatives 2 and 5; however, Alternative 3 does not include the use of offsets and their associated environmental impacts that occur with the Proposed Scoping Plan, Alternative 2, and Alternative 5. Alternative 3's effectiveness in reducing GHG and creating attendant air quality co-benefits would be less than the Proposed Scoping Plan, Alternative 2 (Cap-and-Trade), and Alternative 5 (Combined Approach), and similar to Alternative 4 (Carbon Fee or Tax), because of the risk of leakage in response to direct regulations.

Alternative 4, the carbon fee or tax approach, would also result in some environmental impacts similar to the Proposed Scoping Plan, such as the construction-related environmental effects where compliance responses by industrial and electricity sources include changes or additions to facilities where sensitive resources may be present. The carbon fee or tax approach offers a potentially effective strategy for reducing GHG emissions, but administrative challenges and legal constraints exist for fees and taxes in California that could constrain ARB's ability to implement such a program. Compared to the Proposed Scoping Plan and other action alternatives, the impacts of Alternative 4 would be similar to the Proposed Scoping Plan, Alternative 2, and Alternative 5 in most ways, except that Alternative 4 does not include the use of offsets with their associated environmental impacts. Alternative 4's effectiveness in reducing GHG and creating attendant air quality co-benefits would be similar to the Proposed Scoping Plan, Alternative 2 (Cap-and-Trade), and Alternative 5 (Combined Approach), and better than Alternative 3 (Direct Regulation), because of Alternative 3's risk of leakage in response to direct regulation.

Achievement of the Proposed Scoping Plan's project objectives varies among the alternatives, as well. Table 2.8-1 presents a summary of the likelihood of meeting the objectives presented in Section 1.2. The table represents a general summary, supported by analysis and discussion in the 2008 Scoping Plan FED, Cap-and-Trade FED, and this FED Supplement.

Table 2.8-1 Comparative Likelihood That Alternatives Achieve Project Objectives

KEY:
L (low) = No or low likelihood to achieve objective
M (medium) = Medium likelihood of achieving objective
H (high) = High likelihood to achieve objective

	ALTERNATIVES	Proposed Scoping Plan	# 1 No Project	# 2 Cap-and-Trade	# 3 Direct Regul.	# 4 Carbon Fee/Tax	# 5 Combo.
OBJECTIVES	1. Achieve reductions	H	L	H	M	M	H
	2. Reduce fossil fuel use	H	L	H	H	H	H
	3. Link with partners	H	L	H	L	L	H
	4. Enforceable, amendable program	H	L	H	H	H	H
	5. Ensure emissions reductions	H	L	H	H	M	H
	6. Technologically feasible, cost effect.	H	L	H	L	L	H
	7. Avoid disproportionate impacts	H	L	H	H	M	H
	8. Credit early action	H	L	H	H	L	H
	9. Complement existing air standards	H	L	H	H	H	H
	10. Consider a broad range of benefits	H	L	H	H	H	H
	11. Minimize administrative burden	H	L	H	M	H	H
	12. Minimize leakage	H	L	H	L	L	H
	13. Weigh relative emissions	H	L	H	H	H	H
	14. Achieve real emissions reductions	H	L	H	H	H	H
	15. Achieve incremental reductions over	H	L	H	H	H	H
	16. Complement direct measures	H	L	H	H	H	H
	17. Consider emissions impacts	H	L	H	H	H	H
	18. Prevent increases in other emissions	M	L	M	H	M	M
	19. Capture co-benefits	H	L	H	H	H	H
	20. Avoid duplication	H	L	H	H	H	M

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California Environmental Protection Agency
Air Resources Board

California Greenhouse Gas Inventory for 2000-2012
— by Category as Defined in the 2008 Scoping Plan

million tonnes of CO2 equivalent - (based upon IPCC Fourth Assessement Report's Global Warming Potentials)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Transportation	176.21	176.62	183.80	183.52	186.88	189.08	189.18	189.27	178.02	171.47	170.46	168.13	167.38
On Road	162.88	163.46	169.64	168.81	171.48	172.68	172.37	172.41	163.00	158.46	157.38	154.91	154.06
Passenger Vehicles	130.10	129.97	134.46	132.91	133.34	132.75	131.79	130.80	124.27	122.41	121.39	118.85	118.28
Heavy Duty Trucks	32.78	33.50	35.19	35.90	38.13	39.92	40.58	41.61	38.73	36.04	36.00	36.06	35.78
Ships & Commercial Boats	3.39	3.21	3.56	3.78	3.84	4.12	4.20	4.31	4.04	3.68	3.71	3.72	3.83
Aviation (Intrastate)	4.15	4.07	4.12	4.25	4.50	4.50	4.57	4.98	4.51	4.04	3.85	3.75	3.72
Rail	1.88	1.89	2.50	2.70	2.91	3.34	3.53	3.17	2.38	1.94	2.33	2.49	2.48
Off Road [1]	2.63	2.79	2.77	2.84	3.03	3.22	3.32	3.18	2.82	2.25	2.03	2.13	2.23
Unspecified	1.28	1.19	1.21	1.13	1.13	1.22	1.20	1.22	1.27	1.10	1.16	1.14	1.06
Electric Power	104.86	122.01	108.65	112.62	115.20	107.86	104.54	113.94	120.15	101.32	90.30	88.04	95.09
In-State Generation	58.96	62.99	49.69	48.06	49.16	45.06	49.86	54.13	54.32	53.28	46.71	41.18	51.02
Natural Gas	50.92	55.46	42.17	40.92	42.40	38.11	43.07	47.12	48.02	46.08	40.59	35.92	45.77
Other Fuels	6.85	6.36	6.37	5.99	5.60	5.78	5.64	5.86	5.16	5.85	5.02	4.01	4.44
Fugitive and Process Emissions	1.18	1.16	1.15	1.15	1.16	1.16	1.15	1.16	1.14	1.34	1.10	1.25	0.82
Imported Electricity	45.90	59.02	58.96	64.56	66.04	62.80	54.68	59.81	65.82	48.04	43.59	46.86	44.07
Unspecified Imports	14.27	25.42	26.92	32.05	32.92	30.01	27.95	32.73	37.92	14.99	13.45	15.52	17.48
Specified Imports	31.64	33.59	32.04	32.51	33.13	32.79	26.73	27.08	27.90	33.05	30.14	31.34	26.59
Commercial and Residential	42.33	41.20	43.17	41.54	42.90	41.24	41.89	42.11	42.44	42.65	43.82	44.32	42.28
Residential Fuel Use	29.70	28.77	28.93	28.47	29.51	28.22	28.58	28.73	29.07	28.69	29.42	29.89	28.09
Natural Gas	28.03	27.43	27.54	26.67	27.38	25.98	26.60	26.73	26.67	26.31	27.04	27.51	25.76
Other Fuels	1.67	1.34	1.39	1.80	2.12	2.25	1.98	2.01	2.40	2.38	2.39	2.38	2.33
Commercial Fuel Use	11.54	11.37	13.18	12.82	12.77	12.61	12.89	12.88	13.00	13.04	13.48	13.65	13.44
Natural Gas	10.07	10.10	11.90	11.38	11.16	10.94	11.62	11.49	11.16	11.02	11.19	11.33	11.24
Other Fuels	1.47	1.27	1.28	1.43	1.61	1.67	1.27	1.40	1.83	2.02	2.29	2.32	2.19
Commercial Cogeneration Heat Output	1.09	1.05	1.06	0.26	0.62	0.40	0.42	0.49	0.37	0.92	0.92	0.78	0.76
Industrial	95.01	93.16	93.14	92.47	94.48	92.29	90.28	87.10	87.54	84.95	88.51	88.34	89.16
Refineries	28.47	29.04	29.20	29.83	29.08	29.75	29.65	29.21	28.42	28.34	30.39	30.12	29.88
General Fuel Use	20.20	19.04	20.28	16.49	17.03	16.01	15.96	14.77	16.00	15.56	17.98	19.14	18.87
Natural Gas	16.82	14.62	15.18	11.97	12.80	12.72	12.38	11.56	12.37	11.46	13.46	14.48	14.30
Other Fuels	3.38	4.42	5.09	4.52	4.23	3.28	3.58	3.20	3.63	4.10	4.52	4.66	4.56
Oil & Gas Extraction [2]	18.71	19.08	17.65	20.21	19.90	18.59	16.94	17.00	18.22	17.12	16.18	16.22	16.86
Fuel Use	17.53	17.76	16.51	19.03	19.20	17.91	15.75	15.78	17.03	15.92	15.01	14.91	15.50
Fugitive Emissions	1.18	1.32	1.14	1.17	0.71	0.69	1.19	1.21	1.20	1.20	1.17	1.31	1.36
Cement Plants	9.41	9.52	9.62	9.71	9.81	9.91	9.74	9.14	8.63	5.72	5.56	6.14	6.92
Clinker Production	5.43	5.52	5.60	5.68	5.77	5.85	5.80	5.55	5.28	3.60	3.46	4.08	4.65
Fuel Use	3.98	4.00	4.01	4.03	4.05	4.06	3.95	3.59	3.34	2.12	2.10	2.06	2.26
Cogeneration Heat Output	11.73	10.48	10.65	10.60	12.92	12.41	12.17	11.16	10.40	12.55	12.60	11.14	10.82
Other Fugitive and Process Emissions	6.49	6.00	5.74	5.62	5.74	5.62	5.83	5.83	5.87	5.65	5.80	5.59	5.82

California Greenhouse Gas Inventory for 2000-2012 — by Category as Defined in the 2008 Scoping Plan

million tonnes of CO2 equivalent - (based upon IPCC Fourth Assessement Report's Global Warming Potentials)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recycling and Waste	**7.35**	**7.49**	**7.43**	**7.57**	**7.57**	**7.75**	**7.80**	**7.93**	**8.09**	**8.23**	**8.34**	**8.42**	**8.49**
Landfills [3]	***7.11***	***7.23***	***7.14***	***7.26***	***7.24***	***7.40***	***7.42***	***7.53***	***7.66***	***7.78***	***7.86***	***7.92***	***7.97***
Composting	***0.24***	***0.26***	***0.29***	***0.31***	***0.33***	***0.36***	***0.38***	***0.40***	***0.43***	***0.45***	***0.47***	***0.50***	***0.52***
High GWP	**8.03**	**7.99**	**8.14**	**8.83**	**9.56**	**10.36**	**11.08**	**11.78**	**12.87**	**13.99**	**15.89**	**17.35**	**18.41**
Ozone Depleting Substance (ODS) Substitutes	***7.00***	***7.17***	***7.37***	***8.06***	***8.87***	***9.71***	***10.41***	***11.16***	***12.24***	***13.49***	***15.36***	***16.58***	***17.73***
Electricity Grid SF6 Losses [4]	***0.33***	***0.32***	***0.30***	***0.29***	***0.30***	***0.29***	***0.28***	***0.26***	***0.27***	***0.26***	***0.24***	***0.24***	***0.23***
Semiconductor Manufacturing [3]	***0.70***	***0.50***	***0.47***	***0.48***	***0.40***	***0.36***	***0.39***	***0.36***	***0.36***	***0.23***	***0.29***	***0.53***	***0.45***
Agriculture	**32.52**	**32.75**	**35.99**	**36.50**	**36.26**	**36.54**	**37.75**	**37.03**	**37.99**	**35.84**	**35.73**	**36.34**	**37.86**
Livestock	***19.66***	***20.44***	***21.06***	***21.63***	***21.06***	***21.81***	***22.22***	***23.73***	***24.09***	***23.88***	***23.35***	***23.38***	***23.92***
Enteric Fermentation (Digestive Process)	10.26	10.45	10.74	10.89	10.78	11.14	11.24	11.93	11.89	11.71	11.51	11.49	11.78
Manure Management	9.40	10.00	10.32	10.75	10.28	10.67	10.98	11.80	12.20	12.17	11.84	11.89	12.14
Crop Growing & Harvesting	***9.05***	***8.48***	***10.54***	***10.49***	***10.67***	***10.11***	***10.20***	***9.50***	***9.98***	***9.31***	***9.57***	***9.30***	***10.22***
Fertilizers	7.01	6.73	8.56	8.57	8.49	8.09	8.01	7.49	8.04	7.32	7.58	7.25	8.16
Soil Preparation and Disturbances	1.96	1.69	1.91	1.86	2.11	1.95	2.12	1.94	1.87	1.92	1.91	1.98	1.98
Crop Residue Burning	0.08	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08
General Fuel Use	***3.82***	***3.83***	***4.39***	***4.38***	***4.53***	***4.63***	***5.33***	***3.80***	***3.92***	***2.65***	***2.81***	***3.66***	***3.72***
Diesel	2.52	2.70	3.05	3.11	3.18	3.41	3.87	2.68	3.00	1.79	1.99	2.37	2.47
Natural Gas	0.98	0.75	0.94	0.85	0.82	0.70	0.88	0.79	0.75	0.69	0.65	0.66	0.70
Gasoline	0.31	0.38	0.41	0.41	0.52	0.52	0.57	0.32	0.17	0.17	0.17	0.63	0.55
Other Fuels	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Total Emissions	***466.32***	***481.23***	***480.32***	***483.05***	***492.86***	***485.13***	***482.52***	***489.16***	***487.10***	***458.44***	***453.06***	***450.94***	***458.68***

[1] Includes equipment used in construction, mining, oil drilling, industrial and airport ground operations
[2] Reflects emissions from combustion of natural gas, diesel, and lease fuel plus fugitive emissions
[3] These categories are listed in the Industrial sector of ARB's GHG Emission Inventory sectors
[4] This category is listed in the Electric Power sector of ARB's GHG Emission Inventory sectors

Assessing the Risk of Persistent Drought Using Climate Model Simulations and Paleoclimate Data

TOBY R. AULT

Department of Earth and Atmospheric Sciences, Cornell University, Ithaca, New York

JULIA E. COLE AND JONATHAN T. OVERPECK

Department of Geosciences and Department of Atmospheric Sciences, The University of Arizona, Tucson, Arizona

GREGORY T. PEDERSON

U.S. Geological Survey, Bozeman, Montana

DAVID M. MEKO

Laboratory of Tree-Ring Research, The University of Arizona, Tucson, Arizona

(Manuscript received 10 May 2012, in final form 4 November 2013)

ABSTRACT

Projected changes in global rainfall patterns will likely alter water supplies and ecosystems in semiarid regions during the coming century. Instrumental and paleoclimate data indicate that natural hydroclimate fluctuations tend to be more energetic at low (multidecadal to multicentury) than at high (interannual) frequencies. State-of-the-art global climate models do not capture this characteristic of hydroclimate variability, suggesting that the models underestimate the risk of future persistent droughts. Methods are developed here for assessing the risk of such events in the coming century using climate model projections as well as observational (paleoclimate) information. Where instrumental and paleoclimate data are reliable, these methods may provide a more complete view of prolonged drought risk. In the U.S. Southwest, for instance, state-of-the-art climate model projections suggest the risk of a decade-scale megadrought in the coming century is less than 50%; the analysis herein suggests that the risk is at least 80%, and may be higher than 90% in certain areas. The likelihood of longer-lived events (>35 yr) is between 20% and 50%, and the risk of an unprecedented 50-yr megadrought is nonnegligible under the most severe warming scenario (5%–10%). These findings are important to consider as adaptation and mitigation strategies are developed to cope with regional impacts of climate change, where population growth is high and multidecadal megadrought—worse than anything seen during the last 2000 years—would pose unprecedented challenges to water resources in the region.

1. Introduction

Information recorded in paleoclimate archives reveals that the twentieth century does not represent the full range of drought variability experienced in western North America (WNA) during the last millennium (e.g., Woodhouse and Overpeck 1998; Stahle et al. 2007; Cook et al. 2004; Meko et al. 2007). Prolonged droughts comprise a source of climate risk in this region and elsewhere (Woodhouse and Overpeck 1998; Shanahan et al. 2009; Buckley et al. 2010; Haug et al. 2003; deMenocal 2001). Decade-scale droughts like the 1930s Dust Bowl occur, on average, once or twice per century (Woodhouse and Overpeck 1998), and considerably longer periods of aridity (megadroughts) are also apparent in paleoclimate records (Woodhouse and Overpeck 1998). Were such megadroughts to occur today, they would exact regionally unprecedented socioeconomic tolls and

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Corresponding author address: Toby R. Ault, Dept. of Earth and Atmospheric Sciences, Bradfield Hall, Cornell University, Ithaca, NY 14853.
E-mail: toby.ault@cornell.edu

DOI: 10.1175/JCLI-D-12-00282.1

ecological consequences. For example, during the 1150s, the 25-yr average of reconstructed Colorado River flow dropped to 85% of the twentieth-century mean for 10 consecutive years (Meko et al. 2007). In modern terms, this would be comparable to losing almost the entire allocation for the state of Arizona from the long-term mean for a decade. What is perhaps even more problematic for water resource management is that the 1150s were centered in a 23-yr interval of below-average moisture across WNA, and a similar interval in the twelfth century spanned 22 yr (1276–99; Cook et al. 2007). Older tree-ring records suggest that regional droughts can persist, and have persisted, for longer still (~50 yr; Routson et al. 2011).

Prolonged droughts have happened during the instrumental era and include the 1930s Dust Bowl (Fye et al. 2003), drought in sub-Saharan Africa (e.g., Charney 1975; Folland et al. 1986), and the recent ''Big Dry'' in Australia (Leblanc et al. 2012). Since these events occur infrequently, it is difficult to understand their statistics using data from the instrumental era alone. Tree-ring reconstructions partially address this limitation, and in the U.S. Southwest they suggest that events similar to the 1150s Colorado River megadrought would be expected to occur every 400–600 yr (Meko et al. 2012). This view of risk is incomplete, however, because it is specific to the 1150s event and ''megadrought risk'' could be applied more generally to a wide range of time scales. More critically, the statistics of twenty-first-century climate will be influenced by anthropogenic greenhouse gases (GHG) (Solomon et al. 2007). The risk of future prolonged drought risk will therefore depend on the internal rate at which these events occur as well as any GHG-forced changes in their underlying statistics. In the U.S. Southwest, for instance, precipitation is projected to decrease as a consequence of GHG-forced changes (e.g., Seager et al. 2007; Solomon et al. 2007; Diffenbaugh and Giorgi 2012). Any assessment of future megadrought risk, therefore, should account for both the natural variability inferred from multicentennial paleoclimate records and the changes in rainfall patterns projected to occur in the coming century.

This paper estimates future prolonged drought risk using information from instrumental records, paleoclimate archives, and climate model simulations in simple Monte Carlo realizations of hydroclimate. The motivation for doing so comes from our notion of risk as a fractional quantity referring to the likelihood of prolonged drought occurrence. We rely on global climate model simulations of change during the twenty-first century as estimates of mean conditions in the future, and we use simple statistical models to build up large ensembles for calculating risk. This technique assumes the following:

1) Coupled global climate model simulations of the twenty-first century present a realistic view of the direction, magnitude, and uncertainty in forced precipitation changes, relative to today.
2) Paleoclimate records and observational data can empirically describe the distribution of variance across the frequency spectrum from interannual to multidecadal time scales in regional hydroclimate.
3) Simple models of time series are adequate for simulating the *local* statistical characteristics of hydroclimate across interannual to multidecadal time scales, regardless of whether these characteristics are externally forced or internally generated.

Justifications for statements 1 and 2 are straightforward: state-of-the-art models agree that semiarid subtropical regions throughout the world will tend to dry under climate change (e.g., Diffenbaugh and Giorgi 2012), and paleoclimate records, especially tree rings, are reasonably well validated and widely used to characterize variations of the past for a wide range of water resource management applications (Meko et al. 2012).

Assumption 3 in the list above deserves further elaboration. We begin by noting that in western North America over the last millennium, stochastic variability and autocorrelation alone may account for the magnitude of hydroclimatic variations on time scales from years to decades (Hunt 2011; Ault et al. 2013; Coats et al. 2013b). Second, one can easily imagine a situation where in a single realization of a given model, climatic forcing enhances overall aridity, but megadroughts do not occur because a few intermittent wet years disrupt their duration. Given the statistics of this model, megadroughts might still be likely, but would not be found in this particular realization.

The scenario delineated above is shown schematically in Fig. 1. Here, an idealized time series of some hydrological variable (say $P - E$) has been generated with unit variance and a mean of zero for the first 100 ''years'' (Fig. 1a). At year 101 the mean is shifted by -0.25σ and an additional 50 years of data are generated while the variance stays the same. Figures 1b and 1c show realizations of 50 yr of data with the same mean and variance as the final 50 yr of the series in Fig. 1a. Although both the time series in Figs. 1b and 1c have the same mean and variance, a prolonged period of time with low values (a ''megadrought'') is found in the first realization (Fig. 1b), whereas in the second realization (Fig. 1c) it is not.

Implied by Fig. 1 is the possibility that deterministic simulations of climate change using state-of-the-art numerical models may be insufficient for estimating megadrought risk because the ensemble sizes of such

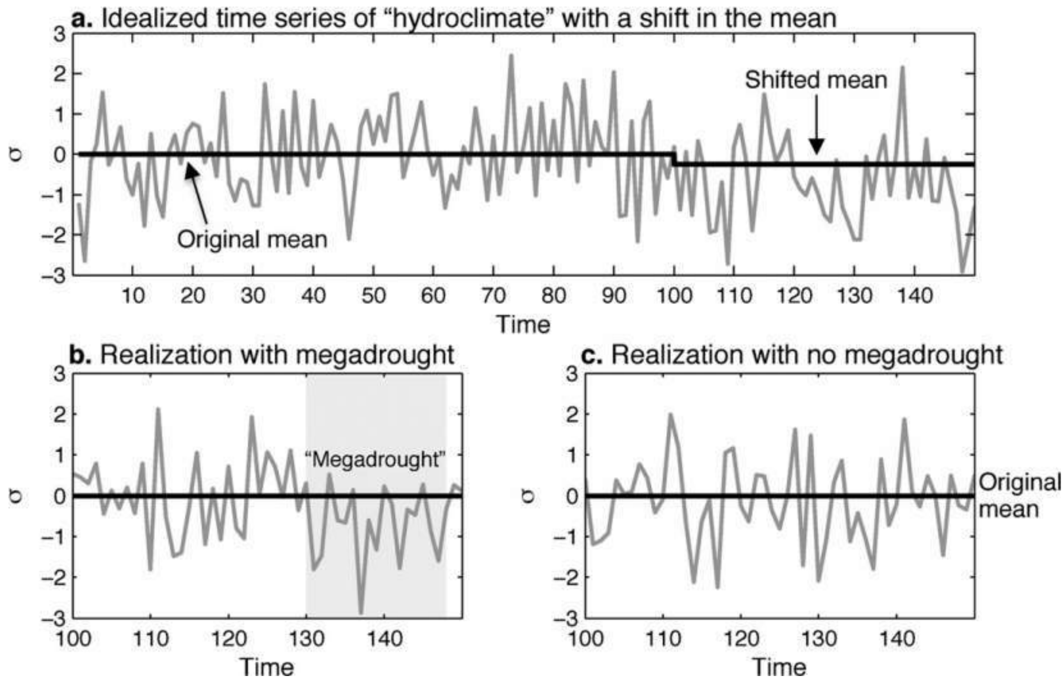

FIG. 1. Schematic illustration of why large ensembles are needed to calculate megadrought risk. (a) The black line shows the original and shifted mean, while (b),(c) the black lines show the original mean for reference. Importantly, the means and variances are the same for the final 50 yr in (a)–(c) but only the realization in (b) experiences a megadrought.

experiments are relatively small (tens of realizations per model at most), and the statistics of infrequent events such as megadroughts might not be robust. Using a multimodel ensemble does not completely guard against this limitation because model simulations disagree on the expression of forced changes in hydroclimate at regional scales (e.g., Diffenbaugh and Giorgi 2012). Instead, we use large ensembles of stochastic variables to emulate the statistics of interannual to decadal variability, and output from global climate models to estimate how precipitation is expected to change this century. The limitations and possible implications of this assumption are discussed in section 4.

2. Data and methods

To establish benchmarks for decadal drought and multidecadal megadrought, we use instrumental precipitation data (Fig. 2; Mitchell and Jones 2005), and several recent reconstructions of hydroclimate including the Palmer drought severity index (PDSI) for the southwestern United States (Cook et al. 2004), Colorado River streamflow reconstructions (Meko et al. 2007), and drought from northern Mexico (Stahle et al. 2011) (Fig. 3). Although the reconstructions are precisely dated, they target different regions and aspects of hydroclimate and hence are not expected to agree with each other through time (and indeed they do not; Fig. 3). In addition to these observational datasets, we use output from 27 coupled general circulation models (GCMs) that are members of the Climate Model Intercomparison Project phase 5 (CMIP5) archive. Models were included if at least one unforced preindustrial control (piControl) and forced "historical" (late nineteenth and/or twentieth century) experiment were available, as well as forced climate change simulations for each of the following representative concentration pathways (RCPs; Moss et al. 2010): RCP2.6, RCP4.5, and RCP8.5. For illustrative purposes, the projected changes in mean precipitation are shown for the RCP8.5 scenario in Fig. 4 (cf. Fig. 2 of Diffenbaugh and Giorgi 2012). The number of available runs from each simulation considered here is reported in the legend of the figure. All model and instrumental data were annualized (January–December) prior to analysis, although our results are not sensitive to the months used for annualization.

a. Standardizing hydroclimate indicators

Here we develop a systematic approach to normalizing hydroclimate fluctuations so that they retain their essential meaning whether they originate from climate model simulations, observational datasets, or

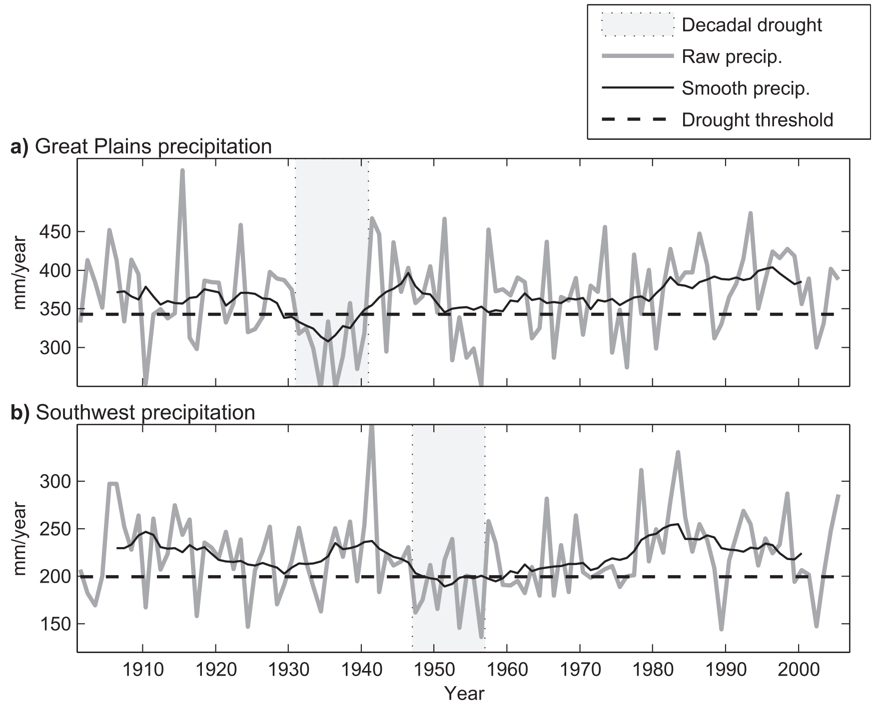

FIG. 2. The 11-yr running means of normalized paleoclimate reconstructions for twentieth-century precipitation data from (a) the U.S. Southwest and (b) the Great Plains. Precipitation data are from the University of East Anglia's Climate Research Unit's time series version 3.1 (TS3.1) dataset (Mitchell and Jones 2005). We identify decadal droughts as -0.5 standard deviations of raw data in the 11-yr mean (vertical gray bars).

paleoclimate reconstructions. We further seek to distinguish between decadal droughts, which have been experienced during the instrumental era (e.g., the 1930s Dust Bowl), and multidecadal megadrought events that are outside the range of variability experienced during the twentieth century. To begin, we consider two of the worst decade-scale droughts during the twentieth century: the 1930s Dust Bowl and the 1950s Southwest drought. Both of these intervals can be identified as -0.5σ departures in the decadal (11-yr) running mean of precipitation (Fig. 2).

Identifying -0.5σ events in the 11-yr means of paleoclimate records requires us to normalize these time series to exhibit unit variance over the twentieth century, so that fluctuations in the past are scaled relative to this baseline period. To that end we represent the entire Colorado streamflow record as normalized departures $[\hat{Z}(t)]$ from the late twentieth-century mean:

$$\hat{Z}(t) = \frac{F(t) - \hat{\mu}}{\hat{\sigma}}, \tag{1}$$

where $F(t)$ is reconstructed flow and $\hat{\mu}$ and $\hat{\sigma}$ are the mean and standard deviation, respectively, of the annual data over the reference period of 1950–2000 CE. The time series of $\hat{Z}(t)$ is a modified z score of $F(t)$, and its values through time are shown in Fig. 3a. Identifying intervals of -0.5σ departures in the running 11-yr mean highlights the 1150s, as well as several other low-flow decades, which occur about once per century (gray vertical bars). Time series from other recent drought studies (Cook et al. 2004; Stahle et al. 2011), normalized in the same way, are also shown in Figs. 3b and 3c. They suggest that the preindustrial rate of comparable decade-long droughts is $\sim$1.5% century^{-1}, which is quite consistent with the literature-based estimate of 1%–2% century^{-1} of Woodhouse and Overpeck (1998).

Our definition of decadal drought captures major intervals of aridity during the twentieth century as well as others during the last millennium (Figs. 3 and 2). We employ a second and more stringent criterion to identify multidecadal megadrought. In this case, -0.5σ departures in the 35-yr mean are identified. Although this definition is somewhat arbitrary, it is useful because the thresholds employed are both longer in time and greater in magnitude than the descriptions of Meko et al. (2007) and Cook et al. (2007) used to characterize the worst droughts of the past millennium in Colorado streamflow and continental-scale hydroclimate, respectively. By setting the criterion for multidecadal megadrought

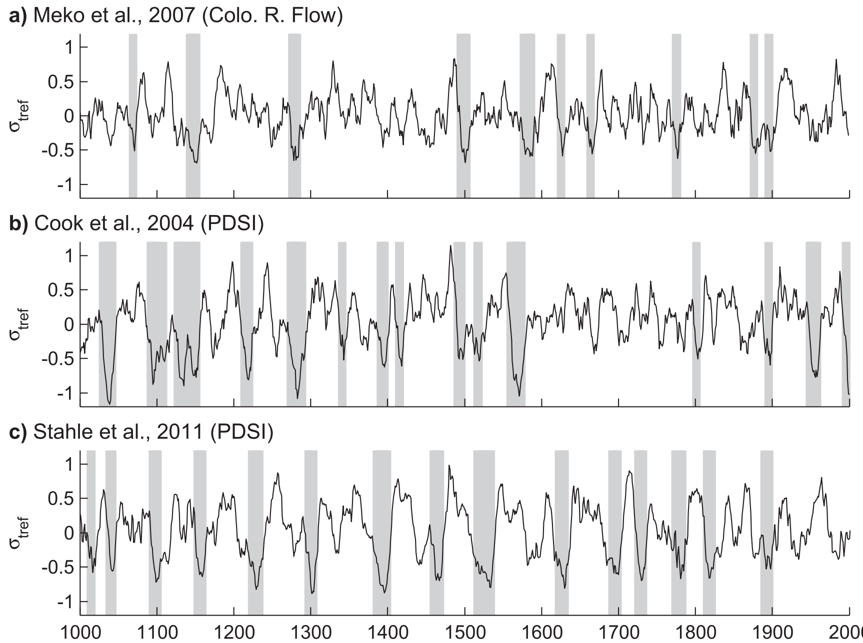

FIG. 3. The 11-yr running means of normalized paleoclimate reconstructions for (a) the Colorado streamflow (Meko et al. 2007), (b) reconstructed PDSI from the southwestern United States (Cook et al. 2004), and (c) reconstructed PDSI from Mexico (Stahle et al. 2011). Vertical gray bars indicate decadal-scale drought (a -0.5σ deviation in the 11-yr mean). All time series are standardized to exhibit one unit of standard deviation and a mean of zero over the 1950–2000 reference period.

beyond anything experienced during the last millennium, we suggest that our results will be insightful for developing adaptation and mitigation strategies for addressing worst-case scenarios. We also note that a 35-yr, -0.5σ event would be on par with the consequential late twentieth-century Sahel drought (e.g., Hoerling et al. 2006). Other similar thresholds (e.g., 25 or 45 yr) would produce qualitatively similar spatial patterns, but the rates of megadrought occurrence and levels of megadrought risk would of course differ from the ones we report here. In particular, for a given magnitude (say -0.5σ) the risk of shorter events would be higher and the risk of longer events would be lower than that for a 35-yr event.

b. *Monte Carlo simulations of drought*

With the definitions of ‘‘decadal drought’’ (an 11-yr, -0.5σ event) and ‘‘multidecadal megadrought’’ (a 35-yr, -0.5σ event) that we have outlined above, we now develop ‘‘null’’ expectations for the rate at which these events would occur from random chance under a stationary climate, but with three different assumptions about the underlying frequency characteristics of hydroclimate variability on interannual to centennial time scales.

We begin by examining the statistics of prolonged drought when interannual hydroclimate fluctuations are simulated as normally distributed white noise with unit variance and standard deviation. An example of one such time series, $X_w(t)$ is shown in Fig. 5. The decadal drought statistics of this type of noise, obtained from 1000 white noise realizations (each of length 100 years), are summarized in Fig. 6. If the distribution of variance across the hydroclimatic continuum were indeed white, then decadal droughts would be expected to occur at a rate of slightly $<1\,(100\,\mathrm{yr})^{-1}$ (Fig. 6a), and the risk of such an event occurring during any given 50-yr period would be around 45% (Fig. 6b). The likelihood of a multidecadal megadrought during any given 50-yr period would be only about 0.45% (Fig. 6b). This preliminary Monte Carlo result establishes a benchmark for the minimum rate at which decadal droughts and megadroughts would occur in a climate with only stochastic interannual variability and no sources of long-term persistence.

Although raw precipitation tends to have a white spectrum on interannual time scales (e.g., Vasseur and Yodzis 2004; Ault and St George 2010), the underlying continuum of hydroclimate may be somewhat ‘‘redder’’ in WNA (Cayan et al. 1998; Ault and St George 2010; Ault et al. 2012, 2013). Moreover, drought indices typically have a source of built-in autocorrelation to accommodate the reality that surface moisture stores

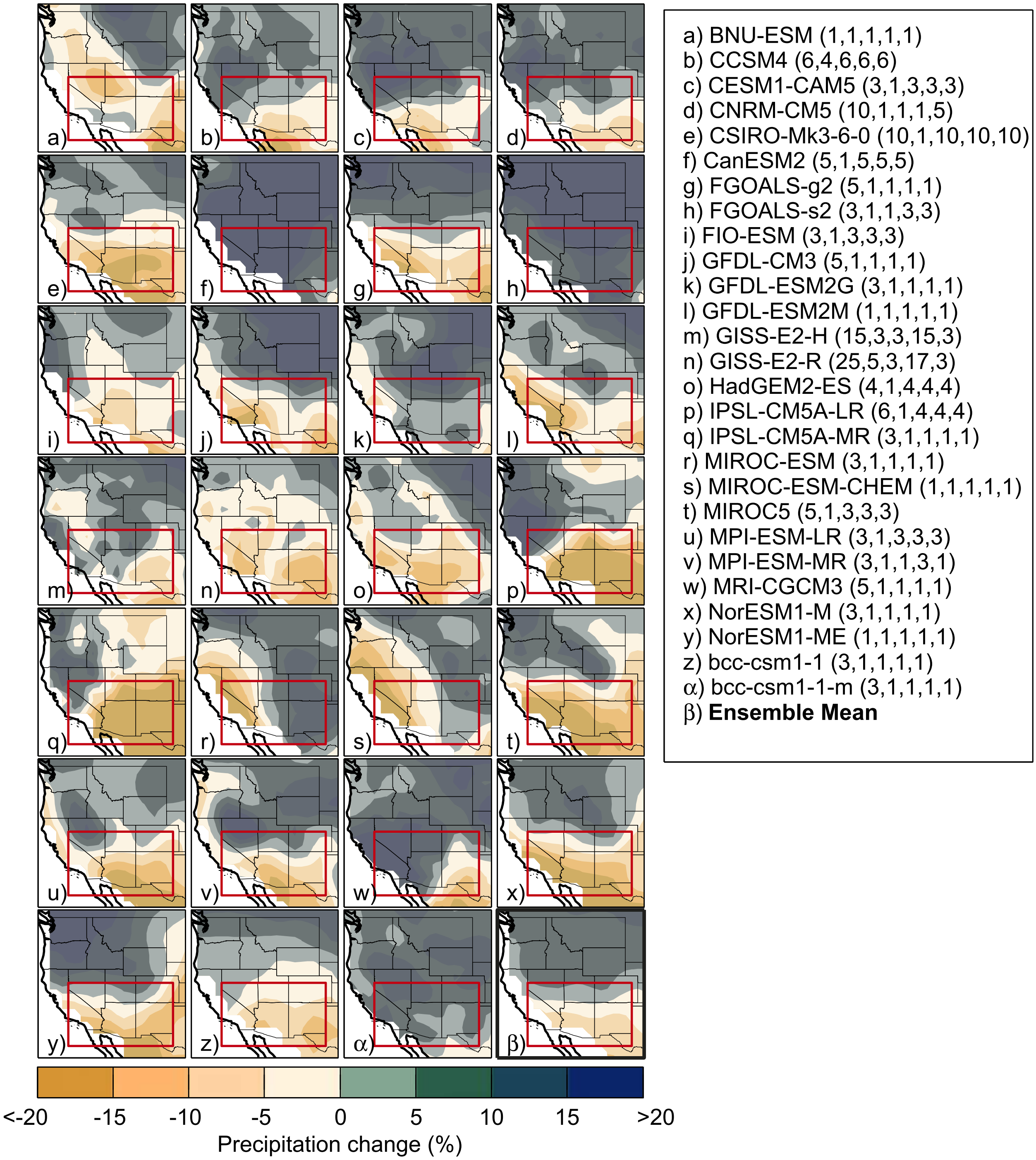

FIG. 4. Map of projected precipitation over the twenty-first-century (2005–2100) change in the RCP8.5 scenario shown as a percentage of twentieth-century precipitation change [as in the global maps of Diffenbaugh and Giorgi (2012)]. For each model, the number of available runs from each experiment is shown in parentheses in the following order: historical, piControl, RCP2.6, RCP4.5, and RCP8.5. The red box shows the greater southwestern United States to emphasize the focus of this study (30°–40°N, 120°–103°W).

depend on their prior states (i.e., they have "memory"). For example, PDSI models the surface water balance using a simplified approximation of soil moisture, and has a built-in autocorrelation function (e.g., Alley 1984; Wells et al. 2004). Similarly, the standardized precipitation index (SPI) integrates anomalies over a number of predefined lags to measure how aggregated rainfall anomalies deviate from their long-term averages.

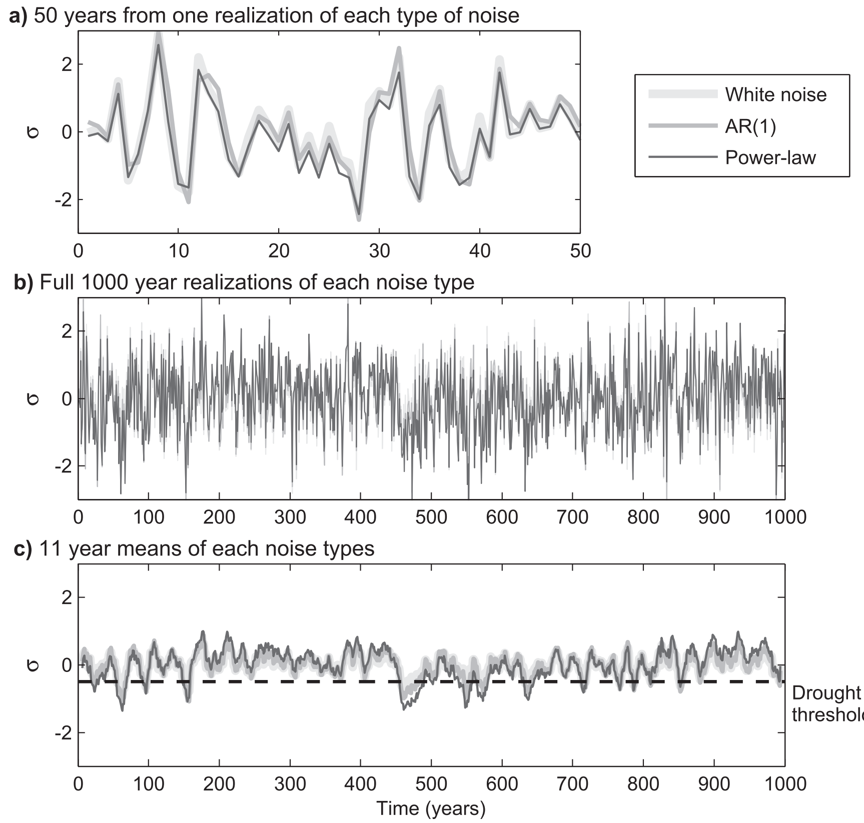

FIG. 5. Examples of Monte Carlo (MC) time series used to simulate decadal drought with three different underlying frequency characteristics [white noise, AR(1), and power law]: (a) 50 yr of a single MC realization of each type of noise, (b) the 1000-yr full realization of each noise type, and (c) the 11-yr running mean of each type of noise, shown with the dashed line denoting a decadal drought (e.g., a -0.5σ in the 11-yr running mean). Importantly, each MC time series has a mean of zero and unit standard deviation, and differ only in the distribution of their variances across the power spectrum. Moreover, the AR(1) and power-law time series are generated by rescaling the white noise data, which is why the different realizations of noise appear so strongly correlated with each other.

In a simplistic sense, year-to-year persistence can be described as a first-order autoregressive [AR(1)] process [$X_{\mathrm{AR(1)}}(t)$]:

$$X_{\mathrm{AR(1)}}(t) = \alpha X_{\mathrm{AR(1)}}(t-1) + X_w(t), \tag{2}$$

where α is the lag-1 (i.e., 1 yr) autocorrelation coefficient and is derived empirically from data, $X_{\mathrm{AR(1)}}(t)$ is autoregressive red noise, and $X_w(t)$ is the white noise input. In WNA, the value of α is about 0.3 on interannual time scales for the three (tree ring based) paleoclimate reconstructions shown in Fig. 3, as well as for many other hydroclimate indicators (Ault et al. 2013). A single realization of this type of noise (normalized to exhibit unit variance overall) is shown in Fig. 5, and the statistical characteristics of megadroughts in this type of noise are shown in Fig. 6.

Despite the intuitive and simple representation of hydroclimate as an AR(1) process—moisture deficits tend to persist through time—there is some evidence that such an approximation misses key characteristics of variability on longer time scales (Pelletier and Turcotte 1997; Kantelhardt et al. 2006; Koscielny-Bunde et al. 2006; Ault et al. 2013). As a complementary approach, we also simulate hydroclimate as a process with underlying frequency characteristics that are described by a weak power-law relationship between frequency f and variance $S(f)$, such that $S(f) \propto f^{-\beta}$. Power spectra with higher values of β correspond to time series that exhibit more variance at lower frequencies. To generate time series with this type of frequency behavior, we employ a method similar to the one described by Pelletier and Turcotte (1997) and explained thoroughly in Pelletier (2008). First, we calculate the discrete Fourier transform of

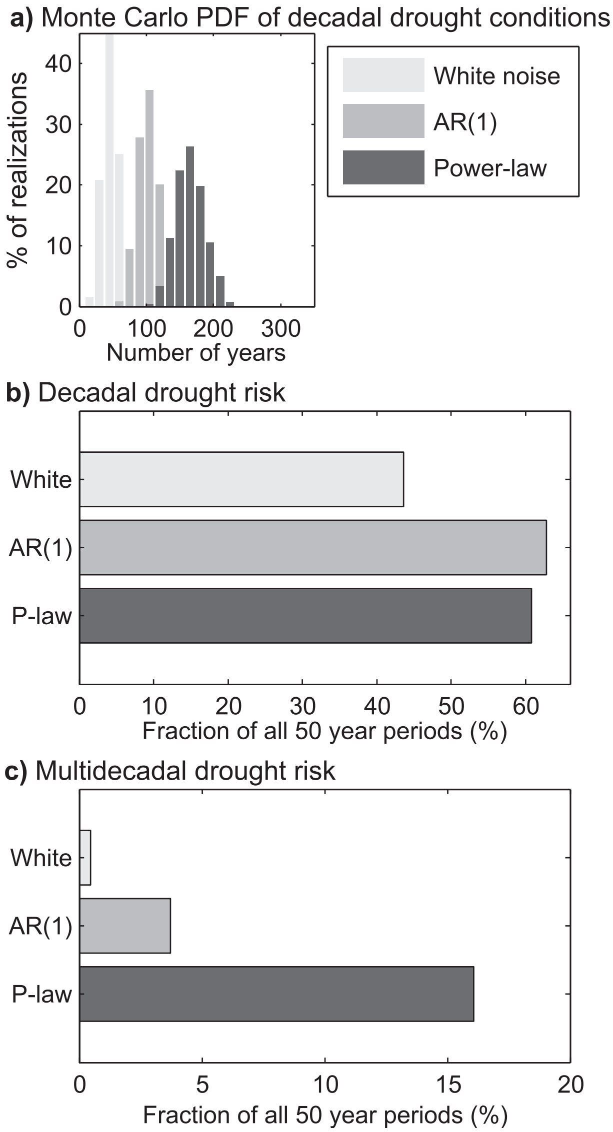

FIG. 6. Statistics summarizing Monte Carlo simulations: (a) distributions of years spent in decadal (≥11 yr) drought conditions for each type of noise (as a percentage of all realizations), (b) risk of *at least* one decadal (≥11 yr) drought during any given 50-yr window in any realizations, and (c) risk of a multidecadal (≥35 yr) drought during any 50-yr window. Risk in (b) and (c) is expressed as a percentage of the total number of simulations.

a white noise time series $X_w(t)$, and filter it to conform to a predefined value of β:

$$\tilde{X}_p(k) = \psi_k \sum_{t=1}^{N} X_w(t) e^{-i2\pi k[(t-1)/N]}, \quad k = 0, \ldots, N-1, \tag{3}$$

where k are the standard Fourier frequencies and N is the length of the time series. The term ψ_k rescales the Fourier coefficients so that they are approximately power-law distributed:

$$\psi_k = \begin{cases} \left(\dfrac{1}{N}\right)^{-\beta/\sqrt{2}} & \text{if} \quad k = 0 \\ \left(\dfrac{k}{N}\right)^{-\beta/\sqrt{2}} & \text{otherwise}. \end{cases} \tag{4}$$

Here the value of β is divided by $\sqrt{2}$ because it is being applied to the raw Fourier coefficients, which have amplitudes proportional to the square root of the power spectrum.

The rescaled Fourier series $\tilde{X}_p(k)$ is then used to generate power-law time series $X_p(t)$ by taking the real part of the inverse Fourier transform of $\tilde{X}_p(k)$:

$$X_p(t) = \mathrm{Re}\left\{\frac{1}{N}\sum_{k=0}^{N-1} \tilde{X}_p(k) e^{-i2\pi k[(t-1)/N]}\right\}, \quad t = 1, \ldots, N. \tag{5}$$

Finally, the mean and variance are restored to the values of the original white noise data (zero and unity, in this case).

We used a value of 0.5 for β to rescale each realization of $X_w(t)$, which was suggested as an appropriate estimate by Ault et al. (2013) from synthesis of tree-ring reconstructions of precipitation, PDSI, and streamflow as well as non-tree-ring estimates of hydroclimate. As a check, we calculated the power laws of the noises after they had been rescaled. We found that the actual values of β varied from one realization to the next, but were generally between 0.4 and 0.6. This range agrees well with instrumental and paleoclimate estimates of this parameter for the region, and is certainly within the observational uncertainty (Ault et al. 2013). Importantly, time series with spectra scaled by power laws of ~0.5 will also appear to exhibit autocorrelation of about 0.3, which in turn implies that the AR(1) and power-law realizations will behave very similarly on short time scales, but not necessarily on longer ones (e.g., Pelletier and Turcotte 1997; Ault et al. 2013). Finally, our use of power-law noises does not make any assumptions about the underlying climate dynamics governing the shape of the power spectrum of hydroclimate: linear and nonlinear processes alike may produce such spectral distributions (Milotti 1995; Penland and Sardeshmukh 2012).

Table 1 highlights a few key features of the two models employed here. In particular, the noise models used to estimate drought risk use parameters that do not vary across space, and all are scaled to the twentieth-century mean and variance. The autocorrelation parameter of 0.3 is a middle-of-the-road value from the time series

TABLE 1. Summary of the two red noise models used here to estimate drought risk in western North America. The key parameters are reported in the second column, and they do not vary spatially. The value of α (0.3) is the approximate autocorrelation of the three time series in Fig. 3, as well as the data analyzed in (Ault et al. 2013, Fig. 2), which supports values between 0.25 and 0.35. The estimate used for β (0.5) is a middle-of-the-road estimate from those reported in (Ault et al. 2013), and also Fig. 7.

Model	Parameters	Estimated from	References
AR(1)	$\alpha(0.3)$	Streamflow, soil moisture, tree-ring reconstructions	Meko et al. (2007); Cook et al. (2004); Stahle et al. (2011); Ault et al. (2013); this study
Power law	$\beta(0.5)$	Long tree-ring chronologies, other hydroclimate proxies	Pelletier and Turcotte (1997); Ault et al. (2013); this study

shown in Fig. 3, and is well within the range of estimates for autocorrelation in the region from other paleoclimate and observational datasets (Ault et al. 2013). The value used for β (0.5) is from the analysis of proxy records in Ault et al. (2013) as well, and is supported by Fig. 7.

Sample time series and statistics of power-law realizations of drought (Figs. 5 and 6, respectively) reveal the importance of low-frequency variability in shaping prolonged drought risk. Over the time scale of 50 years, the white, AR(1), and power-law noises are all remarkably similar to each other [because the initial realization of $X_w(t)$ is rescaled to produce both $X_{\mathrm{AR(1)}}(t)$ and $X_p(t)$]. On the time scale of a millennium (Fig. 5b), the low-frequency differences are more apparent. The running 11-yr mean of each noise type (Fig. 5b) makes the implications for risk clear: the AR(1) and power-law time series spend more time in drought and depict higher levels of risk for megadrought. In Fig. 6a, it is also clear that the fraction of time spent in decadal drought conditions is about 17% for the power-law noise realizations, as opposed to 10% for the AR(1) simulations, and less than 5% for the white noise time series. Although the AR(1) and power-law time series exhibit similar likelihoods that a single decadal drought will occur during any given 50-yr period, the power-law series yields events that persist for longer. Drought risk on longer time scales, however, is clearly far higher for the power-law distributed time series than for the other two, with the risk of a 35-yr (-0.5σ) megadrought being greater than 16% for any given 50-yr segment. We stress that these risks apply to a stationary climate with no local feedbacks or externally forced changes. They are therefore our most conservative baseline estimates of prolonged drought risk during the coming century.

c. Projected risk of persistent drought in CMIP5 simulations

Our definition of megadrought is easily extended to climate model data. For instance, projected precipitation at the jth position of each grid of a given model can be transformed as

$$\hat{Z}_j(t) = \frac{P_j(t) - \hat{\mu}_j}{\hat{\sigma}_j}, \tag{6}$$

where $\hat{\mu}_j$ and $\hat{\sigma}_j$ are the late twentieth-century (1950–2000 CE) mean and standard deviation, respectively. The subscript j is used as a spatial index (i.e., a point on a grid).

Certain limitations make estimating megadrought risk in the CMIP5 archive more complicated than simply

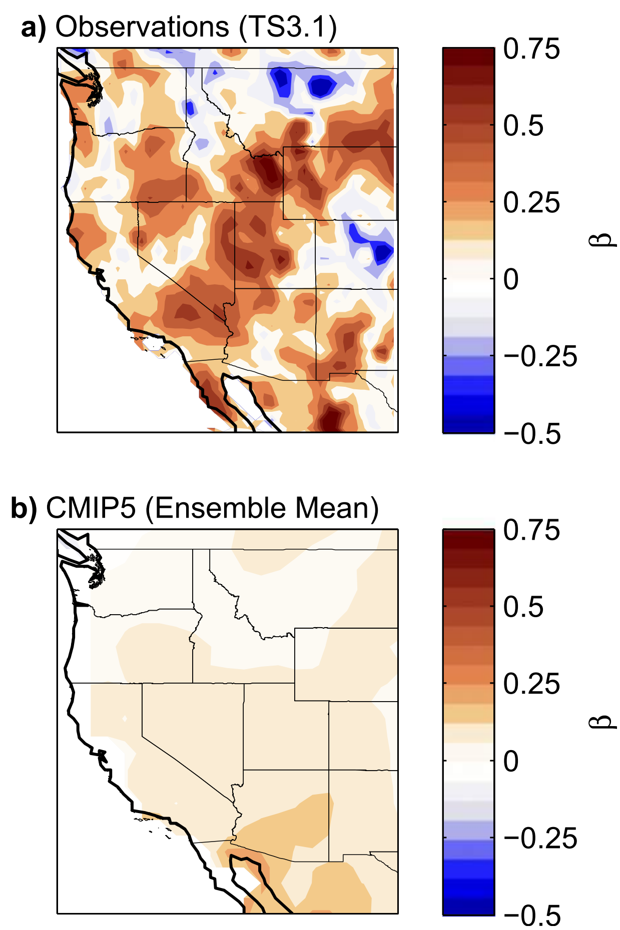

FIG. 7. Power-law estimates (β) from (a) twentieth-century instrumental data and (b) and CMIP5 historical (1850–2005 CE) simulations. Instrumental data originate from the University of East Anglia's TS3.1 data product and, like the CMIP5 records, were annualized prior to calculating β.

calculating how often these events occur in climate projections. First, the number of ensemble members available from each model is small (Fig. 4), and the role for internal variability may be substantial on decadal to multidecadal time scales (Hawkins and Sutton 2009; Deser et al. 2012). This makes it difficult to reliably estimate risks stemming from the combined influences of forced changes and internal variability. Second, the distribution of variance across time scales is different in observational data than in models. In particular, models tend to exhibit power spectra resembling white noise in WNA, even when run for many centuries or forced with the time-evolving boundary conditions of the last millennium (Ault et al. 2012, 2013). To illustrate this point further here, we show power-law estimates from observations and CMIP5 data in Fig. 7. In this case, the power-law coefficients are calculated from each model individually and then averaged together to produce this map. Importantly, the results of individual models appear similar to this ensemble average, supporting recent findings that the continuum of hydroclimate in WNA appears to be considerably redder in observations than in models (Ault et al. 2013, 2012).

We address the aforementioned challenges by developing a Monte Carlo model of hydroclimate variability to emulate the statistics of both natural variability and climate change in WNA. This approach enables us to evaluate projected risk of prolonged drought in the twenty-first century for a given climate change scenario. We use the underlying frequency characteristics of observational data (including paleodata), as well as projected changes in precipitation simulated by models archived as part of CMIP5. The Monte Carlo model is described by

$$\hat{Z}_{ij}(t) = X_w(t)\left(\frac{\hat{\varrho}_{ij}}{\hat{\sigma}_{ij}}\right) + \xi(\Delta\hat{\mu}_{ij}, \sigma^2_{\mu_{ij}}), \qquad (7)$$

where $\hat{Z}_{ij}(t)$ is normalized precipitation of the ith model at the jth point on a grid, and $X_w(t)$ is a normally distributed time series of white noise with unit variance. The quantity $\hat{\varrho}_{ij}/\hat{\sigma}_{ij}$ scales the white noise by normalizing the twenty-first-century standard deviations ($\hat{\varrho}_{ij}$) from a given model grid point by the corresponding twentieth-century reference standard deviation ($\hat{\sigma}_{ij}$). Twentieth- to twenty-first-century differences in mean precipitation at each point in each model are represented by the random, normally distributed variable ξ_{ij}, with expected mean of $\Delta\hat{\mu}_{ij}$ (the change in precipitation) and variance ($\sigma^2_{\mu_{ij}}$), estimated from ensembles of runs when possible, and otherwise set to zero. Finally, to generate Monte Carlo twenty-first-century realizations of hydroclimate with AR(1) and power-law distributions in frequency space, we rescale $\hat{Z}_{ij}(t)$ following the same methods described above.

We estimate decadal drought and multidecadal megadrought risk in three climate change scenarios (RCP2.6, RCP4.5, and RCP8.5) for each of the 27 CMIP5 models considered here by generating 1000 stochastic (white noise) realizations, each 1000 years long, of WNA hydroclimate using Eq. (7), as well as the AR(1) and power-law rescaling procedures. In each model, and for each RCP, estimates of $\hat{\sigma}$ are made using the 1950–2000 portion of the model's historical simulation, and $\hat{\varrho}$ is estimated over the 50-yr interval spanning 2050–2100. Likewise, $\Delta\hat{\mu}$ and σ^2_{μ}, are estimated from the differences between historical (1950–2000) and late twenty-first-century (2050–2100) precipitation means. We then identify the percentage of all 1000 realizations that experience decadal drought or multidecadal megadrought conditions in each RCP, model, and type of noise.

3. Results

In the CMIP5 control runs, rates of decadal drought occurrence (the average number of events per century) are spatially uniform and close to one (Fig. 8a). Similarly, white noise realizations also tend to produce about one event per century. Under climate change, rates of decadal drought occurrence show more regional diversity than in the controls (Figs. 8b–d). In the northern part of WNA, rates are close to zero, whereas throughout much of the U.S. Southwest they are between 1.5 and 1.75. Multidecadal megadrought rates are close to zero in the control runs of the CMIP5 archive (Fig. 8e). Under climate change, these rates are closer to 0.5 (or 1 event per 200 yr), but they are still quite rare (Figs. 8f–h).

The risk of a single decade-long drought over any given 50-yr period in the control runs is about 50% (Fig. 9a), which is intuitive because the corresponding rate is about one per century. Decadal drought risk in the climate change scenarios, estimated over the period 2050–2100, depicts a decrease in the northern regions, and an increase to between 60% and 80% (Figs. 9b–d) in the U.S. Southwest. Moreover, risk increases in the U.S. Southwest with the intensity of the warming; the highest levels are found under the RCP8.5 scenario.

In the unforced control runs, the risk of a multidecadal megadrought is less than 1% throughout the region (Fig. 9e). Under climate change, however, risks in the U.S. Southwest increase to 10%–20% in RCP2.6 (Fig. 9f), 20%–40% in RCP4.5 (Fig. 9g), and 30%–50% in RCP8.5 (Fig. 9h).

A qualitatively similar picture of risk to that in Fig. 9 is seen in Figs. 10 and 11, which summarize our Monte

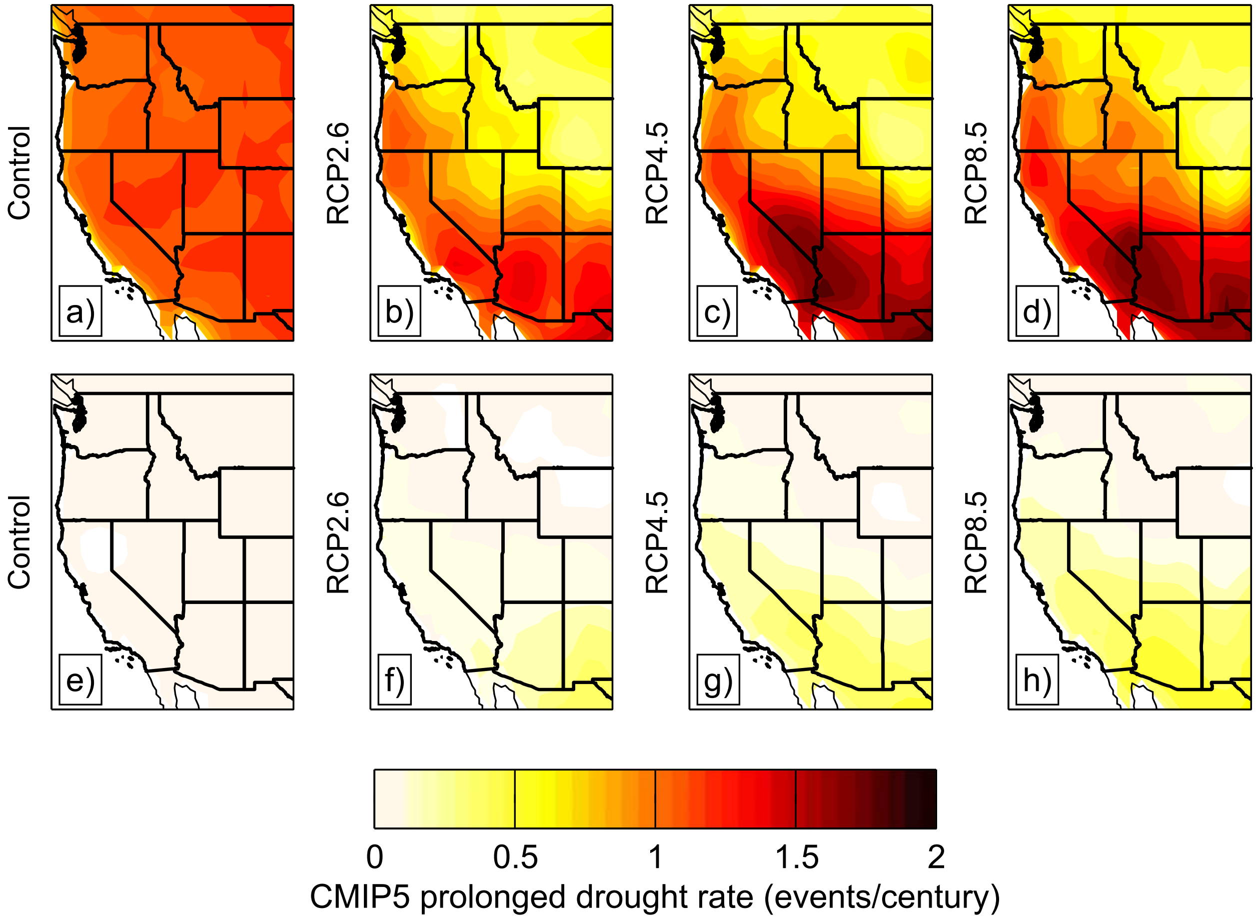

FIG. 8. Estimated rate of prolonged drought occurrence in (a),(e) control and (b)–(d),(f)–(h) forced CMIP5 simulations. The rate is calculated as the number of events per century averaged across all models, and across all centuries in the control cases in (a) and (e). (top) Indicates the rate of decadal (≥11 yr) drought, and (bottom) the rate of multidecadal (≥35 yr) megadrought occurrence. Forcing scenarios are indicated to the left of each map.

Carlo experiments using Eq. (7) to generate stochastic hydroclimate realizations, and the procedures described in section 2b to rescale them to exhibit AR(1) and power-law frequency distributions. In the U.S. Southwest, for example, risk of droughts at both decadal and multidecadal time scales increases with the intensity of the greenhouse gas forcing (columns) and type of noise (rows). Uncertainty in our risk estimates is depicted by the standard deviations of the individual model estimates of risk in Fig. 12. Results for the multidecadal megadrought risk standard deviations are shown in Fig. 13.

Thus far, we have only considered the risk of a prolonged period of aridity using two somewhat narrow definitions of decadal drought and megadrought. To develop a more complete representation of drought risk across a wide range of time scales and magnitudes, we examine the two-dimensional probability density function of drought risk using the same time scale-independent definition employed by Ault et al. (2013). Specifically, a drought is defined as a period of time during which 3/5 of the antecedent years are below a particular threshold. These thresholds are the values of the x axes on the individual panels of Fig. 14, and the time scales are shown on the y axes of that figure. As in the earlier figures, risk is estimated from all Monte Carlo simulations of each model for each RCP, then averaged across the individual CMIP5 members to produce the ''magnitude versus duration'' diagrams in Fig. 14.

The results in Fig. 14 show that risk increases with GHG forcing intensity across all time scales in the raw CMIP5 archive (Figs. 14a–c), as well as for each type of noise. It also illustrates that the AR(1) and power-law distributions depict higher levels of risk on decadal and longer time scales than the white noise and CMIP5 ensembles. To emphasize this point further, we show the differences in drought risk across time scales between each type of noise and the raw CMIP5 estimates in Fig. 15. From this figure, it is clear that the low-probability (but

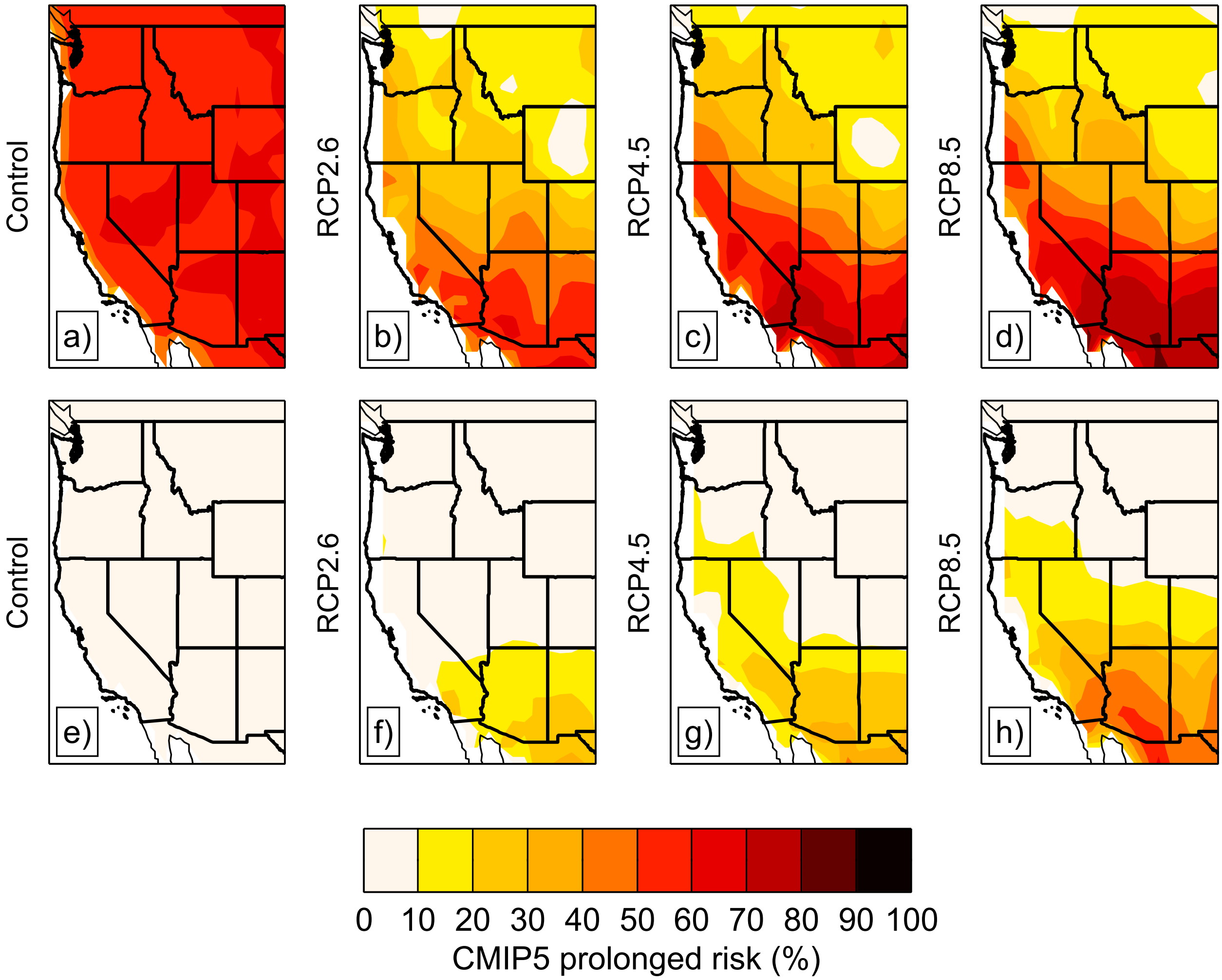

FIG. 9. Estimated risk of at least one prolonged drought in (a),(e) control and (b)–(d),(f)–(h) simulations. (top) Indicates the risk of decadal (>11 yr) drought, and (bottom) indicates the risk of multidecadal (>35 yr) megadrought. The risk is calculated as the percent of the total number of models (27) that simulate decadal or multidecadal megadrought. Forcing scenarios are indicated to the left of each map.

presumably consequential) "tails" of the distributions are far more likely in the AR(1) and power-law noises than in the raw CMIP5 archive. For instance, under the RCP8.5 scenario, the risk of a 0.5σ event on 40-yr time scales is below 5% as estimated from CMIP5 runs (Fig. 14c), but closer to 10% in the power-law noise realizations (Fig. 14i).

We extend our analysis of megadrought risk in the western United States to the rest of the world by examining raw CMIP5 estimates of decadal drought and multidecadal megadrought from the three RCP scenarios (Fig. 16). Risks throughout the subtropics appear as high as or higher than our estimates for the U.S. Southwest (e.g., in the Mediterranean region, western and southern Africa, Australia, and much of South America). We do not attempt to develop regionally appropriate stochastic realizations of precipitation at this time, although such an endeavor could be straightforward in areas where instrumental and paleoclimate data are adequate to characterize the underlying continuum of hydroclimate. In areas where low-frequency variability in precipitation is substantial and not well simulated by climate models (e.g., West Africa; Ault et al. 2012), the results shown here likely underestimate future risk of persistent drought.

We stress that our results have only used precipitation, yet temperature may play a substantial role in driving or exacerbating drought. Also, we used the low end of β estimates from Ault et al. (2013) to generate the power-law noises, but higher values might be realistic on long time scales, according to the preponderance of paleoclimate evidence considered in that study, and would raise the levels of risk. Hence, to the extent that the global climate models simulate future change realistically and

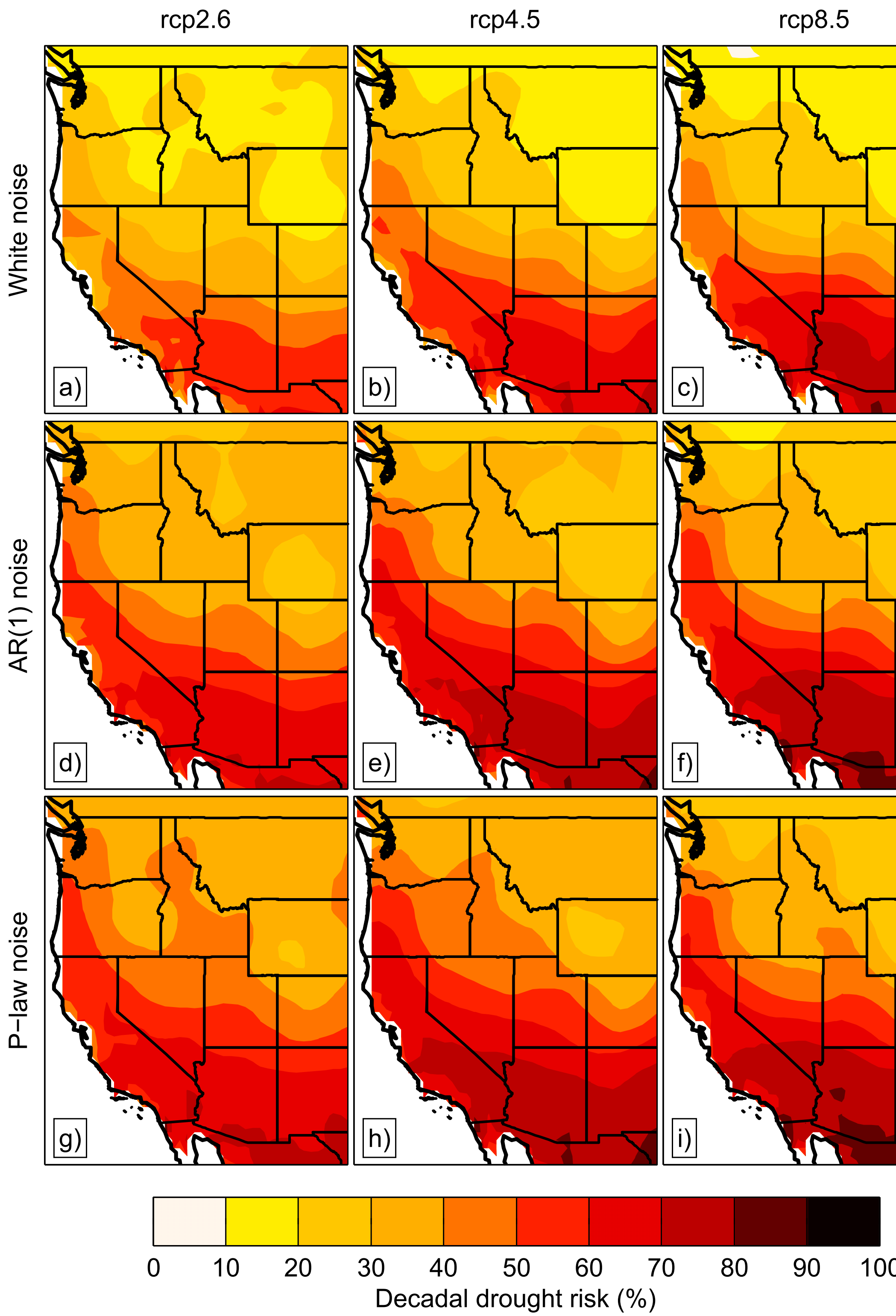

FIG. 10. Decadal (>11 yr) drought risk estimates obtained from Monte Carlo simulations of projected precipitation changes across all models in three different climate change scenarios (columns) and for three different types of noises (rows). These maps express the average risk estimates obtained from Monte Carlo simulations of precipitation in each model under three climate change scenarios. For each of the 27 individual CMIP5 models, risk is calculated as the percentage of the total number of Monte Carlo simulations (1000) that show a decadal drought. Here, those estimates of risk are averaged across the multimodel archive.

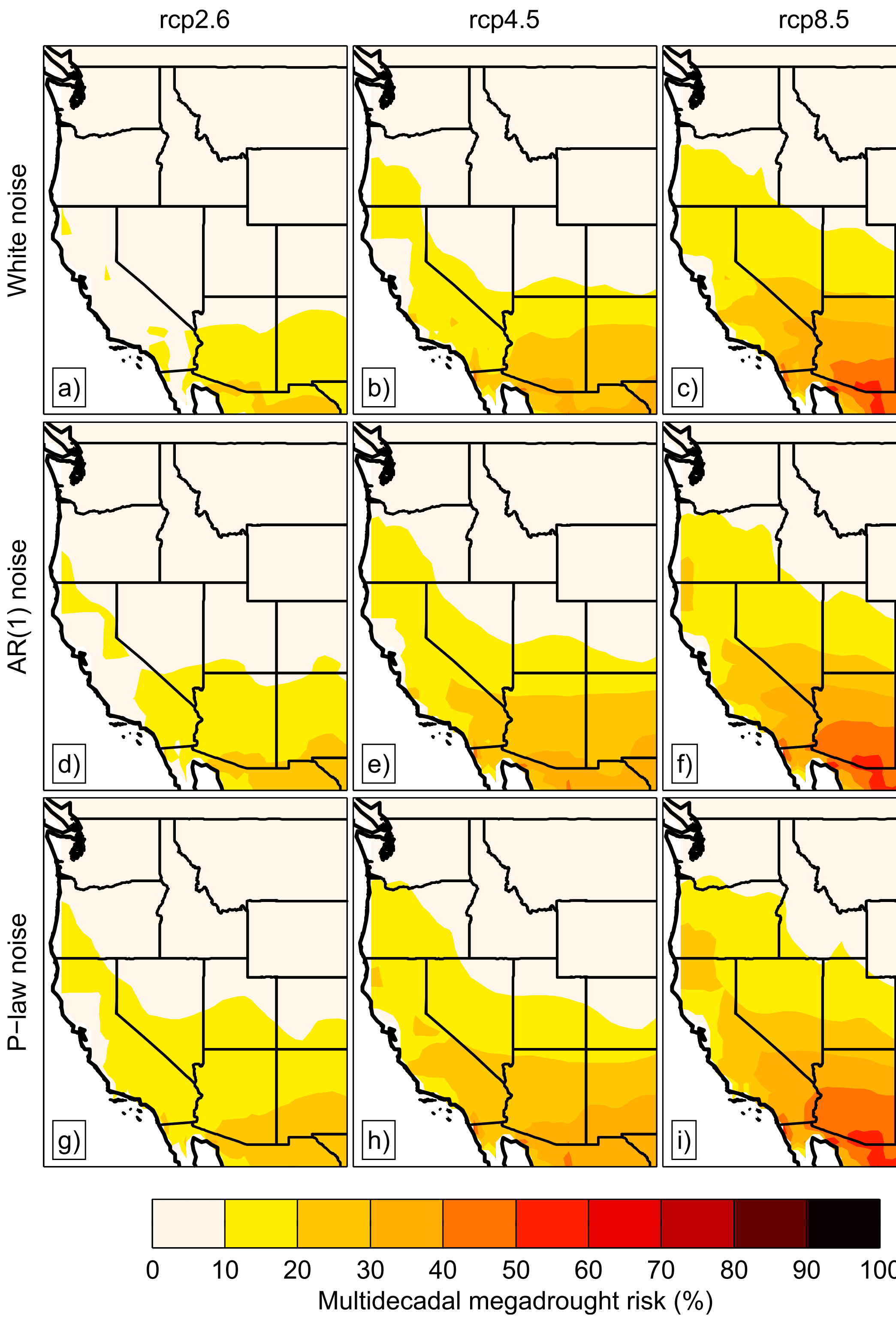

FIG. 11. Multidecadal (>35 yr) megadrought risk estimates obtained from Monte Carlo simulations of projected precipitation changes across all 27 CMIP5 models in three different climate change scenarios (columns) and for three different types of noises (rows). These maps express the average risk estimates obtained from Monte Carlo simulations of precipitation in each model under three climate change scenarios. For each of the 27 individual CMIP5 models, risk is calculated as the percentage of the total number of Monte Carlo simulations (1000) that show a multidecadal megadrought. Here, those estimates of risk are averaged across the multimodel archive.

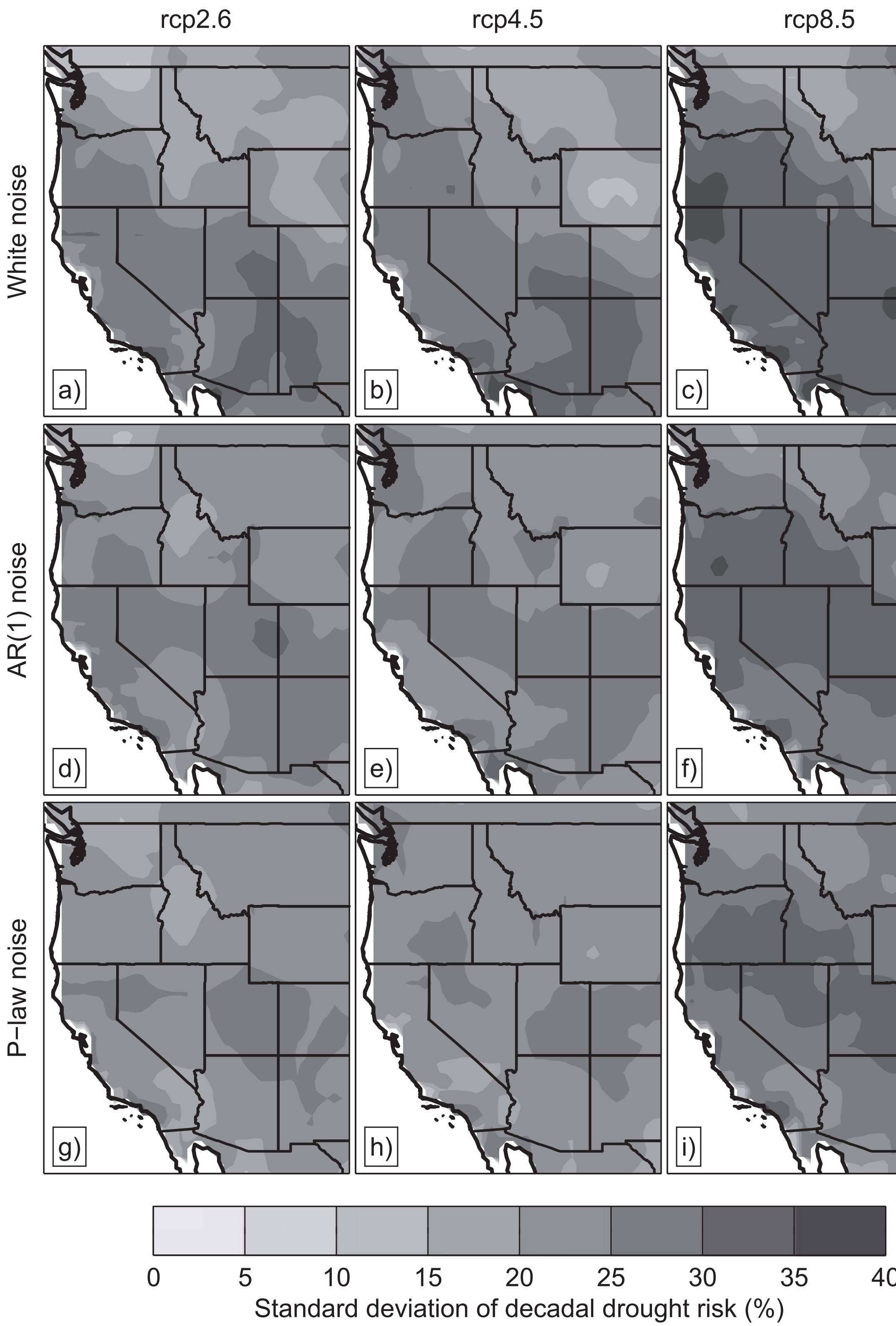

FIG. 12. Standard deviations of decadal (>11 yr) drought risk estimates in Fig. 10. Standard deviations are calculated from the individual risk estimates of each model at each point for three different climate change scenarios (columns) and for three different types of noises (rows). These maps express the spatial variability of uncertainty in the risk estimates of Fig. 10.

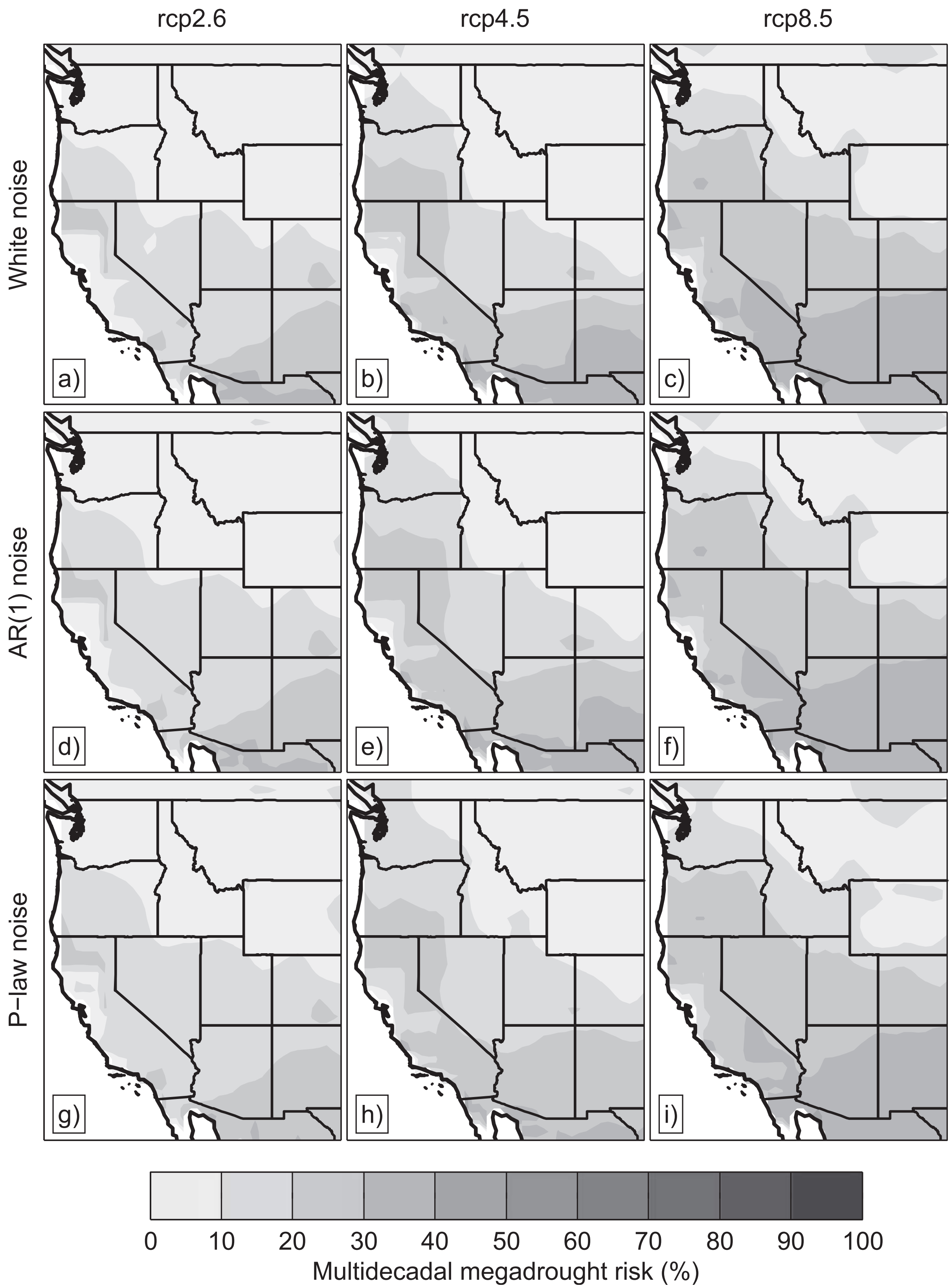

FIG. 13. Standard deviations of drought risk estimates as in Fig. 12, but for multidecadal (>35 yr) megadrought risk.

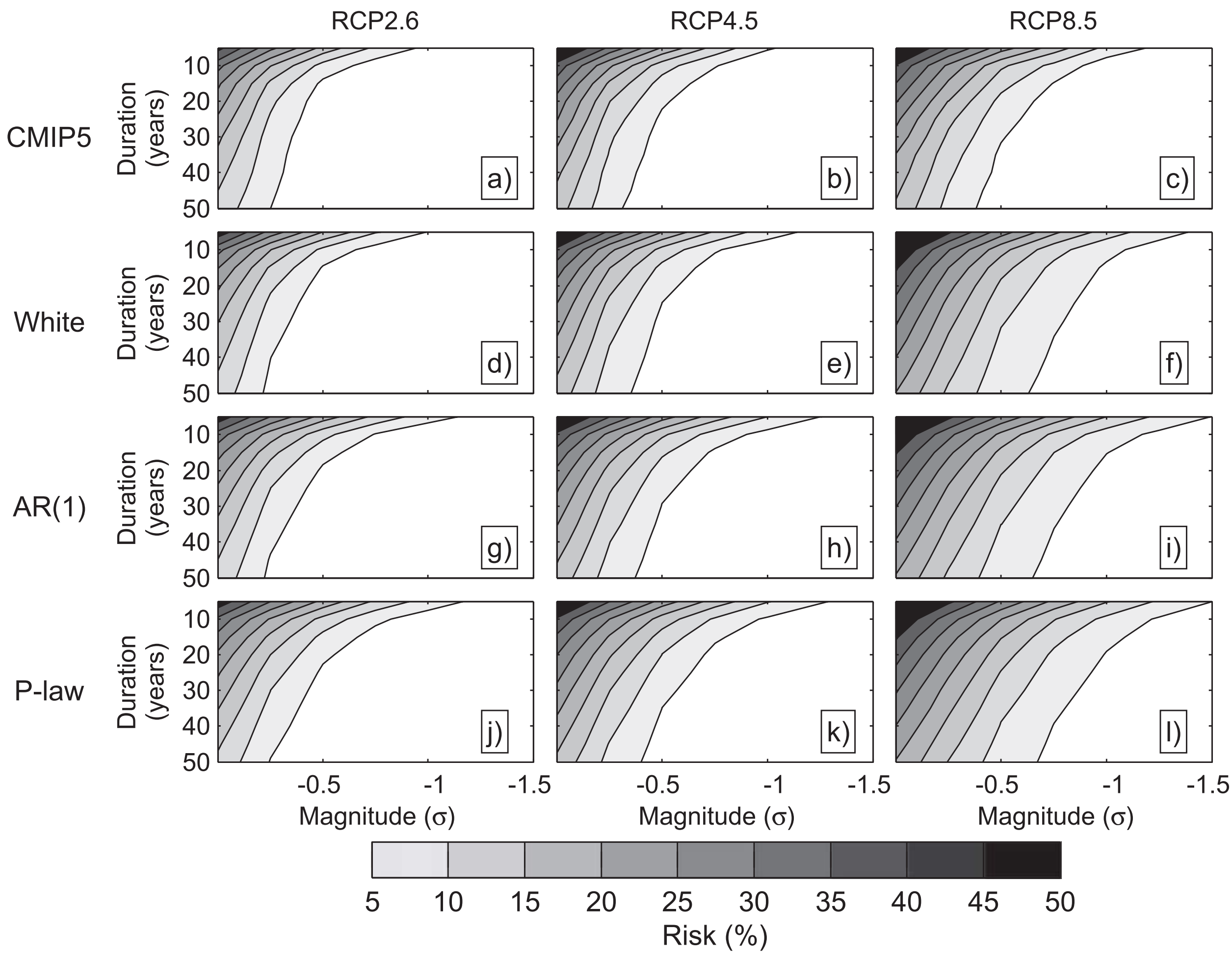

FIG. 14. Drought magnitude vs duration for realizations of southwestern U.S. precipitation time series in each climate change scenario, obtained from the following sources: (a)–(c) raw CMIP5 projections, (d)–(f) white noise, (g)–(i) AR(1) realizations, and (j)–(l) power-law realizations.

our simple Monte Carlo models are adequate, the view of risk presented here is quite conservative.

4. Discussion and conclusions

In the current generation of global climate models, the risk of a decade-scale drought occurring this century is at least 50% for most of the greater southwestern United States and may indeed be closer to 80% (Figs. 9 and 10). The probability of multidecadal megadrought is also high: the likelihood of a 35-yr event is between 10% and 50% depending on how much climate change is realized during the coming century. The probability of even longer events (>50-yr, or "permanent," megadrought) is nonnegligible (5%–10%) for the most intense warming scenario (Fig. 14). Risk levels correspond to the intensity of forcing and the underlying distribution of hydroclimatic variance across the frequency continuum. The RCP8.5 scenario, for instance, depicts the highest levels of risk regardless of the underlying noise type. Likewise, the power-law noises produce higher megadrought likelihoods for each RCP than the other noises.

An obvious limitation of our work is that it is "blind" to certain aspects of dynamically driven changes in prolonged drought risk. For instance, changes in the magnitude, frequency, or teleconnection patterns of El Niño and La Niña (e.g., Coats et al. 2013a) may alter the statistics of interannual variability in ways that are not captured by our simple models. Further, megadrought statistics over the last millennium may be forcing dependent, as suggested by Cook et al. (2004), for instance, which shows that megadroughts were more common during the medieval climate era of 850–1200 CE. Another very serious limitation is imposed by the reliability of the models themselves to make realistic predictions of changes in climatological precipitation for the end of the twenty-first century.

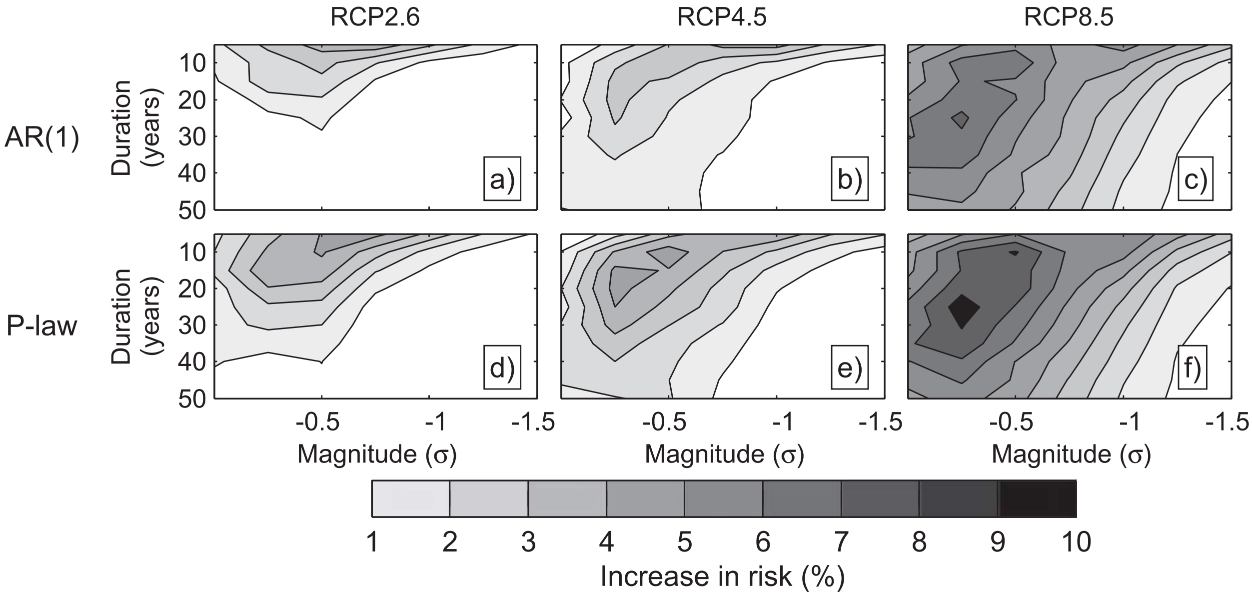

FIG. 15. Differences in duration vs magnitude risk estimates between raw CMIP5 and the two types of noises with low-frequency variability. These results are for the southwestern U.S. region, and they illustrate the difference in drought risk at a given magnitude and duration if low-frequency noise is prominent. Under the strongest forcing, the low-frequency noise models increase the risk of a multidecadal megadrought by about 8%–10%.

The projected increases in risk for the U.S. Southwest reflect forced changes in the global hydrological cycle (e.g., Held and Soden 2006; Solomon et al. 2007; Vecchi and Soden 2007; Seager et al. 2010). As such, the global picture of persistent drought risk in the CMIP5 archive (Fig. 16) bears a striking resemblance to the projected decreases in precipitation throughout many semiarid regions of the world (Diffenbaugh and Giorgi 2012; Knutti and Sedlacek 2013). It follows that prolonged drought risk is a function not only of forced changes in the global hydrological cycle and the severity of future warming, but also of the accuracy with which GCMs project large-scale changes in hydroclimate (e.g., Held and Soden 2006; Seager et al. 2007; Vecchi and Soden 2007; Seager et al. 2010). Moreover, we have based our analysis on precipitation projections, yet this variable has been notoriously challenging for GCMs to simulate accurately and large biases may remain in some models (e.g., Knutti and Sedlacek 2013; Jiang et al. 2012). Our estimates of risk are consequently only as accurate as climate model projections of changes in precipitation. An alternative approach, employed for instance by Seager et al. (2007, 2010), examines the role of large-scale dynamic and thermodynamic controls on precipitation minus evapotranspiration ($P - E$). Such studies have found that drought conditions like the Dust Bowl will become normal in the Southwest and in other subtropical dry zones. If such transitions are indeed ‘‘imminent,’’ as stated in those studies, then the risk of decadal drought is 100%, and the risk of longer-lived events is probably also extremely high. By orienting our analysis around precipitation, the risks of prolonged drought we show here are in fact the lowest levels consistent with model simulations of future climates.

From Fig. 16 it is also clear that several other areas may be facing similar (or worse) levels of prolonged risk in the coming century. Synthesis of paleoclimatic, instrumental, and model data for these regions may lead to improvements in projecting risks in these areas and preparing appropriate adaptation and mitigation strategies. For example, high-resolution tree-ring and cave records are available from Southeast Asia (e.g., Cook et al. 2010a; Buckley et al. 2010; Sinha et al. 2007, 2011; Zhang et al. 2008) and could be used in conducting such an analysis for that region.

Despite the simplicity of our Monte Carlo model of hydroclimate in WNA, our results illustrate a crucial point for water resource managers in the region: CMIP5 models alone underestimate megadrought risk. This argument was implied in several recent studies (Cook et al. 2010b; Ault et al. 2012, 2013), but its details and implications are laid out more explicitly here (Fig. 15 specifically). Future work could refine estimates of future risks by adding additional layers of complexity to the framework we have outlined. For example, we have only used annual precipitation, which we found to be approximately normally distributed in most of WNA in most models. A more sophisticated approach could simulate the joint PDF of

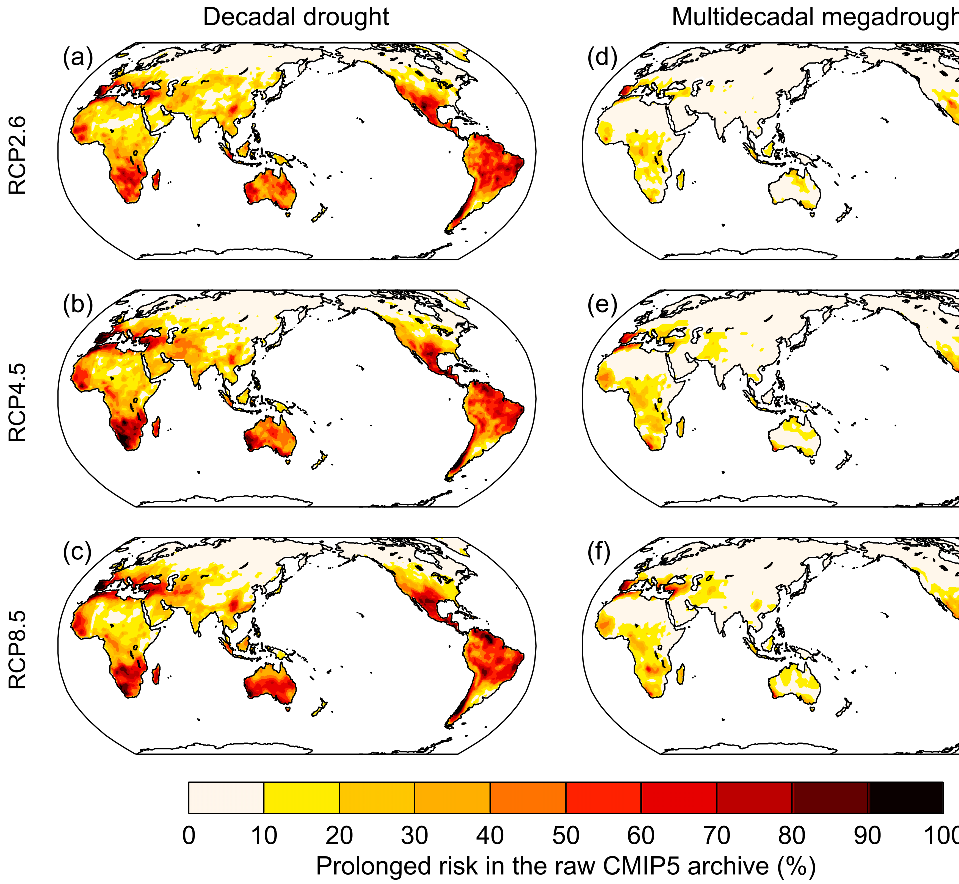

FIG. 16. Global estimates of (left) decadal and (right) multidecadal megadrought in the raw CMIP5 archive. As in Fig. 9, risk is calculated as the percent of the total number of models (27) that simulate a decadal or multidecadal megadrought. Forcing scenarios are indicated to the left of each map.

temperature and precipitation at monthly resolution, and use a more fine-tuned type of distribution and various drought indices to do so. Moreover, our noise simulations are one-dimensional in the sense that we did not build spatial autocorrelation into the noises. Developing and applying a model with realistic spatial covariance structures could help in addressing risks associated with persistent drought across large geographic scales. Likewise, it is possible that improvements in climate models, along with increasing computer power to run larger and larger ensembles, will allow for dynamically constrained assessments of megadrought risk using future generations of fully coupled climate models. In the meantime, our results provide quantitative benchmarks for water management and climate modeling communities.

5. Implications

Droughts in the past have had particularly notable human and financial costs. In the United States alone, for instance, the Federal Crop Insurance Corporation spent an average of $1.7 billion annually to compensate losses from 1980 to 2005, and this number has been increasing (Stephenson 2007). In the future, such losses might be curtailed if the full range of natural and forced hydroclimatic variability can be included in megadrought risk mitigation strategies. Here, we have described a method for combining insights from observational data and projections from climate models to estimate the risk of persistent intervals of aridity in the coming century in the U.S. Southwest. In this region where high-quality proxy records of hydroclimate have been used to constrain the underlying features of hydroclimate on decadal and longer time scales, the risk of decadal drought is at least 70% and may be higher than 90%. The risk of a multidecadal megadrought may be as high as 20%–50%, and the likelihood of an unprecedented 50-yr drought is nonnegligible (5%–10%). A number of other regions face similarly high levels of risk including southern Africa, Australia, and the Amazon basin. Moreover, future drought severity will be exacerbated by increases in temperature, implying that our results should be viewed as conservative provided that the models depict accurate forced trends in regional hydroclimate. These findings emphasize the need to develop drought mitigation strategies that can cope with decadal and multidecadal droughts in changing climates with substantial sources of low-frequency variability.

Acknowledgments. We thank Steve Gray, Jeff Lukas, Connie Woodhouse, and the U.S. Bureau of Reclamation for assistance, and we appreciate the helpful reviews we received from Joellen Russell and Scott St. George. We are also grateful for the extensive insight and feedback we received from an anonymous reviewer. This project was supported in part by NSF graduate and NCAR-ASP postdoctoral fellowships to T. Ault, NOAA CCDD (NA07OAR4310054), NSF P2C2 (0903093) support for J. Cole, and NOAA Climate Program Office support for CLIMAS (J. Overpeck), as well as NSF EaSM2 Grant (1243125) to Cole and Overpeck. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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Under the California Environmental Quality Act (CEQA), local agencies have a very important role to play in California's fight against global warming – one of the most serious environmental effects facing the State today. Local agencies can lead by example in undertaking their own projects, insuring that sustainability is considered at the earliest stages. Moreover, they can help shape private development. Where a project as proposed will have significant global warming related effects, local agencies can require feasible changes or alternatives, and impose enforceable, verifiable, feasible mitigation to substantially lessen those effects. By the sum of their actions and decisions, local agencies will help to move the State away from "business as usual" and toward a low-carbon future.

Included in this document are various measures that may reduce the global warming related impacts at the individual project level. (For more information on actions that local governments can take at the program and general plan level, please visit the Attorney General's webpage, "CEQA, Global Warming, and General Plans" at http://ag.ca.gov/globalwarming/ceqa/generalplans.php.)

As appropriate, the measures can be included as design features of a project, required as changes to the project, or imposed as mitigation (whether undertaken directly by the project proponent or funded by mitigation fees). The measures set forth in this package are examples; the list is not intended to be exhaustive. Moreover, the measures cited may not be appropriate for every project. The decision of whether to approve a project – as proposed or with required changes or mitigation – is for the local agency, exercising its informed judgment in compliance with the law and balancing a variety of public objectives.

Mitigation Measures by Category

Energy Efficiency

Incorporate green building practices and design elements.	The California Department of Housing and Community Development's Green Building & Sustainability Resources handbook provides extensive links to green building resources. The handbook is available at http://www.hcd.ca.gov/hpd/green_build.pdf. The American Institute of Architects (AIA) has compiled fifty readily available strategies for reducing fossil fuel use in buildings by fifty percent. AIA "50 to 50" plan is presented in both guidebook and wiki format at http://wiki.aia.org/Wiki%20Pages/Home.aspx.

Meet recognized green building and energy efficiency benchmarks.	For example, an ENERGY STAR-qualified building uses less energy, is less expensive to operate, and causes fewer greenhouse gas emissions than comparable, conventional buildings. http://www.energystar.gov/index.cfm?c=business.bus_index. California has over 1600 ENERGY STAR-qualified school, commercial and industrial buildings. View U.S. EPA's list of Energy Star non-residential buildings at http://www.energystar.gov/index.cfm?fuseaction=labeled_buildings.locator. Los Angeles and San Francisco top the list of U.S. cities with the most ENERGY STAR non-residential buildings. http://www.energystar.gov/ia/business/downloads/2008_Top_25_cities_chart.pdf. Qualified ENERGY STAR homes must surpass the state's Title 24 energy efficiency building code by at least 15%. Los Angeles, Sacramento, San Diego, and San Francisco-Oakland are among the top 20 markets for ENERGY STAR homes nationwide. http://www.energystar.gov/ia/new_homes/mil_homes/top_20_markets.html. Builders of ENERGY STAR homes can be more competitive in a tight market by providing a higher quality, more desirable product. See http://www.energystar.gov/ia/partners/manuf_res/Horton.pdf. There are a variety of private and non-profit green building certification programs in use in the U.S. See U.S. EPA's Green Building / Frequently Asked Questions website, http://www.epa.gov/greenbuilding/pubs/faqs.htm. Public-Private Partnership for Advancing Housing Technology maintains a list of national and state Green Building Certification Programs for housing. See http://www.pathnet.org/sp.asp?id=20978. These include the national Leadership in Energy and Environmental Design (LEED) program, and, at the state level, Build it Green's GreenPoint Rated system and the California Green Builder program. Other organizations may provide other relevant benchmarks.
Install energy efficient lighting (e.g., light emitting diodes (LEDs)), heating and cooling systems, appliances, equipment, and control systems.	Information about ENERGY STAR-certified products in over 60 categories is available at http://www.energystar.gov/index.cfm?fuseaction=find_a_product. The California Energy Commission maintains a database of all appliances meeting either federal efficiency standards or, where there are no federal efficiency standards, California's appliance efficiency standards. See http://www.appliances.energy.ca.gov/. The Electronic Product Environmental Assessment Tool (EPEAT) ranks computer products based on a set of environmental criteria, including energy efficiency. See http://www.epeat.net/AboutEPEAT.aspx. The nonprofit American Council for an Energy Efficient Economy maintains an Online Guide to Energy Efficient Commercial Equipment, available at http://www.aceee.org/ogeece/ch1_index.htm. Utilities offer many incentives for efficient appliances, lighting, heating and cooling. To search for available residential and commercial incentives, visit Flex Your Power's website at http://www.fypower.org/.

Use passive solar design, e.g., orient buildings and incorporate landscaping to maximize passive solar heating during cool seasons, minimize solar heat gain during hot seasons, and enhance natural ventilation. Design buildings to take advantage of sunlight.	See U.S. Department of Energy, Passive Solar Design (website) http://www.energysavers.gov/your_home/designing_remodeling/index.cfm/mytopic=10250. See also California Energy Commission, Consumer Energy Center, Passive Solar Design (website) http://www.consumerenergycenter.org/home/construction/solardesign/index.html. Lawrence Berkeley National Laboratories' Building Technologies Department is working to develop innovative building construction and design techniques. Information and publications on energy efficient buildings, including lighting, windows, and daylighting strategies, are available at the Department's website at http://btech.lbl.gov.
Install light colored "cool" roofs and cool pavements.	A white or light colored roof can reduce surface temperatures by up to 100 degrees Fahrenheit, which also reduces the heat transferred into the building below. This can reduce the building's cooling costs, save energy and reduce associated greenhouse gas emissions, and extend the life of the roof. Cool roofs can also reduce the temperature of surrounding areas, which can improve local air quality. See California Energy Commission, Consumer Energy Center, Cool Roofs (webpage) at http://www.consumerenergycenter.org/coolroof/. See also Lawrence Berkeley National Laboratories, Heat Island Group (webpage) at http://eetd.lbl.gov/HeatIsland/.
Install efficient lighting, (including LEDs) for traffic, street and other outdoor lighting.	LED lighting is substantially more energy efficient than conventional lighting and can save money. See http://www.energy.ca.gov/efficiency/partnership/case_studies/TechAsstCity.pdf (noting that installing LED traffic signals saved the City of Westlake about $34,000 per year). As of 2005, only about a quarter of California's cities and counties were using 100% LEDs in traffic signals. See California Energy Commission (CEC), Light Emitting Diode Traffic Signal Survey (2005) at p. 15, available at http://www.energy.ca.gov/2005publications/CEC 400 2005 003/CEC 400 2005 003.PDF. The California Energy Commission's Energy Partnership Program can help local governments take advantage of energy saving technology, including, but not limited to, LED traffic signals. See http://www.energy.ca.gov/efficiency/partnership/.
Reduce unnecessary outdoor lighting.	See California Energy Commission, Reduction of Outdoor Lighting (webpage) at http://www.energy.ca.gov/efficiency/lighting/outdoor_reduction.html.

Use automatic covers, efficient pumps and motors, and solar heating for pools and spas.	During the summer, a traditional backyard California pool can use enough energy to power an entire home for three months. Efficiency measures can substantially reduce this waste of energy and money. See California Energy Commission, Consumer Energy Center, Pools and Spas (webpage) at http://www.consumerenergycenter.org/home/outside/pools_spas.html. See also Sacramento Municipal Utilities District, Pool and Spa Efficiency Program (webpage) at http://www.smud.org/en/residential/saving-energy/Pages/poolspa.aspx.
Provide education on energy efficiency to residents, customers and/or tenants.	Many cities and counties provide energy efficiency education. See, for example, the City of Stockton's Energy Efficiency website at http://www.stocktongov.com/energysaving/index.cfm. See also "Green County San Bernardino," http://www.greencountysb.com at pp. 4-6. Businesses and development projects may also provide education. For example, a homeowners' association (HOA) could provide information to residents on energy-efficient mortgages and energy saving measures. See The Villas of Calvera Hills, Easy Energy Saving Tips to Help Save Electricity at http://www.thevillashoa.org/green/energy/. An HOA might also consider providing energy audits to its residents on a regular basis.

Renewable Energy and Energy Storage

Meet "reach" goals for building energy efficiency and renewable energy use.	A "zero net energy" building combines building energy efficiency and renewable energy generation so that, on an annual basis, any purchases of electricity or natural gas are offset by clean, renewable energy generation, either on-site or nearby. Both the California Energy Commission (CEC) and the California Public Utilities Commission (CPUC) have stated that residential buildings should be zero net energy by 2020, and commercial buildings by 2030. See CEC, 2009 Integrated Energy Policy Report (Dec. 2009) at p. 226, available at http://www.energy.ca.gov/2009publications/CEC-100-2009-003/CEC-100-2009-003-CMF.PDF; CPUC, Long Term Energy Efficiency Strategic Plan (Sept. 2008), available at http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/eesp/.
Install solar, wind, and geothermal power systems and solar hot water heaters.	The California Public Utilities Commission (CPUC) approved the California Solar Initiative on January 12, 2006. The initiative creates a $3.3 billion, ten-year program to install solar panels on one million roofs in the State. Visit the one-stop GoSolar website at http://www.gosolarcalifornia.org/. As mitigation, a developer could, for example, agree to participate in the New Solar Homes program. See http://www.gosolarcalifornia.org/builders/index.html. The CPUC is in the process of establishing a program to provide solar water heating incentives under the California Solar Initiative. For more information, visit the CPUC's website at http://www.cpuc.ca.gov/puc/energy/solar/swh.htm. To search for available residential and commercial renewable energy incentives, visit Flex Your Power's website at http://www.fypower.org/.

Install solar panels on unused roof and ground space and over carports and parking areas.	In 2008 Southern California Edison (SCE) launched the nation's largest installation of photovoltaic power generation modules. The utility plans to cover 65 million square feet of unused commercial rooftops with 250 megawatts of solar technology – generating enough energy to meet the needs of approximately 162,000 homes. Learn more about SCE's Solar Rooftop Program at http://www.sce.com/solarleadership/solar-rooftop-program/general-faq.htm. In 2009, Walmart announced its commitment to expand the company's solar power program in California. The company plans to add solar panels on 10 to 20 additional Walmart facilities in the near term. These new systems will be in addition to the 18 solar arrays currently installed at Walmart facilities in California. See http://walmartstores.com/FactsNews/NewsRoom/9091.aspx. Alameda County has installed two solar tracking carports, each generating 250 kilowatts. By 2005, the County had installed eight photovoltaic systems totaling over 2.3 megawatts. The County is able to meet 6 percent of its electricity needs through solar power. See http://www.acgov.org/gsa/Alameda%20County%20-%20Solar%20Case%20Study.pdf. In 2007, California State University, Fresno installed at 1.1-megawatt photovoltaic (PV)-paneled parking installation. The University expects to save more than $13 million in avoided utility costs over the project's 30-year lifespan. http://www.fresnostatenews.com/2007/11/solarwrapup2.htm.
Where solar systems cannot feasibly be incorporated into the project at the outset, build "solar ready" structures.	U.S. Department of Energy, A Homebuilder's Guide to Going Solar (brochure) (2008), available at http://www.eere.energy.gov/solar/pdfs/43076.pdf.
Incorporate wind and solar energy systems into agricultural projects where appropriate.	Wind energy can be a valuable crop for farmers and ranchers. Wind turbines can generate energy to be used on-site, reducing electricity bills, or they can yield lease revenues (as much as $4000 per turbine per year). Wind turbines generally are compatible with rural land uses, since crops can be grown and livestock can be grazed up to the base of the turbine. See National Renewable Energy Laboratory, Wind Powering America Fact Sheet Series, Wind Energy Benefits, available at http://www.nrel.gov/docs/fy05osti/37602.pdf. Solar PV is not just for urban rooftops. For example, the Scott Brothers' dairy in San Jacinto, California, has installed a 55-kilowatt solar array on its commodity barn, with plans to do more in the coming years. See http://www.dairyherd.com/directories.asp?pgID=724&ed_id=8409 (additional California examples are included in article.)

Include energy storage where appropriate to optimize renewable energy generation systems and avoid peak energy use.	See National Renewable Energy Laboratory, Energy Storage Basics (webpage) at http://www.nrel.gov/learning/eds_energy_storage.html. California Energy Storage Alliance (webpage) at http://storagealliance.org/about.html. Storage is not just for large, utility scale projects, but can be part of smaller industrial, commercial and residential projects. For example, Ice Storage Air Conditioning (ISAC) systems, designed for residential and nonresidential buildings, produce ice at night and use it during peak periods for cooling. See California Energy Commission, Staff Report, Ice Storage Air Conditioners, Compliance Options Application (May 2006), available at http://www.energy.ca.gov/2006publications/CEC-400-2006-006/CEC-400-2006-006-SF.PDF.
Use on-site generated biogas, including methane, in appropriate applications.	At the Hilarides Dairy in Lindsay, California, an anaerobic-lagoon digester processes the run-off of nearly 10,000 cows, generating 226,000 cubic feet of biogas per day and enough fuel to run two heavy duty trucks. This has reduced the dairy's diesel consumption by 650 gallons a day, saving the dairy money and improving local air quality. See http://www.arb.ca.gov/newsrel/nr021109b.htm; see also Public Interest Energy Research Program, Dairy Power Production Program, Dairy Methane Digester System, 90-Day Evaluation Report, Eden Vale Dairy (Dec. 2006) at http://www.energy.ca.gov/2006publications/CEC 500 2006 083/CEC 500 2006 083.PDF. Landfill gas is a current and potential source of substantial energy in California. See Tom Frankiewicz, Program Manager, U.S. EPA Landfill Methane Outreach Program, Landfill Gas Energy Potential in California, available at http://www.energy.ca.gov/2009_energypolicy/documents/2009-04-21_workshop/presentations/05-SCS_Engineers_Presentation.pdf. There are many current and emerging technologies for converting landfill methane that would otherwise be released as a greenhouse gas into clean energy. See California Integrated Waste Management Board, Emerging Technologies, Landfill Gas-to-Energy (webpage) at http://www.ciwmb.ca.gov/LEACentral/TechServices/EmergingTech/default.htm.

Use combined heat and power (CHP) in appropriate applications.	Many commercial, industrial, and campus-type facilities (such as hospitals, universities and prisons) use fuel to produce steam and heat for their own operations and processes. Unless captured, much of this heat is wasted. CHP captures waste heat and re-uses it, e.g., for residential or commercial space heating or to generate electricity. See U.S. EPA, Catalog of CHP Technologies at http://www.epa.gov/chp/documents/catalog_of_%20chp_tech_entire.pdf and California Energy Commission, Distributed Energy Resource Guide, Combined Heat and Power (webpage) at http://www.energy.ca.gov/distgen/equipment/chp/chp.html. The average efficiency of fossil-fueled power plants in the United States is 33 percent. By using waste heat recovery technology, CHP systems typically achieve total system efficiencies of 60 to 80 percent. CHP can also substantially reduce emissions of carbon dioxide. http://www.epa.gov/chp/basic/efficiency.html. Currently, CHP in California has a capacity of over 9 million kilowatts. See list of California CHP facilities at http://www.eea-inc.com/chpdata/States/CA.html. The Waste Heat and Carbon Emissions Reduction Act (Assembly Bill 1613 (2007), amended by Assembly Bill 2791 (2008)) is designed to encourage the development of new CHP systems in California with a generating capacity of not more than 20 megawatts. Among other things, the Act requires the California Public Utilities Commission to establish (1) a standard tariff allowing CHP generators to sell electricity for delivery to the grid and (2) a "pay as you save" pilot program requiring electricity corporations to finance the installation of qualifying CHP systems by nonprofit and government entities. For more information, see http://www.energy.ca.gov/wasteheat/.

Water Conservation and Efficiency

Incorporate water-reducing features into building and landscape design.	According to the California Energy Commission, water-related energy use – which includes conveyance, storage, treatment, distribution, wastewater collection, treatment, and discharge – consumes about 19 percent of the State's electricity, 30 percent of its natural gas, and 88 billion gallons of diesel fuel every year. See http://www.energy.ca.gov/2007publications/CEC 999 2007 008/CEC 999 2007 008.PDF. Reducing water use and improving water efficiency can help reduce energy use and greenhouse gas emissions.
Create water-efficient landscapes.	The California Department of Water Resources' updated Model Water Efficient Landscape Ordinance (Sept. 2009) is available at http://www.water.ca.gov/wateruseefficiency/landscapeordinance/technical.cfm. A landscape can be designed from the beginning to use little or no water, and to generate little or no waste. See California Integrated Waste Management Board, Xeriscaping (webpage) at http://www.ciwmb.ca.gov/organics/Xeriscaping/.

Install water-efficient irrigation systems and devices, such as soil moisture-based irrigation controls and use water-efficient irrigation methods.	U.S. Department of Energy, Best Management Practice: Water-Efficient Irrigation (webpage) at http://www1.eere.energy.gov/femp/program/waterefficiency_bmp5.html. California Department of Water Resources, Landscape Water Use Efficiency (webpage) at http://www.water.ca.gov/wateruseefficiency/landscape/. Pacific Institute, More with Less: Agricultural Water Conservation and Efficiency in California (2008), available at http://www.pacinst.org/reports/more_with_less_delta/index.htm.
Make effective use of graywater. (Graywater is untreated household waste water from bathtubs, showers, bathroom wash basins, and water from clothes washing machines. Graywater to be used for landscape irrigation.)	California Building Standards Commission, 2008 California Green Building Standards Code, Section 604, pp. 31-32, available at http://www.documents.dgs.ca.gov/bsc/2009/part11_2008_calgreen_code.pdf. California Department of Water Resources, Dual Plumbing Code (webpage) at http://www.water.ca.gov/recycling/DualPlumbingCode/. See also Ahwahnee Water Principles, Principle 6, at http://www.lgc.org/ahwahnee/h2o_principles.html. The Ahwahnee Water Principles have been adopted by City of Willits, Town of Windsor, Menlo Park, Morgan Hill, Palo Alto, Petaluma, Port Hueneme, Richmond, Rohnert Park, Rolling Hills Estates, San Luis Obispo, Santa Paula, Santa Rosa, City of Sunnyvale, City of Ukiah, Ventura, Marin County, Marin Municipal Water District, and Ventura County.
Implement low-impact development practices that maintain the existing hydrology of the site to manage storm water and protect the environment.	Retaining storm water runoff on-site can drastically reduce the need for energy-intensive imported water at the site. See U.S. EPA, Low Impact Development (webpage) at http://www.epa.gov/nps/lid/. Office of Environmental Health Hazard Assessment and the California Water and Land Use Partnership, Low Impact Development at http://www.coastal.ca.gov/nps/lid-factsheet.pdf.
Devise a comprehensive water conservation strategy appropriate for the project and location.	The strategy may include many of the specific items listed above, plus other innovative measures that are appropriate to the specific project.
Design buildings to be water-efficient. Install water-efficient fixtures and appliances.	Department of General Services, Best Practices Manual, Water-Efficient Fixtures and Appliances (website) at http://www.green.ca.gov/EPP/building/SaveH2O.htm. Many ENERGY STAR products have achieved their certification because of water efficiency. See California Energy Commission's database, available at http://www.appliances.energy.ca.gov/.

Offset water demand from new projects so that there is no net increase in water use.	For example, the City of Lompoc has a policy requiring new development to offset new water demand with savings from existing water users. See http://www.cityoflompoc.com/utilities/pdf/2005_uwmp_final.pdf at p. 29.
Provide education about water conservation and available programs and incentives.	See, for example, the City of Santa Cruz, Water Conservation Office at http://www.ci.santa-cruz.ca.us/index.aspx?page=395; Santa Clara Valley Water District, Water Conservation at http://www.valleywater.org/conservation/index.shtm; and Metropolitan Water District and the Family of Southern California Water Agencies, Be Water Wise at http://www.bewaterwise.com. Private projects may provide or fund similar education.

Solid Waste Measures

Reuse and recycle construction and demolition waste (including, but not limited to, soil, vegetation, concrete, lumber, metal, and cardboard).	Construction and demolition materials account for almost 22 percent of the waste stream in California. Reusing and recycling these materials not only conserves natural resources and energy, but can also save money. For a list of best practices and other resources, see California Integrated Waste Management Board, Construction and Demolition Debris Recycling (webpage) at http://www.ciwmb.ca.gov/condemo/.
Integrate reuse and recycling into residential industrial, institutional and commercial projects.	Tips on developing a successful recycling program, and opportunities for cost-effective recycling, are available on the California Integrated Waste Management Board's Zero Waste California website. See http://zerowaste.ca.gov/. The Institute for Local Government's Waste Reduction & Recycling webpage contains examples of "best practices" for reducing greenhouse gas emissions, organized around waste reduction and recycling goals and additional examples and resources. See http://www.ca-ilg.org/wastereduction.
Provide easy and convenient recycling opportunities for residents, the public, and tenant businesses.	Tips on developing a successful recycling program, and opportunities for cost effective recycling, are available on the California Integrated Waste Management Board's Zero Waste California website. See http://zerowaste.ca.gov/.
Provide education and publicity about reducing waste and available recycling services.	Many cities and counties provide information on waste reduction and recycling. See, for example, the Butte County Guide to Recycling at http://www.recyclebutte.net. The California Integrated Waste Management Board's website contains numerous publications on recycling and waste reduction that may be helpful in devising an education project. See http://www.ciwmb.ca.gov/Publications/default.asp?cat=13. Private projects may also provide waste and recycling education directly, or fund education.

Land Use Measures

Ensure consistency with "smart growth" principles – mixed-use, infill, and higher density projects that provide alternatives to individual vehicle travel and promote the efficient delivery of services and goods.	U.S. EPA maintains an extensive Smart Growth webpage with links to examples, literature and technical assistance, and financial resources. See http://www.epa.gov/smartgrowth/index.htm. The National Oceanic and Atmospheric Administration's webpage provides smart growth recommendations for communities located near water. See Coastal & Waterfront Smart Growth (webpage) at http://coastalsmartgrowth.noaa.gov/. The webpage includes case studies from California. The California Energy Commission has recognized the important role that land use can play in meeting our greenhouse gas and energy efficiency goals. The agency's website, Smart Growth & Land Use Planning, contains useful information and links to relevant studies, reports, and other resources. See http://www.energy.ca.gov/landuse/. The Metropolitan Transportation Commission's webpage, Smart Growth / Transportation for Livable Communities, includes resources that may be useful to communities in the San Francisco Bay Area and beyond. See http://www.mtc.ca.gov/planning/smart_growth/. The Sacramento Area Council of Governments (SACOG) has published examples of smart growth in action in its region. See Examples from the Sacramento Region of the Seven Principles of Smart Growth / Better Ways to Grow, available at http://www.sacog.org/regionalfunding/betterways.pdf.
Meet recognized "smart growth" benchmarks.	For example, the LEED for Neighborhood Development (LEED-ND) rating system integrates the principles of smart growth, urbanism and green building into the first national system for neighborhood design. LEED-ND is a collaboration among the U.S. Green Building Council, Congress for the New Urbanism, and the Natural Resources Defense Council. For more information, see http://www.usgbc.org/DisplayPage.aspx?CMSPageID=148.
Educate the public about the many benefits of well-designed, higher density development.	See, for example, U.S. EPA, Growing Smarter, Living Healthier: A Guide to Smart Growth and Active Aging (webpage), discussing how compact, walkable communities can provide benefits to seniors. See http://www.epa.gov/aging/bhc/guide/index.html. U.S. EPA, Environmental Benefits of Smart Growth (webpage) at http://www.epa.gov/dced/topics/eb.htm (noting local air and water quality improvements). Centers for Disease Control and Prevention (CDC), Designing and Building Healthy Places (webpage), at http://www.cdc.gov/healthyplaces/. The CDC's website discusses the links between walkable communities and public health and includes numerous links to educational materials. California Department of Housing and Community Development, Myths and Facts About Affordable and High Density Housing (2002), available at http://www.hcd.ca.gov/hpd/mythsnfacts.pdf.

Incorporate public transit into the project's design.	Federal Transit Administration, Transit-Oriented Development (TOD) (webpage) at http://www.fta.dot.gov/planning/planning_environment_6932.html (describing the benefits of TOD as "social, environmental, and fiscal.") California Department of Transportation (Caltrans), Statewide Transit-Oriented Development Study: Factors for Success in California (2002), available at http://transitorienteddevelopment.dot.ca.gov/miscellaneous/StatewideTOD.htm Caltrans, California Transit-Oriented Development Searchable Database (includes detailed information on numerous TODs), available at http://transitorienteddevelopment.dot.ca.gov/miscellaneous/NewHome.jsp. California Department of Housing and Community Development, Transit Oriented Development (TOD) Resources (Aug. 2009), available at http://www.hcd.ca.gov/hpd/tod.pdf.
Preserve and create open space and parks. Preserve existing trees, and plant replacement trees at a set ratio.	U.S. EPA, Smart Growth and Open Space Conservation (webpage) at http://www.epa.gov/dced/openspace.htm.
Develop "brownfields" and other underused or defunct properties near existing public transportation and jobs.	U.S. EPA, Smart Growth and Brownfields (webpage) at http://www.epa.gov/dced/brownfields.htm. For example, as set forth in the Local Government Commission's case study, the Town of Hercules, California reclaimed a 426-acre brownfield site, transforming it into a transit-friendly, walkable neighborhood. See http://www.lgc.org/freepub/docs/community_design/fact_sheets/er_case_studies.pdf. For financial resources that can assist in brownfield development, see Center for Creative Land Recycling, Financial Resources for California Brownfields (July 2008), available at http://www.cclr.org/media/publications/8-Financial_Resources_2008.pdf.
Include pedestrian and bicycle facilities within projects and ensure that existing non-motorized routes are maintained and enhanced.	See U.S. Department of Transportation, Federal Highway Administration, Bicycle and Pedestrian Program (webpage) at http://www.fhwa.dot.gov/environment/bikeped/. Caltrans, Pedestrian and Bicycle Facilities in California / A Technical Reference and Technology Transfer Synthesis for Caltrans Planners and Engineers (July 2005), available at http://www.dot.ca.gov/hq/traffops/survey/pedestrian/TR_MAY0405.pdf. This reference includes standard and innovative practices for pedestrian facilities and traffic calming.

Transportation and Motor Vehicles

Meet an identified transportation-related benchmark.	A logical benchmark might be related to vehicles miles traveled (VMT), e.g., average VMT per capita, per household, or per employee. As the California Energy Commission has noted, VMT by California residents increased "a rate of more than 3 percent a year between 1975 and 2004, markedly faster than the population growth rate over the same period, which was less than 2 percent. This increase in VMT correlates to an increase in petroleum use and GHG production and has led to the transportation sector being responsible for 41 percent of the state's GHG emissions in 2004." CEC, The Role of Land Use in Meeting California's Energy and Climate Change Goals (Aug. 2007) at p. 9, available at http://www.energy.ca.gov/2007publications/CEC-600-2007-008/CEC-600-2007-008-SF.PDF. Even with regulations designed to increase vehicle efficiency and lower the carbon content of fuel, "reduced VMT growth will be required to meet GHG reductions goals." *Id.* at p. 18.
Adopt a comprehensive parking policy that discourages private vehicle use and encourages the use of alternative transportation.	For example, reduce parking for private vehicles while increasing options for alternative transportation; eliminate minimum parking requirements for new buildings; "unbundle" parking (require that parking is paid for separately and is not included in rent for residential or commercial space); and set appropriate pricing for parking. See U.S. EPA, Parking Spaces / Community Places, Finding the Balance Through Smart Growth Solutions (Jan. 2006), available at http://www.epa.gov/dced/pdf/EPAParkingSpaces06.pdf. Reforming Parking Policies to Support Smart Growth, Metropolitan Transportation Commission (June 2007) at http://www.mtc.ca.gov/planning/smart_growth/parking_seminar/Toolbox Handbook.pdf. See also the City of Ventura's Downtown Parking and Mobility Plan, available at http://www.cityofventura.net/community_development/resources/mobility_parking_plan.pdf, and Ventura's Downtown Parking Management Program, available at http://www.ci.ventura.ca.us/depts/comm_dev/downtownplan/chapters.asp.
Build or fund a major transit stop within or near the development.	"'Major transit stop' means a site containing an existing rail transit station, a ferry terminal served by either a bus or rail transit service, or the intersection of two or more major bus routes with a frequency of service interval of 15 minutes or less during the morning and afternoon peak commute periods." (Pub. Res. Code, § 21064.3.) Transit Oriented Development (TOD) is a moderate to higher density development located within an easy walk of a major transit stop. http://transitorienteddevelopment.dot.ca.gov/miscellaneous/NewWhatisTOD.htm. By building or funding a major transit stop, an otherwise ordinary development can become a TOD.

Provide public transit incentives such as free or low-cost monthly transit passes to employees, or free ride areas to residents and customers.	See U.S. Department of Transportation and U.S. EPA, Commuter Choice Primer / An Employer's Guide to Implementing Effective Commuter Choice Programs, available at http://www.its.dot.gov/JPODOCS/REPTS_PR/13669.html. The Emery Go Round shuttle is a private transportation service funded by commercial property owners in the citywide transportation business improvement district. The shuttle links a local shopping district to a Bay Area Rapid Transit stop. See http://www.emerygoround.com/. Seattle, Washington maintains a public transportation "ride free" zone in its downtown from 6:00 a.m. to 7:00 p.m. daily. See http://transit.metrokc.gov/tops/accessible/paccessible_map.html#fare.
Promote "least polluting" ways to connect people and goods to their destinations.	Promoting "least polluting" methods of moving people and goods is part of a larger, integrated "sustainable streets" strategy now being explored at U.C. Davis's Sustainable Transportation Center. Resources and links are available at the Center's website, http://stc.ucdavis.edu/outreach/ssp.php.
Incorporate bicycle lanes, routes and facilities into street systems, new subdivisions, and large developments.	Bicycling can have a profound impact on transportation choices and air pollution reduction. The City of Davis has the highest rate of bicycling in the nation. Among its 64,000 residents, 17 percent travel to work by bicycle and 41 percent consider the bicycle their primary mode of transportation. See Air Resources Board, Bicycle Awareness Program, Bicycle Fact Sheet, available at http://www.arb.ca.gov/planning/tsaq/bicycle/factsht.htm. For recommendations on best practices, see the many resources listed at the U.S. Department of Transportation, Federal Highway Administration's Bicycle and Pedestrian website at http://www.fhwa.dot.gov/environment/bikeped/publications.htm. See also Caltrans Division of Research and Innovation, Designing Highway Facilities To Encourage Walking, Biking and Transit (Preliminary Investigation) (March 2009), available at http://www.dot.ca.gov/research/researchreports/preliminary_investigations/docs/pi-design_for_walking_%20biking_and_transit%20final.pdf.
Require amenities for non-motorized transportation, such as secure and convenient bicycle parking.	According to local and national surveys of potential bicycle commuters, secure bicycle parking and workplace changing facilities are important complements to safe and convenient routes of travel. See Air Resources Board, Bicycle Awareness Program, Bicycle Fact Sheet, available at http://www.arb.ca.gov/planning/tsaq/bicycle/factsht.htm.

Ensure that the project enhances, and does not disrupt or create barriers to, non-motorized transportation.	See, e.g., U.S. EPA's list of transit-related "smart growth" publications at http://www.epa.gov/dced/publications.htm#air, including Pedestrian and Transit-Friendly Design: A Primer for Smart Growth (1999), available at www.epa.gov/dced/pdf/ptfd_primer.pdf. See also Toolkit for Improving Walkability in Alameda County, available at http://www.acta2002.com/ped toolkit/ped_toolkit_print.pdf. Pursuant to the California Complete Streets Act of 2008 (AB 1358, Gov. Code, §§ 65040.2 and 65302), commencing January 1, 2011, upon any substantive revision of the circulation element of the general plan, a city or county will be required to modify the circulation element to plan for a balanced, multimodal transportation network that meets the needs of all users.
Connect parks and open space through shared pedestrian/bike paths and trails to encourage walking and bicycling. Create bicycle lanes and walking paths directed to the location of schools, parks and other destination points.	Walk Score ranks the "walkability" of neighborhoods in the largest 40 U.S. cities, including seven California cities. Scores are based on the distance to nearby amenities. Explore Walk Score at http://www.walkscore.com/. In many markets, homes in walkable neighborhoods are worth more than similar properties where walking is more difficult. See Hoak, *Walk appeal / Homes in walkable neighborhoods sell for more: study*, Wall Street Journal (Aug. 18, 2009), available at http://www.marketwatch.com/story/homes-in-walkable-neighborhoods-sell-for-more-2009-08-18. By creating walkable neighborhoods with more transportation choices, Californians could save $31 million and cut greenhouse gas emissions by 34 percent, according to a study released by Transform, a coalition of unions and nonprofits. See Windfall for All / How Connected, Convenient Neighborhoods Can Protect Our Climate and Safeguard California's Economy (Nov. 2009), available at http://transformca.org/windfall-for-all#download-report.
Work with the school districts to improve pedestrian and bike access to schools and to restore or expand school bus service using lower-emitting vehicles.	In some communities, twenty to twenty-five percent of morning traffic is due to parents driving their children to school. Increased traffic congestion around schools in turn prompts even more parents to drive their children to school. Programs to create safe routes to schools can break this harmful cycle. See California Department of Public Health, Safe Routes to School (webpage) and associated links at http://www.cdph.ca.gov/HealthInfo/injviosaf/Pages/SafeRoutestoSchool.aspx. See also U.S. EPA, Smart Growth and Schools (webpage), available at http://www.epa.gov/dced/schools.htm. California Center for Physical Activity, California Walk to School (website) at http://www.cawalktoschool.com Regular school bus service (using lower-emitting buses) for children who cannot bike or walk to school could substantially reduce private vehicle congestion and air pollution around schools. See Air Resources Board, Lower Emissions School Bus Program (webpage) at http://www.arb.ca.gov/msprog/schoolbus/schoolbus.htm.

Institute teleconferencing, telecommute and/or flexible work hour programs to reduce unnecessary employee transportation.	There are numerous sites on the web with resources for employers seeking to establish telework or flexible work programs. These include U.S. EPA's Mobility Management Strategies: Commuter Programs website at http://www.epa.gov/otaq/stateresources/rellinks/mms_commprograms.htm; and Telework, the federal government's telework website, at http://www.telework.gov/. Through a continuing FlexWork Implementation Program, the Traffic Solutions division of the Santa Barbara County Association of Governments sponsors flexwork consulting, training and implementation services to a limited number of Santa Barbara County organizations that want to create or expand flexwork programs for the benefit of their organizations, employees and the community. See http://www.flexworksb.com/read_more_about_the_fSBp.html. Other local government entities provide similar services.
Provide information on alternative transportation options for consumers, residents, tenants and employees to reduce transportation-related emissions.	Many types of projects may provide opportunities for delivering more tailored transportation information. For example, a homeowner's association could provide information on its website, or an employer might create a Transportation Coordinator position as part of a larger Employee Commute Reduction Program. See, e.g., South Coast Air Quality Management District, Transportation Coordinator training, at http://www.aqmd.gov/trans/traing.html.
Educate consumers, residents, tenants and the public about options for reducing motor vehicle-related greenhouse gas emissions. Include information on trip reduction; trip linking; vehicle performance and efficiency (e.g., keeping tires inflated); and low or zero-emission vehicles.	See, for example U.S. EPA, SmartWay Transport Partnership: Innovative Carrier Strategies (webpage) at http://www.epa.gov/smartway/transport/what-smartway/carrier-strategies.htm. This webpage includes recommendations for actions that truck and rail fleets can take to make ground freight more efficient and cleaner. The Air Resources Board's Drive Clean website is a resource for car buyers to find clean and efficient vehicles. The web site is designed to educate Californians that pollution levels range greatly between vehicles. See http://www.driveclean.ca.gov/. The Oregon Department of Transportation and other public and private partners launched the Drive Less/Save More campaign. The comprehensive website contains fact sheets and educational materials to help people drive more efficiently. See http://www.drivelesssavemore.com/.
Purchase, or create incentives for purchasing, low or zero-emission vehicles.	See Air Resources Board, Low-Emission Vehicle Program (webpage) at http://www.arb.ca.gov/msprog/levprog/levprog.htm. Air Resource Board, Zero Emission Vehicle Program (webpage) at http://www.arb.ca.gov/msprog/zevprog/zevprog.htm. All new cars sold in California are now required to display an Environmental Performance (EP) Label, which scores a vehicle's global warming and smog emissions from 1 (dirtiest) to 10 (cleanest). To search and compare vehicle EP Labels, visit www.DriveClean.ca.gov.

Create a ride sharing program. Promote existing ride sharing programs e.g., by designating a certain percentage of parking spaces for ride sharing vehicles, designating adequate passenger loading and unloading for ride sharing vehicles, and providing a web site or message board for coordinating rides.	For example, the 511 Regional Rideshare Program is operated by the Metropolitan Transportation Commission (MTC) and is funded by grants from the Federal Highway Administration, U.S. Department of Transportation, the Metropolitan Transportation Commission, the Bay Area Air Quality Management District and county congestion management agencies. For more information, see http://rideshare.511.org/. As another example, San Bernardino Associated Governments works directly with large and small employers, as well as providing support to commuters who wish to share rides or use alternative forms of transportation. See http://www.sanbag.ca.gov/commuter/rideshare.html. Valleyrides.com is a ridesharing resource available to anyone commuting to and from Fresno and Tulare Counties and surrounding communities. See http://www.valleyrides.com/. There are many other similar websites throughout the state.
Create or accommodate car sharing programs, e.g., provide parking spaces for car share vehicles at convenient locations accessible by public transportation.	There are many existing car sharing companies in California. These include City CarShare (San Francisco Bay Area), see http://www.citycarshare.org/; and Zipcar, see http://www.zipcar.com/. Car sharing programs are being successfully used on many California campuses.
Provide a vanpool for employees.	Many local Transportation Management Agencies can assist in forming vanpools. See, for example, Sacramento Transportation Management Association, Check out Vanpooling (webpage) at http://www.sacramento-tma.org/vanpool.html.
Create local "light vehicle" networks, such as neighborhood electric vehicle systems.	See California Energy Commission, Consumer Energy Center, Urban Options - Neighborhood Electric Vehicles (NEVs) (webpage) at http://www.consumerenergycenter.org/transportation/urban_options/nev.html. The City of Lincoln has an innovative NEV program. See http://www.lincolnev.com/index.html.
Enforce and follow limits idling time for commercial vehicles, including delivery and construction vehicles.	Under existing law, diesel-fueled motor vehicles with a gross vehicle weight rating greater than 10,000 pounds are prohibited from idling for more than 5 minutes at any location. The minimum penalty for an idling violation is now $300 per violation. See http://www.arb.ca.gov/enf/complaints/idling_cv.htm.
Provide the necessary facilities and infrastructure to encourage the use of low or zero-emission vehicles.	For a list of existing alternative fuel stations in California, visit http://www.cleancarmaps.com/. See, e.g., Baker, *Charging-station network built along 101*, S.F. Chron. (9/23/09), available at http://articles.sfgate.com/2009-09-23/news/17207424_1_recharging-solar-array-tesla-motors.

Agriculture and Forestry (additional strategies noted above)

Require best management practices in agriculture and animal operations to reduce emissions, conserve energy and water, and utilize alternative energy sources, including biogas, wind and solar.	Air Resources Board (ARB), Economic Sectors Portal, Agriculture (webpage) at http://www.arb.ca.gov/cc/ghgsectors/ghgsectors.htm. ARB's webpage includes information on emissions from manure management, nitrogen fertilizer, agricultural offroad equipment, and agricultural engines. "A full 90% of an agricultural business' electricity bill is likely associated with water use. In addition, the 8 million acres in California devoted to crops consume 80% of the total water pumped in the state." See Flex Your Power, Agricultural Sector (webpage) at http://www.fypower.org/agri/. Flex Your Power, Best Practice Guide / Food and Beverage Growers and Processors, available at http://www.fypower.org/bpg/index.html?b=food_and_bev. Antle et al., Pew Center on Global Climate Change, Agriculture's Role in Greenhouse Gas Mitigation (2006), available at http://www.pewclimate.org/docUploads/Agriculture's%20Role%20in%20GHG%20Mitigation.pdf.
Preserve forested areas, agricultural lands, wildlife habitat and corridors, wetlands, watersheds, groundwater recharge areas and other open space that provide carbon sequestration benefits.	"There are three general means by which agricultural and forestry practices can reduce greenhouse gases: (1) avoiding emissions by maintaining existing carbon storage in trees and soils; (2) increasing carbon storage by, e.g., tree planting, conversion from conventional to conservation tillage practices on agricultural lands; (3) substituting bio-based fuels and products for fossil fuels, such as coal and oil, and energy-intensive products that generate greater quantities of CO2 when used." U.S. EPA, Carbon Sequestration in Agriculture and Forestry, Frequently Asked Questions (webpage) at http://www.epa.gov/sequestration/faq.html. Air Resources Board, Economic Sectors Portal, Forestry (webpage) at http://www.arb.ca.gov/cc/ghgsectors/ghgsectors.htm.
Protect existing trees and encourage the planting of new trees. Adopt a tree protection and replacement ordinance.	Tree preservation and planting is not just for rural areas of the state; suburban and urban forests can also serve as carbon sinks. See Cal Fire, Urban and Community Forestry (webpage) at http://www.fire.ca.gov/resource_mgt/resource_mgt_urbanforestry.php.

Off-Site Mitigation

If, after analyzing and requiring all reasonable and feasible on-site mitigation measures for avoiding or reducing greenhouse gas-related impacts, the lead agency determines that additional mitigation is required, the agency may consider additional off-site mitigation. The project proponent could, for example, fund off-site mitigation projects that will reduce carbon emissions, conduct an audit of its other existing operations and agree to retrofit, or purchase verifiable carbon "credits" from another entity that will undertake mitigation.

The topic of off-site mitigation can be complicated. A full discussion is outside the scope of this summary document. Issues that the lead agency should consider include:

- The location of the off-site mitigation. (If the off-site mitigation is far from the project, any additional, non-climate related co-benefits of the mitigation may be lost to the local community.)

- Whether the emissions reductions from off-site mitigation can be quantified and verified. (The California Registry has developed a number of protocols for calculating, reporting and verifying greenhouse gas emissions. Currently, industry-specific protocols are available for the cement sector, power/utility sector, forest sector and local government operations. For more information, visit the California Registry's website at http://www.climateregistry.org/.)

- Whether the mitigation ratio should be greater than 1:1 to reflect any uncertainty about the effectiveness of the off-site mitigation.

Offsite mitigation measures that could be funded through mitigation fees include, but are not limited to, the following:

- Energy efficiency audits of existing buildings.

- Energy efficiency upgrades to existing buildings not otherwise required by law, including heating, ventilation, air conditioning, lighting, water heating equipment, insulation and weatherization (perhaps targeted to specific communities, such as low-income or senior residents).

- Programs to encourage the purchase and use of energy efficient vehicles, appliances, equipment and lighting.

- Programs that create incentives to replace or retire polluting vehicles and engines.

- Programs to expand the use of renewable energy and energy storage.

- Preservation and/or enhancement of existing natural areas (e.g., forested areas, agricultural lands, wildlife habitat and corridors, wetlands, watersheds, and groundwater recharge areas) that provide carbon sequestration benefits.

- Improvement and expansion of public transit and low- and zero-carbon transportation alternatives.

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CEQA & Climate Change

Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act

January 2008

Disclaimer

The California Air Pollution Control Officers Association (CAPCOA) has prepared this white paper consideration of evaluating and addressing greenhouse gas emissions under the California Environmental Quality Act (CEQA) to provide a common platform of information and tools to support local governments.

This paper is intended as a resource, not a guidance document. It is not intended, and should not be interpreted, to dictate the manner in which an air district or lead agency chooses to address greenhouse gas emissions in the context of its review of projects under CEQA.

This paper has been prepared at a time when California law has been recently amended by the Global Warming Solutions Act of 2006 (AB 32), and the full programmatic implications of this new law are not yet fully understood. There is also pending litigation in various state and federal courts pertaining to the issue of greenhouse gas emissions. Further, there is active federal legislation on the subject of climate change, and international agreements are being negotiated. Many legal and policy questions remain unsettled, including the requirements of CEQA in the context of greenhouse gas emissions. This paper is provided as a resource for local policy and decision makers to enable them to make the best decisions they can in the face of incomplete information during a period of change.

Finally, this white paper reviews requirements and discusses policy options, but it is not intended to provide legal advice and should not be construed as such. Questions of legal interpretation, particularly in the context of CEQA and other laws, or requests for advice should be directed to the agency's legal counsel.

Acknowledgements

This white paper benefited from the hard work and creative insights of many people. CAPCOA appreciates the efforts of all who contributed their time and energy to the project. In particular, the Association thanks the following individuals:

Principal Authors

Greg Tholen, BAAQMD
Dave Vintze, BAAQMD
Jean Getchell, MBUAPCD
Matt Jones, YSAQMD
Larry Robinson, SMAQMD
Ron Tan, SBCAPCD

Editor

Barbara Lee, NSAPCD

Reviewers

CAPCOA Climate Protection Committee

Barbara Lee (NSCAPCD), Chair

Larry Allen, SLOCPCD
Bobbie Bratz, SBAPCD
Karen Brooks, SLOCAPCD
Chris Brown, MCAQMD
Tom Christofk, PCAPCD
Jorge DeGuzman, SMAQMD
Mat Ehrhardt, YSAQMD
Jean Getchell, MBUAPCD
Larry Greene, SMAQMD
Henry Hilken, BAAQMD
Alan Hobbs, PCAPCD
Jim Jester, SMAQMD
Dave Jones, KCAPCD
Tom Jordan, SJVUAPCD
Tom Murphy, SBAPCD
Don Price, VCAPCD
Jean Roggenkamp, BAAQMD
Ana Sandoval, BAAQMD
Amy Taketomo, MBUAPCD
Tim Taylor, SMAQMD
Mike Villegas, VCAPCD
David Vintze, BAAQMD
Dave Warner, SJVUAPCD
Jill Whynot, SCAQMD
John Yu, CAPCOA
Mel Zeldin, CAPCOA

CAPCOA Planning Managers:
CEQA & Climate Change Subcommittee

Dave Vintze (BAAQMD), Chair
Greg Tholen (BAAQMD), Project Manager

Charles Anderson, SMAQMD
Aeron Arlin Genet, SLOCAPCD
Jean Getchell, MBUAPCD
Melissa Guise, SLOCAPCD
Matt Jones, YSAQMD
Barbara Lee, NSCAPCD
Ryan Murano, NSAQMD
Tom Murphy, SBCAPCD
Susan Nakamura, SCAQMD
Larry Robinson, SMAQMD
Jean Roggenkamp, BAAQMD
Ana Sandoval, BAAQMD
Ron Tan, SBCAPCD
Brigette Tollstrup, SMAQMD
Jill Whynot, SCAQMD

External Reviewers

James Goldstene, CARB
Annmarie Mora, CARB
Terri Roberts, OPR

Proofing & Layout

Jake Toolson, CAPCOA
John Yu, CAPCOA

Contract Support

Jones & Stokes, Sacramento, CA *(analysis of non-zero threshold approaches)*
EDAW, Inc., Sacramento, CA *(review of analytical methods and mitigation strategies)*.

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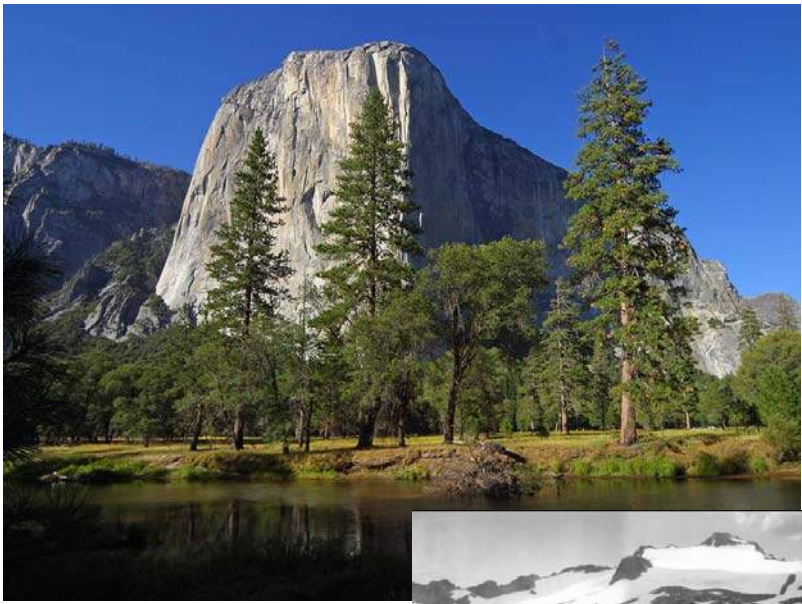
Acronym/ Abbreviation	Meaning
AB 32	Assembly Bill 32 Global Warming Solutions Act of 2006
AG	Attorney General
ARB	Air Resources Board
ASTM	American Society of Testing and Material
BAAQMD	Bay Area Air Quality Management District
BAU	Business as Usual
BEES	Building for Environmental and Economic Sustainability
Calfire	California Fire
Caltrans	California Department of Transportation
CAP	Criteria Air Pollutants
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resource Board
CAT	Climate Action Team
CCAP	Center for Clean Air Policy
CCAR	California Climate Action Registry
CDFA	California Department of Food and Agriculture
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CF	Connectivity Factor
CH_4	Methane
CIWMB	California Integrated Waste Management Board
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CNG	Compressed Natural Gas
CPUC	California Public Utilities Commission
CUFR	California Urban Forestry
DGS	Department of General Services
DOE	U.S. Department of Energy
DOF	Department of Finance
DPF	Diesel Particulate Filter
DWR	Department of Water Resources
E85	85% Ethanol
EEA	Massachusetts Executive Office of Energy and Environmental Affairs
EERE	Energy Efficiency and Renewable Energy
EIR	Environmental Impact Report
EOE	Encyclopedia of Earth
EPA	U.S. Environmental Protection Agency
ETC	Edmonton Trolley Coalition
EV	Electric Vehicles
FAR	Floor Area Ratio

GHG	Greenhouse Gas
GGEP	Greenhouse Gas Emissions Policy
GGRP	Greenhouse Gas Reduction Plan
GP	General Plan
GWP	Global Warming Potential
IGCC	Integrated Gasification Combined Cycle
IOU	Investor Owned Utility
IPCC	International Panel on Climate Change
IT	Information Technology
ITE	Institute of Transportation Engineers
J&S	Jones & Stokes
km	Kilometer
LandGem	Landfill Gas Emissions Model
LEED	Leadership in Energy and Environmental Design
LNG	Liquefied Natural Gas
MBUAPCD	Monterey Bay Unified Air Pollution Control District
MEPA	Massachusetts Environmental Policy Act
MND	Mitigated Negative Declaration
MMT CO_2e	Million Metric Tons Carbon Dioxide Equivalent
MW	Megawatts
N_2O	Nitrous Oxide
NACAA	National Association Clean Air Agencies
ND	Negative Declaration
NEV	Neighborhood Electric Vehicle
NIST	National Institute of Standards and Technology
NO_X	Oxides of Nitrogen
NREL	National Renewable Energy Laboratory
NSCAPCD	Northern Sonoma County Air Pollution Control District
NSR	New Source Review
OPR	State Office of Planning and Research
PFC	Perfluorocarbon
PG&E	Pacific Gas & Electric
POU	Publicly Owned Utility
PM	Particulate Mater
RoadMod	Road Construction Emissions Model
ROG	Reactive Organic Gas
RPS	Renewable Portfolio Standards
RTP	Regional Transportation Plan
S-3-05	Executive Order S-3-05
SB	Senate Bill
SBCAPCD	Santa Barbara County Air Pollution Control District
SCAQMD	South Coast Air Quality Management District
SCM	Sustainable Communities Model
SIP	State Implementation Plan
SJVAPCD	San Joaquin Valley Unified Air Pollution Control District
SLOCAPCD	San Luis Obispo County Air Pollution Control District

SMAQMD	Sacramento Metropolitan Air Quality Management District
SMUD	Sacramento Municipal Utilities District
SO_X	Sulfur Oxides
SP	Service Population
SRI	Solar Reflectance Index
SWP	State Water Project
TAC	Toxic Air Contaminants
TBD	To Be Determined
TDM	Transportation Demand Management
TMA	Transportation Management Association
THC	Total Hydrocarbon
UC	University of California
ULEV	Ultra Low Emission Vehicle
UNFCCC	United Nations Framework Convention on Climate Change
URBEMIS	Urban Emissions Model
USGBC	U.S. Green Building Council
VMT	Vehicle Miles Traveled
VTPI	Victoria Transit Policy
YSAQMD	Yolo-Solano Air Quality Management District

Introduction

The California Environmental Quality Act (CEQA) requires that public agencies refrain from approving projects with significant adverse environmental impacts if there are feasible alternatives or mitigation measures that can substantially reduce or avoid those impacts. There is growing concern about greenhouse gas emissions[1] (GHG) and recognition of their significant adverse impacts on the world's climate and on our environment. In its most recent reports, the International Panel on Climate Change (IPCC) has called the evidence for this "unequivocal." In California, the passage of the Global Warming Solutions Act of 2006 (AB 32) recognizes the serious threat to the "economic well-being, public health, natural resources, and the environment of California" resulting from global warming. In light of our current understanding of these impacts, public agencies approving projects subject to the CEQA are facing increasing pressure to identify and address potential significant impacts due to GHG emissions. Entities acting as lead agencies in the CEQA process are looking for guidance on how to adequately address the potential climate change impacts in meeting their CEQA obligations.



Air districts have traditionally provided guidance to local lead agencies on evaluating and addressing air pollution impacts from projects subject to CEQA. Recognizing the need for a common platform of information and tools to support decision makers as they establish policies and programs for GHG and CEQA, the California Air Pollution Control Officers Association has prepared a white paper reviewing policy choices, analytical tools, and mitigation strategies.

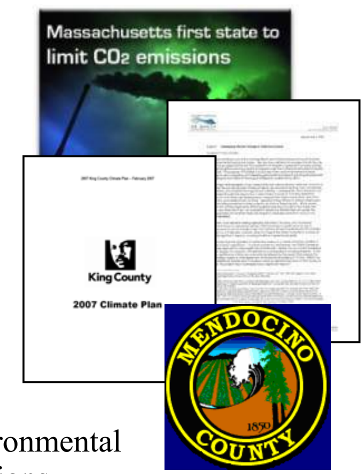
This paper is intended to serve as a resource for public agencies as they establish agency procedures for reviewing GHG emissions from projects under CEQA. It considers the application of thresholds and offers three alternative programmatic approaches toward

[1] Throughout this paper GHG, CO_2, CO_2e, are used interchangeably and refer generally to greenhouse gases but do not necessarily include all greenhouse gases unless otherwise specified.

determining whether GHG emissions are significant. The paper also evaluates tools and methodologies for estimating impacts, and summarizes mitigation measures. It has been prepared with the understanding that the programs, regulations, policies, and procedures established by the California Air Resources Board (CARB) and other agencies to reduce GHG emissions may ultimately result in a different approach under CEQA than the strategies considered here. The paper is intended to provide a common platform for public agencies to ensure that GHG emissions are appropriately considered and addressed under CEQA while those programs are being developed.

Examples of Other Approaches

Many states, counties, and cities have developed policies and regulations concerning greenhouse gas emissions that seek to require or promote reductions in GHG emissions through standards for vehicle emissions, fuels, electricity production/renewables, building efficiency, and other means. A few have developed guidance and are currently considering formally requiring or recommending the analysis of greenhouse gas emissions for development projects during their associated environmental processes. Key work in this area includes:



- Massachusetts Office of Energy and Environmental Affairs Greenhouse Gas Emissions Policy;
- King County, Washington, Executive Order on the Evaluation of Climate Change Impacts through the State Environmental Policy Act;
- Sacramento AQMD interim policy on addressing climate change in CEQA documents; and
- Mendocino AQMD updated guidelines for use during preparation of air quality impacts in Environmental Impact Reports (EIRs) or mitigated negative declarations.

The following paper evaluates options for lead agencies to ensure that GHG emissions are appropriately addressed as part of analyses under CEQA. It considers the use of significance thresholds, tools and methodologies for analyzing GHG emissions, and measures and strategies to avoid, reduce, or mitigate impacts.

Greenhouse Gas Significance Criteria

This white paper discusses three basic options air districts and lead agencies can pursue when contemplating the issues of CEQA thresholds for greenhouse gas emissions. This paper explores each path and discusses the benefits and disbenefits of each. The three basic paths are:

- No significance threshold for GHG emissions;

- GHG emissions threshold set at zero; or

- GHG threshold set at a non-zero level.

Each has inherent advantages and disadvantages. Air districts and lead agencies may believe the state or national government should take the lead in identifying significance thresholds to address this global impact. Alternatively, the agency may believe it is premature or speculative to determine a clear level at which a threshold should be set. On the other hand, air districts or lead agencies may believe that every GHG emission should be scrutinized and mitigated or offset due to the cumulative nature of this impact. Setting the threshold at zero will place all discretionary projects under the CEQA microscope. Finally, an air district or lead agency may believe that some projects will not benefit from a full environmental impact report (EIR), and may believe a threshold at some level above zero is needed.

This paper explores the basis and implications of setting no threshold, setting a threshold at zero and two primary approaches for those who may choose to consider a non-zero threshold. The first approach is grounded in statute (AB 32) and executive order (EO S-3-05) and explores four possible options under this scenario. The options under this approach are variations of ways to achieve the 2020 goals of AB 32 from new development, which is estimated to be about a 30 percent reduction from business as usual.

The second approach explores a tiered threshold option. Within this option, seven variations are discussed. The concepts explored here offer both quantitative and qualitative approaches to setting a threshold as well as different metrics by which tier cut-points can be set. Variations range from setting the first tier cut-point at zero to second-tier cut-points set at defined emission levels or based on the size of a project. It should be noted that some applications of the tiered threshold approach may require inclusion in a General Plan or adoption of enabling regulations or ordinances to render them fully effective and enforceable.

Greenhouse Gas Analytical Methodologies

The white paper evaluates various analytical methods and modeling tools that can be applied to estimate the greenhouse gas emissions from different project types subject to CEQA. In addition, the suitability of the methods and tools to characterize accurately a project's emissions is discussed and the paper provides recommendations for the most appropriate methodologies and tools currently available.

The suggested methodologies are applied to residential, commercial, specific plan and general plan scenarios where GHG emissions are estimated for each example. This chapter also discusses estimating emissions from solid waste facilities, a wastewater treatment plant, construction, and air district rules and plans.

Another methodology, a service population metric, that would measure a project's overall GHG efficiency to determine if a project is more efficient than the existing statewide average for per capita GHG emissions is explored. This methodology may be more directly correlated to a project's ability to help achieve objectives outlined in AB 32, although it relies on establishment of an efficiency-based significance threshold. The subcommittee believes this methodology may eventually be appropriate to evaluate the long-term GHG emissions from a project in the context of meeting AB 32 goals. However, this methodology will need further work and is not considered viable for the interim guidance presented in this white paper.

Greenhouse Gas Mitigation Measures

Common practice in environmental protection is first to avoid, then to minimize, and finally to compensate for impacts. When an impact cannot be mitigated on-site, off-site mitigation can be effectively implemented in several resource areas, either in the form of offsetting the same impact or preserving the resource elsewhere in the region.

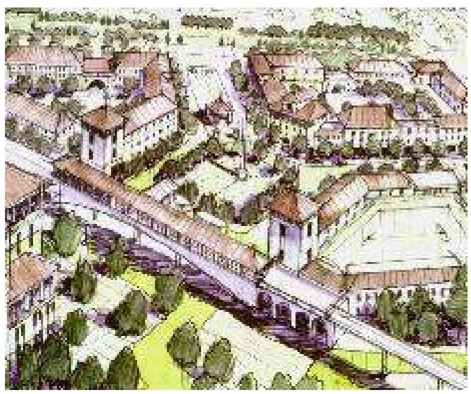
This white paper describes and evaluates currently available mitigation measures based on their economic, technological and logistical feasibility, and emission reduction effectiveness. The potential for secondary impacts to air quality are also identified for each measure. A summary of current rules and regulations affecting greenhouse gas emissions and climate change is also provided.

Reductions from transportation related measures (e.g., bicycle, pedestrian, transit, and parking) are explored as a single comprehensive approach to land use. Design measures that focus on enhancing alternative transportation are discussed. Mitigation measures are identified for transportation, land use/building design, mixed-use development, energy efficiency, education/social awareness and construction.

Purpose

CEQA requires the avoidance or mitigation of significant adverse environmental impacts where there are feasible alternatives available. The contribution of GHG to climate change has been documented in the scientific community. The California Global Warming Solutions Act of 2006 (AB 32) mandates significant reductions in greenhouse gases (GHG); passage of that law has highlighted the need to consider the impacts of GHG emissions from projects that fall under the jurisdiction of the California Environmental Quality Act (CEQA). Because we have only recently come to fully recognize the potential for significant environmental impacts from GHG, most public agencies have not yet established policies and procedures to consider them under CEQA. As a result, there is great need for information and other resources to assist public agencies as they develop their programs.

Air districts have historically provided guidance to local governments on the evaluation of air pollutants under CEQA. As local concern about climate change and GHG has increased, local governments have requested guidance on incorporating analysis of these impacts into local CEQA review. The California Air Pollution Control Officers Association (CAPCOA), in coordination with the CARB, the Governor's Office of Planning and Research (OPR) and two environmental consulting firms, has harnessed the collective expertise to evaluate approaches to analyzing GHG in CEQA. The purpose of this white paper is to provide a common platform of information and tools to address climate change in CEQA analyses, including the evaluation and mitigation of GHG emissions from proposed projects and identifying significance threshold options.

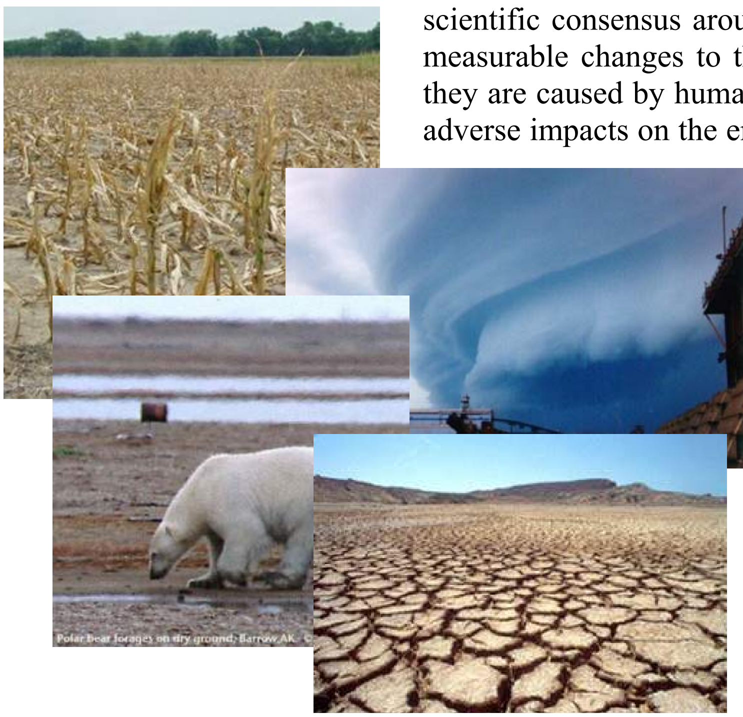


CEQA requires public agencies to ensure that potentially significant adverse environmental effects of discretionary projects are fully characterized, and avoided or mitigated where there are feasible alternatives to do so. Lead agencies have struggled with how best to identify and characterize the magnitude of the adverse effects that individual projects have on the global-scale phenomenon of climate change, even more so since Governor Schwarzenegger signed Executive Order S-3-05 and the state Legislature enacted The Global Warming Solutions Act of 2006 (AB 32). There is now a resounding call to establish procedures to analyze and mitigate greenhouse gas (GHG) emissions. The lack of established thresholds does not relieve lead agencies of their responsibility to analyze and mitigate significant impacts, so many of these agencies are seeking guidance from state and local air quality agencies. This white paper addresses issues inherent in establishing CEQA thresholds, evaluates tools, catalogues mitigation measures and provides air districts and lead agencies with options for incorporating climate change into their programs.

Background

National and International Efforts

International and Federal legislation have been enacted to deal with climate change issues. The Montreal Protocol was originally signed in 1987 and substantially amended in 1990 and 1992. In 1988, the United Nations and the World Meteorological Organization established the IPCC to assess the scientific, technical and socioeconomic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts, and options for adaptation and mitigation. The most recent reports of the IPCC have emphasized the scientific consensus around the evidence that real and measurable changes to the climate are occurring, that they are caused by human activity, and that significant adverse impacts on the environment, the economy, and human health and welfare are unavoidable.



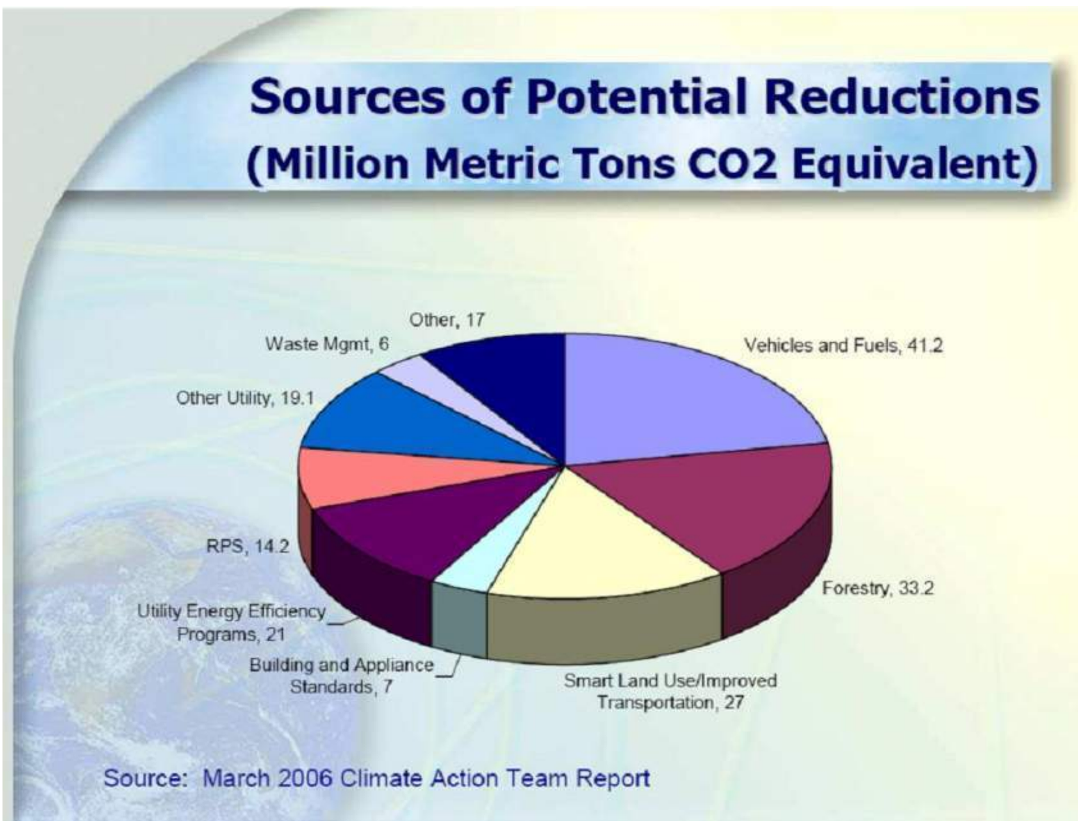
In October 1993, President Clinton announced his Climate Change Action Plan, which had a goal to return greenhouse gas emissions to 1990 levels by the year 2000. This was to be accomplished through 50 initiatives that relied on innovative voluntary partnerships between the private sector and government aimed at producing cost-effective reductions in greenhouse gas emissions. On March 21, 1994, the United States joined a number of countries around the world in signing the United Nations Framework Convention on Climate Change (UNFCCC). Under the Convention, governments agreed to gather and share information on greenhouse gas emissions, national policies, and best practices; launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and cooperate in preparing for adaptation to the impacts of climate change.

These efforts have been largely policy oriented. In addition to the national and international efforts described above, many local jurisdictions have adopted climate change policies and programs. However, thus far little has been done to assess the significance of the affects new development projects may have on climate change.

Executive Order S-3-05

On June 1, 2005, Governor Schwarzenegger issued Executive Order S-3-05 (S-3-05). It included the following GHG emission reduction targets: by 2010, reduce GHG emissions to 2000 levels; by 2020, reduce GHG emissions to 1990 levels; by 2050, reduce GHG emissions to 80 percent below 1990 levels. To meet the targets, the Governor directed the Secretary of the California Environmental Protection Agency to coordinate with the Secretary of the Business, Transportation and Housing Agency, Secretary of the Department of Food and Agriculture, Secretary of the Resources Agency, Chairperson of the CARB, Chairperson of the Energy Commission and President of the Public Utilities Commission on development of a Climate Action Plan.

The Secretary of CalEPA leads a Climate Action Team (CAT) made up of representatives from the agencies listed above to implement global warming emission reduction programs identified in the Climate Action Plan and report on the progress made toward meeting the statewide greenhouse gas targets that were established in the Executive Order.



SOURCE: ARB 2007

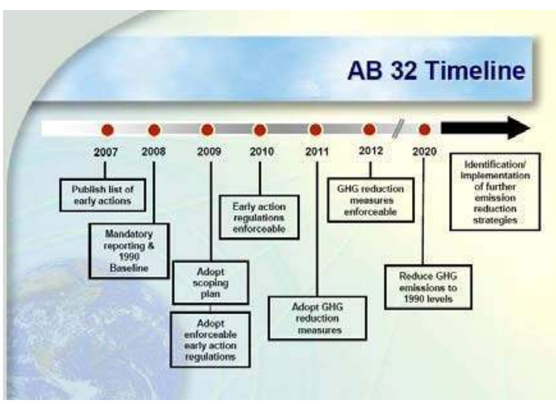
In accord with the requirements of the Executive Order, the first report to the Governor and the Legislature was released in March 2006 and will be issued bi-annually thereafter. The CAT Report to the Governor contains recommendations and strategies to help ensure the targets in Executive Order S-3-05 are met.

California Global Warming Solutions Act of 2006 (AB 32)

In 2006, the California State Legislature adopted the California Global Warming Solutions Act of 2006. AB 32 establishes a cap on statewide greenhouse gas emissions and sets forth the regulatory framework to achieve the corresponding reduction in statewide emissions levels. AB 32 charges the California Air Resources Board (CARB), the state agency charged with regulating statewide air quality, with implementation of the act. Under AB 32, greenhouse gases are defined as: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

The regulatory steps laid out in AB 32 require CARB to: adopt early action measures to reduce GHGs; to establish a statewide greenhouse gas emissions cap for 2020 based on 1990 emissions; to adopt mandatory reporting rules for significant source of greenhouse gases; and to adopt a scoping plan indicating how emission reductions will be achieved via regulations, market mechanisms and other actions; and to adopt the regulations needed to achieve the maximum technologically feasible and cost-effective reductions in greenhouse gases.

AB 32 requires that by January 1, 2008, the State Board shall determine what the statewide greenhouse gas emissions inventory was in 1990, and approve a statewide greenhouse gas emissions limit that is equivalent to that level, to be achieved by 2020. While the level of 1990 GHG emissions has not yet been approved, CARB's most recent emission inventory indicates that California had annual emissions of 436 million metric tons of carbon dioxide equivalent (MMT CO_2e) in 1990 and 497 MMT CO_2e in 2004.



SOURCE: ARB 2007

The regulatory timeline laid out in AB 32 requires that by July 1, 2007, CARB adopt a list of discrete early action measures, or regulations, to be adopted and implemented by January 1, 2010. These actions will form part of the State's comprehensive plan for achieving greenhouse gas emission reductions. In June 2007, CARB adopted three discrete early action measures. These three new proposed regulations meet the definition of "discrete early action greenhouse gas reduction measures," which include the following: a low carbon fuel standard; reduction of HFC-134a emissions from non-professional servicing of motor vehicle air conditioning systems; and improved landfill methane capture. CARB estimates that by 2020, the reductions from those three discrete early action measures would be approximately 13-26 MMT CO_2e.

CARB evaluated over 100 possible measures identified by the CAT for inclusion in the list of discrete early action measures. On October 25, 2007 CARB gave final approval to the list of Early Action Measures, which includes nine discrete measures and 35 additional measures, all of which are to be enforceable by January 1, 2010. AB 32 requires that by January 1, 2009, CARB adopt a scoping plan indicating how emission reductions will be achieved via regulations, market mechanisms and other actions.

Senate Bill 97

Senate Bill (SB) 97, signed in August 2007, acknowledges that climate change is an important environmental issue that requires analysis under CEQA. This bill directs the OPR to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions, by July 1, 2009. The Resources Agency is required to certify or adopt those guidelines by January 1, 2010. This bill also protects projects funded by the Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act of 2006, or the Disaster Preparedness and Flood Protection Bond Act of 2006 (Proposition 1B or 1E) from claims of inadequate analysis of GHG as a legitimate cause of action. This latter provision will be repealed on January 1, 2010. Thus, this "protection" is highly limited to a handful of projects and for a short time period.

The Role of Air Districts in the CEQA Process

Air districts assume one of three roles in the CEQA process. They may be lead agencies when they are adopting regulations and air quality plans. In some instances, they can also be a lead agency when approving permits to construct or operate for applicants subject to district rules. However, in many cases where an air district permit is involved, another agency has broader permitting authority over the project and assumes the role of lead agency. In these situations, the air district becomes what is referred to as a responsible agency under CEQA. When CEQA documents are prepared for projects that do not involve discretionary approval of a district regulation, plan or permit, the air district may assume the role of a concerned or commenting agency. In this role, it is typical for air districts to comment on CEQA documents where there may be air quality-related adverse impacts, such as projects that may create significant contributions to existing violations of ambient standards, cause a violation of an ambient standard or create an exposure to toxic air contaminants or odors. In some cases, the air district may also act in an "advisory" capacity to a lead agency early on in its review of an application for a proposed development project.

A few air districts in California began developing significance thresholds for use in CEQA analyses in the late 1980's and early 1990's. By the mid-1990's most air districts had developed CEQA thresholds for air quality analyses. Many of the districts have included in their guidance the analysis of rule development and permits that may be subject to CEQA.

What is Not Addressed in this Paper

Impacts of Climate Change to a Project

The focus of this paper is addressing adverse impacts to climate change and the ability to meet statewide GHG reduction goals caused by proposed new land development projects. CEQA also requires an assessment of significant adverse impacts a project might cause by bringing development and people into an area affected by climate change (CEQA Guidelines §15126.2). For example, an area that experiences higher average temperatures due to climate change may expose new development to more frequent exceedances and higher levels of ozone concentrations. Alternatively, a rise in sea level brought on by climate change may inundate new development locating in a low-lying area. The methodologies, mitigation and threshold approaches discussed in this paper do not specifically address the potential adverse impacts resulting from climate change that may affect a project.

Impacts from Construction Activity

Although construction activity has been addressed in the analytical methodologies and mitigation chapters, this paper does not discuss whether any of the threshold approaches adequately addresses impacts from construction activity. More study is needed to make this assessment or to develop separate thresholds for construction activity. The focus of this paper is the long-term adverse operational impacts of land use development.

Introduction

Any analysis of environmental impacts under CEQA includes an assessment of the nature and extent of each impact expected to result from the project to determine whether the impact will be treated as significant or less than significant. CEQA gives lead agencies discretion whether to classify a particular environmental impact as significant. "The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved," ref: CEQA Guidelines §15064(b) ("Guidelines"). Ultimately, formulation of a standard of significance requires the lead agency to make a policy judgment about where the line should be drawn distinguishing adverse impacts it considers significant from those that are not deemed significant. This judgment must, however, be based on scientific information and other factual data to the extent possible (Guidelines §15064(b)).

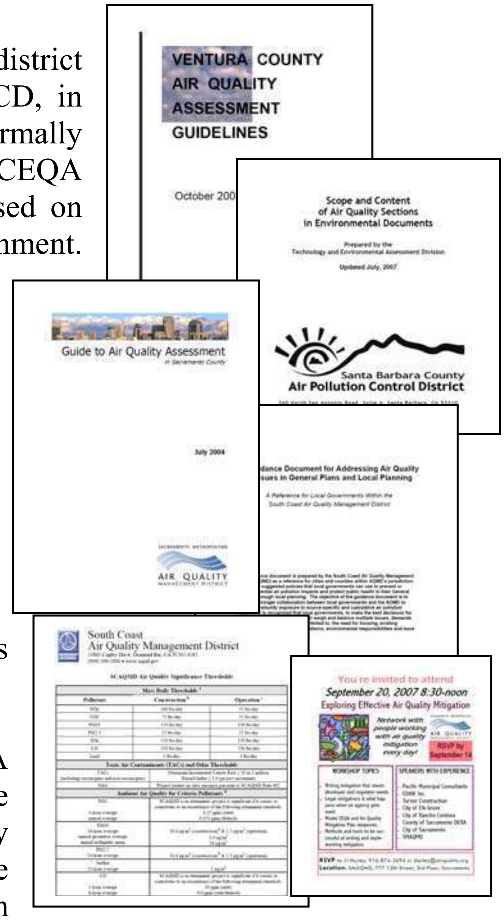
CEQA does not require that agencies establish thresholds of significance. Guidelines §15064.7(a) encourages each public agency "…to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which normally means the effect will be determined to be less than significant."

Once such thresholds are established, an impact that complies with the applicable threshold will "normally" be found insignificant and an impact that does not comply with the applicable threshold will "normally" be found significant.

Additionally, Guidelines §15064.7(b) requires that if thresholds of significance are adopted for general use as part of the lead agency's environmental review process they must be adopted by ordinance, resolution, rule or regulation, and developed through a public review process and be supported by substantial evidence.

While many public agencies adopt regulatory standards as thresholds, the standards do not substitute for a public agency's use of careful judgment in determining significance. They also do not replace the legal standard for significance (i.e., if there is a fair argument, based on substantial evidence in light of the whole record that the project may have a significant effect, the effect should be considered significant) (Guidelines §15064(f)(1). Also see *Communities for a Better Environment v. California Resource Agency* 103 Cal. App. 4th 98 (2002)). In other words, the adoption of a regulatory standard does not create an irrebuttable presumption that impacts below the regulatory standard are less than significant.

Summary of CEQA Thresholds at Air Districts



This section briefly summarizes the evolution of air district CEQA significance thresholds. Ventura County APCD, in 1980, was the first air district in California that formally adopted CEQA significance thresholds. Their first CEQA assessment document contained impact thresholds based on project type: residential, nonresidential, and government. Then, as now, the District's primary CEQA thresholds applied only to ROG and NO_x. The 1980 Guidelines did not address other air pollutants.

Santa Barbara County APCD and the Bay Area AQMD adopted thresholds in 1985. The South Coast AQMD recommended regional air quality thresholds in 1987 for CO, SO_2, NO_2, particulates, ROG, and lead. Most of the other California air districts adopted CEQA guidance and thresholds during the 1990's. Air districts have updated their thresholds and guidelines several times since they were first published.

Originally, most districts that established CEQA thresholds focused on criteria pollutants for which the district was nonattainment and the thresholds only addressed project level impacts. Updates during the 1990's began to add additional air quality impacts such as odors, toxic air contaminants and construction. Several air districts also developed thresholds for General Plans that relied on an assessment of the plan consistency with the district's air quality plans. A consistency analysis involves comparing the project's land use to that of the general plan and the population and employment increase to the forecasts underlying the assumptions used to develop the air quality plan.

Most air district thresholds for CEQA are based on the threshold for review under the New Source Review (NSR). The NSR threshold level is set by district rule and is different depending on the nonattainment classification of the air district. Areas with a less severe classification have a higher NSR trigger level while the most polluted areas have the lowest NSR trigger level. Some districts, such as Ventura County APCD, have significantly lower CEQA thresholds that are not tied to the NSR requirements. In Ventura, one set of CEQA thresholds is 25 pounds per day for all regions of Ventura County, except the Ojai Valley. The second set of CEQA thresholds was set at 5 pounds per day for the Ojai Valley.

The Sacramento Metropolitan AQMD bases its thresholds for ozone precursors on the projected land use share of emission reductions needed for attainment. The emission reductions needed to reach attainment are based on commitments made in the state implementation plan (SIP) prepared for the federal clean air act.

CEQA Considerations in Setting Thresholds

Public agencies use significance thresholds to disclose to their constituents how they plan on evaluating and characterizing the severity of various environmental impacts that could be associated with discretionary projects that they review. Significance thresholds are also used to help identify the level of mitigation needed to reduce a potentially significant impact to a less than significant level and to determine what type of an environmental document should be prepared for a project; primarily a negative declaration, mitigated negative declaration or an environmental impact report.

While public agencies are not required to develop significance thresholds, if they decide to develop them, they are required to adopt them by ordinance, resolution, rule or regulation through a public process. A lead agency is not restrained from adopting any significance threshold it sees as appropriate, as long as it is based on substantial evidence. CEQA Guidelines §15064.7 encourages public agencies to develop and publish significance thresholds that are identifiable, quantitative, qualitative or performance level that the agency uses in the determination of the significance of environmental effects. The courts have ruled that a "threshold of significance" for a given environmental effect is simply that level at which the lead agency finds the effects of the project to be significant.

Before an agency determines its course with regard to climate change and CEQA, it must be made clear that a threshold, or the absence of one, will not relieve a lead agency from having to prepare an EIR or legal challenges to the adequacy of an analysis leading to a conclusion, or lack of a conclusion, of significance under CEQA. CEQA has generally favored the preparation of an EIR where there is any substantial evidence to support a fair argument that a significant adverse environmental impact may occur due to a proposed project. This paper explores three alternative approaches to thresholds, including a no threshold option, a zero threshold option and a non-zero threshold option.

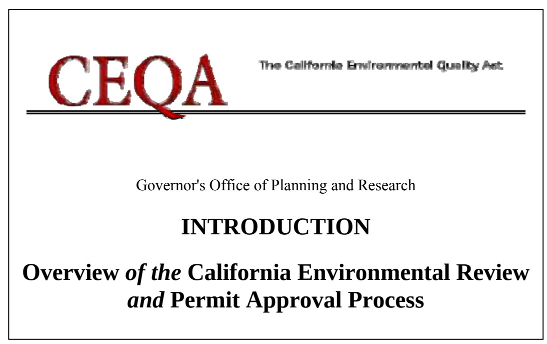
<u>Fair Argument Considerations</u>

Under the CEQA fair argument standard, an EIR must be prepared whenever it can be fairly argued, based on substantial evidence in the administrative record, that a project may have a significant adverse effect on the environment. "Substantial evidence" comprises "enough relevant information and reasonable inferences from this information that a fair argument can be made to support a conclusion, even though other conclusions might also be reached." (Guidelines §15384) This means that if factual information is presented to the public agency that there is a reasonable possibility the project could have a significant effect on the environment, an EIR is required even if the public agency has information to the contrary (Guidelines §15064 (f)).

The courts have held that the fair argument standard "establishes a low threshold for initial preparation of an EIR, which reflects a preference for resolving doubts in favor of environmental review." (*Santa Teresa Citizen Action Group v. City of San Jose* [2003] 114 Cal.App.4th 689) Although the determination of whether a fair argument exists is made by the public agency, that determination is subject to judicial scrutiny when challenged in litigation. When the question is whether an EIR should have been prepared, the court will review the administrative record for factual evidence supporting a fair argument.

The fair argument standard essentially empowers project opponents to force preparation of an EIR by introducing factual evidence into the record that asserts that the project may have a significant effect on the environment. This evidence does not need to be conclusive regarding the potential significant effect.

In 1998, the Resources Agency amended the State CEQA Guidelines to encourage the use of thresholds of significance. Guidelines §15064 (h) provided that when a project's impacts did not exceed adopted standards, the impacts were to be considered less than significant. The section went on to describe the types of adopted standards that were to be considered thresholds. Guidelines § 15064.7 provided that agencies may adopt thresholds of significance to guide their determinations of significance. Both of these sections were challenged when environmental groups sued the Resources Agency in 2000 over the amendments. The trial court concluded that §15064.7 was proper, if it was applied in the context of the fair argument standard.


CEQA The California Environmental Quality Act

Governor's Office of Planning and Research

INTRODUCTION

Overview *of the* California Environmental Review *and* Permit Approval Process

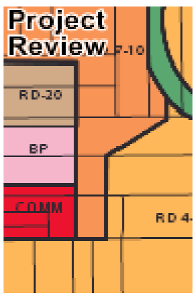
At the appellate court level, §15064(h) was invalidated.[2] Establishing a presumption that meeting an adopted standard would avoid significant impacts was "inconsistent with controlling CEQA law governing the fair argument approach." The Court of Appeal explained that requiring agencies to comply with a regulatory standard "relieves the agency of a duty it would have under the fair argument approach to look at evidence beyond the regulatory standard, or in contravention of the standard, in deciding whether an EIR must be prepared. Under the fair argument approach, any substantial evidence supporting a fair argument that a project may have a significant environmental effect would trigger the preparation of an EIR." (*Communities for a Better Environment v. California Resources Agency* [2002] 103 Cal.App.4th 98)

[2] Prior §15064(h) has been removed from the State CEQA Guidelines. Current §15064(h) discusses cumulative impacts.

In summary, CEQA law does not require a lead agency to establish significance thresholds for GHG. CEQA guidelines encourage the development of thresholds, but the absence of an adopted threshold does not relieve the agency from the obligation to determine significance.

Defensibility of CEQA Analyses

The basic purposes of CEQA, as set out in the State CEQA Guidelines, include: (1) informing decision makers and the public about the significant environmental effects of proposed projects; (2) identifying ways to reduce or avoid those impacts; (3) requiring the implementation of feasible mitigation measures or alternatives that would reduce or avoid those impacts; and (4) requiring public agencies to disclose their reasons for approving any project that would have significant and unavoidable impacts (Guidelines §15002). CEQA is enforced through civil litigation over procedure (i.e., did the public agency follow the correct CEQA procedures?) and adequacy (i.e., has the potential for impacts been disclosed, analyzed, and mitigated to the extent feasible?).



The California Supreme Court has held that CEQA is "to be interpreted in such manner as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language." (*Friends of Mammoth v. Board of Supervisors* [1972] 8 Cal.3d 247, 259) Within that context, the role of the courts is to weigh the facts in each case and apply their judgment. Although the court may rule on the adequacy of the CEQA work, the court is not empowered to act in the place of the public agency to approve or deny the project for which the CEQA document was prepared. Further, the court's review is limited to the evidence contained in the administrative record that was before the public agency when it acted on the project.

Putting aside the issue of CEQA procedure, the defensibility of a CEQA analysis rests on the following concerns:

- whether the public agency has sufficiently analyzed the environmental consequences to enable decision makers to make an intelligent decision;

- whether the conclusions of the public agency are supported by substantial evidence in the administrative record; and

- whether the agency has made a good faith effort at the full disclosure of significant effects.

CEQA analyses need not be perfect or exhaustive -- the depth and breadth of the analysis is limited to what is "reasonably feasible." (Guidelines §15151) At the same time, the analysis "must include detail sufficient to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed project." (Laurel Heights Improvement Assn. v. Regents of University of California (1988) 47 Cal.3d 376)

By itself, establishment of a GHG threshold will not insulate individual CEQA analyses from challenge. Defensibility depends upon the adequacy of the analysis prepared by the lead agency and the process followed. However, the threshold can help to define the boundaries of what is a reasonable analysis by establishing when an analysis will be required and the basic scope of that analysis. The threshold would attempt to define the point at which an analysis will be required and when a level of impact becomes significant, requiring preparation of an EIR. If the threshold includes recommendations for the method or methods of analysis, it can establish the minimum level of analysis to address this issue.

Considerations in Setting Thresholds for Stationary Source Projects

In many respects, the analysis of GHG emissions from stationary sources is much more straightforward than the analysis of land use patterns, forecasted energy consumption, and emissions from mobile sources. The reason is that, for the most part, the latter analyses depend largely on predictive models with myriad inputs and have a wider range of error. Emissions from stationary sources involve a greater reliance on mass and energy balance calculations and direct measurements of emissions from the same or similar sources. Energy demand is more directly tied to production, and even associated mobile source emissions will likely fall within narrower predictive windows.

Implementing CEQA Without a Threshold

A lead agency is not required to establish significance thresholds for GHG emissions from stationary sources. The lead agency may find that it needs more information or experience evaluating GHG from these types of projects to determine an appropriate significance threshold. As with other project types, the lead agency could conduct a project specific analysis to determine whether an environmental impact report is needed and to determine the level of mitigation that is appropriate. The agency might also rely on thresholds established for criteria pollutants as a screening method, and analyze GHG emissions (and require mitigation) from projects with emissions above the criteria pollutant thresholds. Over time, the agency could amass information and experience with specific project categories that would support establishing explicit thresholds. The lead agency may also choose to base local CEQA thresholds on state guidelines or on the category-specific reduction targets established by ARB in its scoping plan for implementing AB32. Resource constraints and other considerations associated with implementing CEQA without GHG thresholds for stationary sources would be similar to those outlined for other types of projects (see Chapter 5 – No Threshold Option).

Implementing CEQA with Threshold of Zero

A lead agency may find that any increase in GHG emissions is potentially significant under CEQA. The resources and other considerations for implementing a threshold of zero for stationary sources are the same as those outlined for other types of projects (see Chapter 6 – Zero Threshold Option).

Implementing CEQA with a Non-Zero Threshold

A lead agency may identify one or more non-zero thresholds for significance of emissions of GHG from stationary sources. The agency could elect to rely on existing thresholds for reviewing new or modified stationary sources of GHG, if the state or local air district has established any. The agency could also apply the threshold(s) established for non-stationary sources to GHG emissions from stationary sources. Significance thresholds could also be established by ordinance, rule, or policy for a given category of stationary sources; this approach is especially conducive to a tiered threshold approach. For example, the agency could establish significance and mitigation tiers for stationary compression-ignition diesel-fueled generators. Under such an approach, the project proponent could be first required to use a lower GHG-emitting power source if feasible, and if not, to apply mitigation based on the size of the generator and other defined considerations, such as hours of operation. Certain classes of generators could be found to be insignificant under CEQA (e.g., those used for emergency stand-by power only, with a limit on the annual hours of use). As with non-stationary projects, the goal of establishing non-zero thresholds is to maximize environmental protection, while minimizing resources used. Resource and other considerations outlined for non-stationary projects are applicable here (see Chapter 7 – Non-Zero Threshold Options).

Implementing CEQA with Different Thresholds for Stationary and Non-stationary Projects

Although a lead agency may apply the same thresholds to stationary and non-stationary projects, it is not required to do so. There are, in fact, some important distinctions between the two types of projects that could support applying different thresholds. The lead agency should consider the methods used to estimate emissions. Are the estimates a "best/worst reasonable scenario" or are they based on theoretical maximum operation? How accurate are the estimates (are they based on models, simulations, emission factors, source test data, manufacturer specifications, etc.)? To what extent could emissions be reduced through regulations after the project is constructed if they were found to be greater than originally expected (i.e., is it possible to retrofit emissions control technology onto the source(s) of GHG at a later date, how long is the expected project life, etc.)? Are there emission limits or emissions control regulations (such as New Source Review) that provide certainty that emissions will be mitigated? Generally, stationary source emissions are based on maximum emissions (theoretical or allowed under law or regulation), are more accurate, and are more amenable to retrofit at a later time than non-stationary source emissions. It is also more likely that category specific rules or some form of NSR will apply to stationary sources than non-stationary projects. Notwithstanding, it is almost always more effective and cost-efficient to apply emission reduction technology at the design phase of a project. There are, therefore, a number of considerations that need to be evaluated and weighed before establishing thresholds – and which may support different thresholds for stationary and non-stationary projects. Furthermore, the considerations may change over time as new regulations are established and as emissions estimation techniques and control technology evolves.

Direct GHG Emissions from Stationary Sources

The main focus of this paper has been the consideration of projects that do not, in the main, involve stationary sources of air pollution, because stationary source projects are generally a smaller percentage of the projects seen by most local land use agencies. That said, some discussion of stationary sources is warranted. As the broader program for regulating GHG from these sources is developed, the strategies for addressing them under CEQA will likely become more refined.

The primary focus of analysis of stationary source emissions has traditionally been those pollutants that are directly emitted by the source, whether through a stack or as fugitive releases (such as leaks). CAPCOA conducted a simplified analysis of permitting activity to estimate the number of stationary source projects with potentially significant emissions of greenhouse gases that might be seen over the course of a year. This analysis looked only at stationary combustion sources (such as boilers and generators), and only considered direct emissions. A lead agency under CEQA may see a different profile of projects than the data provided here suggest, depending on what other resources are affected by projects. In addition, air districts review like-kind replacements of equipment to ensure the new equipment meets current standards, but such actions might not constitute a project for many land use agencies or other media regulators. The data does provide a useful benchmark, however, for lead agencies to assess the order of magnitude of potential stationary source projects. A similar analysis is included for non-stationary projects in Chapter 7.

Table 1: Analysis of GHG Emissions from Stationary Combustion Equipment Permits[3]

	BAAQMD	SMAQMD	SJVUAPCD	SCAQMD
Total Applications for Year	1499	778	1535	1179
Affected at threshold of:				
900 metric tons/year	26	43	63	108
10,000 metric tons/year	7	5	26	8
25,000 metric tons/year	3	1	11	4

[3] District data varies based on specific local regulations and methodologies.

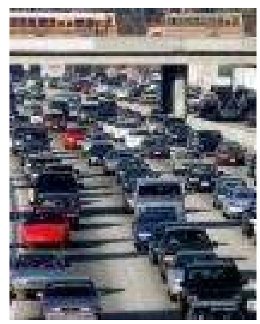
Emissions from Energy Use

In addition to the direct emissions of GHG from stationary projects, CEQA will likely need to consider the project's projected energy use. This could include an analysis of opportunities for energy efficiency, onsite clean power generation (e.g., heat/energy recovery, co-generation, geothermal, solar, or wind), and the use of dedicated power

contracts as compared to the portfolio of generally available power. In some industries, water use and conservation may provide substantial GHG emissions reductions, so the CEQA analysis should consider alternatives that reduce water consumption and wastewater discharge. The stationary project may also have the opportunity to use raw or feedstock materials that have a smaller GHG footprint; material substitution should be evaluated where information is available to do so.

Emissions from Associated Mobile Sources

The stationary project will also include emissions from associated mobile sources. These will include three basic components: emissions from employee trips, emissions from delivery of raw or feedstock materials, and emissions from product transport. Employee trips can be evaluated using trip estimation as is done for non-stationary projects, and mitigations would include such measures as providing access to and incentives for use of public transportation, accessibility for bicycle and pedestrian modes of transport, employer supported car or vanpools (including policies such as guaranteed rides home, etc). Upstream and downstream emissions related to goods movement can also be estimated with available models. The evaluation will need to determine the extent of the transport chain that should be included



(to ensure that all emissions in the chain have been evaluated and mitigated, but to avoid double counting). Mitigations could include direct actions by operators who own their own fleet, or could be implemented through contractual arrangements with independent carriers; again, the evaluation will need to consider how far up and down the chain mitigation is feasible and can be reasonably required.

Comparing Emissions Changes Across Pollutant Categories

The potential exists for certain GHG reduction measures to increase emissions of criteria and toxic pollutants known to cause or aggravate respiratory, cardiovascular, and other health problems. For instance, GHG reduction efforts such as alternative fuels and methane digesters may create significant levels of increased pollutants that are detrimental to the health of the nearby population (e.g.; particulate matter, ozone precursors, toxic air contaminants). Such considerations should be included in any CEQA analysis of a project's environmental impacts. While there are many win-win strategies that can reduce both GHG and criteria/toxic pollutant emissions, when faced with situations that involve tradeoffs between the two, the more immediate public health concerns that may arise from an increase in criteria or toxic pollutant emissions should take precedence. GHG emission reductions could be achieved offsite through other mitigation programs.

Introduction

Under state law, it is the purview of each lead agency to determine what, if any, significance thresholds will be established to guide its review of projects under CEQA. While the state does provide guidelines for implementing CEQA, the guidelines have left the decision of whether to establish thresholds (and if so, at what level) to individual lead agencies. Frequently, lead agencies consult with resource-specific agencies (such as air districts) for assistance in determining what constitutes a significant impact on that specific resource.

With the passage of AB 32, the ARB has broad authority to regulate GHG emissions as necessary to meet the emission reduction goals of the statute. This may include authority to establish emission reduction requirements for new land use projects, and may also enable them to recommend statewide thresholds for GHG under CEQA.

In developing this white paper, CAPCOA recognizes that, as the GHG reduction program evolves over time, GHG thresholds and other policies and procedures for CEQA may undergo significant revision, and that uniform statewide thresholds and procedures may be established. This paper is intended to serve as a resource for public agencies until such time that statewide guidance is established, recognizing that decisions will need to be made about GHG emissions from projects before such guidance is available. This paper is not, however, uniform statewide guidance. As stated before, it outlines several possible approaches without endorsing any one over the others.

Some air districts may choose to use this paper to support their establishment of guidance for GHG under CEQA, including thresholds. This paper does not, nor should it be construed to require a district to implement any of the approaches evaluated here. Decisions about whether to provide formal local guidance on CEQA for projects with GHG emissions, including the question of thresholds, will be made by individual district boards.

Each of the 35 air districts operates independently and has its own set of regulations and programs to address the emissions from stationary, area and mobile sources, consistent with state and federal laws, regulations, and guidelines. The independence of the districts allows specific air quality problems to be addressed on a local level. In addition, districts have also established local CEQA thresholds of significance for criteria pollutants – also to address the specific air quality problems relative to that particular district.

The overall goal of air district thresholds is to achieve and maintain health based air quality standards within their respective air basins and to reduce transport of emissions to other air basins. In establishing recommended thresholds, air districts consider the existing emission inventory of criteria pollutants and the amount of emission reductions needed to attain and maintain ambient air quality standards.

However, unlike criteria pollutants where individual districts are characterized by varying levels of pollutant concentrations and source types, greenhouse gases (GHG) and their attendant climate change ramifications are a global problem and, therefore, may suggest a uniform approach to solutions that ensure both progress and equity.

Under SB97, the Office of Planning and Research is directed to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions through CEQA by July 1, 2009. Those guidelines may recommend thresholds. As stated, this paper is intended to provide a common platform of information and tools to support local decision makers until such time that statewide guidance or requirements are promulgated.

Local Ability to Promulgate District-Specific GHG Thresholds

One of the primary reasons behind the creation of air districts in California is the recognition that some regions within the state face more critical air pollution problems than others and, as has often been pointed out – one size does not fit all. For example, a "Serious" federal nonattainment district would need greater emission reductions than a district already in attainment – and, therefore, the more "serious" district would set its criteria pollutant CEQA thresholds of significance much lower than the air district already in attainment.

The action of GHGs is global in nature, rather than local or regional (or even statewide or national). Ultimately there may be a program that is global, or at least national in scope. That said, actions taken by a state, region, or local government can contribute to the solution of the global problem. Local governments are not barred from developing and implementing programs to address GHGs. In the context of California and CEQA, lead agencies have the primary responsibility and authority to determine the significance of a project's impacts.

Further, air districts have primary authority under state law for "control of air pollution from all sources, other than emissions from motor vehicles." (H&SC §40000) The term air contaminant or "air pollutant" is defined extremely broadly, to mean "any discharge, release, or other propagation into the atmosphere" and includes, but is not limited to, soot, carbon, fumes, gases, particulate matter, etc. Greenhouse gases and other global warming pollutants such as black carbon would certainly be included in this definition, just as the U.S. Supreme Court held in Massachusetts v. EPA that greenhouse gases were air pollutants under the federal Clean Air Act. Therefore, air districts have the primary authority to regulate global warming pollutants from nonvehicular sources. AB 32 does not change this result. Although it gives wide responsibility to CARB to regulate greenhouse gases from all sources, including nonvehicular sources, it does not preempt the districts. AB 32 specifically states That "nothing in this division shall limit or expand the existing authority of any district..."(H&SC § 38594). Thus, districts and CARB retain concurrent authority over nonvehicular source greenhouse gas emissions.

Introduction

The CEQA statutes do not require an air district or any lead agency to establish significance thresholds under CEQA for any pollutant. While there are considerations that support the establishment of thresholds (which are discussed in other sections of this document), there is no obligation to do so.

An air district or other lead agency may elect not to establish significance thresholds for a number of reasons. The agency may believe that the global nature of the climate change problem necessitates a statewide or national framework for consideration of environmental impacts. SB 97 directs OPR to develop "guidelines for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions by July 1, 2009," and directs the California Resources Agency to certify and adopt the guidelines by June 30, 2010.

An agency may also believe there is insufficient information to support selecting one specific threshold over another. As described earlier, air districts have historically set CEQA thresholds for air pollutants in the context of the local clean air plan, or (in the case of toxic air pollutants) within the framework of a rule or policy that manages risks and exposures due to toxic pollutants. There is no current framework that would similarly manage impacts of greenhouse gas pollutants, although the CARB is directed to establish one by June 30, 2009, pursuant to AB 32. A local agency may decide to defer any consideration of thresholds until this framework is in place.

Finally, an agency may believe that the significance of a given project should be assessed on a case-by-case basis in the context of the project at the time it comes forward.

Implementing CEQA Without Significance Thresholds for GHG

The absence of a threshold does not in any way relieve agencies of their obligations to address GHG emissions from projects under CEQA. The implications of not having a threshold are different depending on the role the agency has under CEQA – whether it is acting in an advisory capacity, as a responsible agency, or as a lead agency.

<u>Implications of No Thresholds for an Agency Acting in an Advisory Capacity</u>

Air districts typically act in an advisory capacity to local governments in establishing the framework for environmental review of air pollution impacts under CEQA. This may include recommendations regarding significance thresholds, analytical tools to assess emissions and impacts, and mitigations for potentially significant impacts. Although districts will also address some of these issues on a project-specific basis as responsible agencies, they may provide general guidance to local governments on these issues that are program wide, and these are advisory (unless they have been established by regulation).

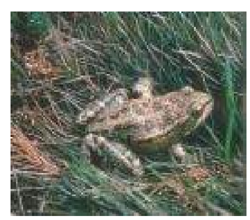
An air district that has not established significance thresholds for GHG will not provide guidance to local governments on this issue. This does not prevent the local government from establishing thresholds under its own authority. One possible result of this would be the establishment of different thresholds by cities and counties within the air district. Alternatively, the air district could advise local governments not to set thresholds and those jurisdictions may follow the air district's guidance.

It is important to note here (as has been clearly stated by the Attorney General in comments and filings) that lack of a threshold does *not* mean lack of significance. An agency may argue lack of significance for any project, but that argument would have to be carried forth on a case-by-case, project specific basis. By extension then, a decision not to establish thresholds for GHG is likely to result in a greater workload for responsible and lead agencies as they consider individual projects under CEQA.

Implications of No Thresholds for a Responsible Agency

If there are no established thresholds of significance, the significance of each project will have to be determined during the course of review. The responsible agency (e.g., the air district) will review each project referred by the lead agency. The review may be qualitative or quantitative in nature. A qualitative review would discuss the nature of GHG emissions expected and their potential effect on climate change as the district understands it. It could also include a discussion of the relative merits of alternative scenarios. A quantitative analysis would evaluate, to the extent possible, the expected GHG emissions; it would also need to evaluate their potential effect on climate change and might include corresponding analysis of alternatives. The air district, as a responsible agency, may also identify mitigation measures for the project.

The lack of established thresholds will make the determination of significance more resource intensive for each project. The district may defer to the lead agency to make this determination, however the district may be obligated, as a responsible agency, to evaluate the analysis and determination.



Implications of No Thresholds for a Lead Agency

The main impact of not having significance thresholds will be on the primary evaluation of projects by the lead agency. Without significance thresholds, the agency will have to conduct some level of analysis of every project to determine whether an environmental impact report is needed. There are three fundamental approaches to the case-by-case analysis of significance, including presumptions of significance or insignificance, or no presumption:

1. The agency can begin with a presumption of significance and the analysis would be used to support a case-specific finding of no significance. This is similar to establishing a threshold of zero, except that here, the “threshold” is rebuttable. This approach may result in a large number of projects proceeding to preparation of an environmental impact report. Because of the attendant costs, project proponents may challenge the determination of significance, although formal challenge is less likely than attempts to influence the determination.

2. The agency can begin with a presumption of insignificance, and the analysis would be used to support a case-specific finding of significance. A presumption of insignificance could be based on the perspective that it would be speculative to attempt to identify the significance of GHG emissions from a project relative to climate change on a global scale. This approach might reduce the number of projects proceeding to preparation of environmental impact reports. It is likely to have greater success with smaller projects than larger ones, and a presumption of *insignificance* may be more likely to be challenged by project opponents.

3. It is not necessary for the lead agency to have any presumption either way. The agency could approach each project from a *tabula rasa* perspective, and have the determination of significance more broadly tied to the specific context of the project; this approach is likely to be resource intensive, and creates the greatest uncertainty for project proponents. To the extent that it results in a lead agency approving similar projects based on different determinations of significance for GHG emissions, it may be more vulnerable to challenge from either proponents or opponents of the project. Alternatively, in the absence of either thresholds or presumptions, the lead agency could use each determination of significance to build its approach in the same way that subsequent judgments define the law.

Relevant Citations

The full text of relevant citations is in Appendix A.

Public Resources Code – §21082.2, Significant Effect on Environment; Determination; Environmental Impact Report Preparation.

State CEQA Guidelines – §15064, Determining the Significance of the Environmental Effects Caused by a Project.

Introduction

If an air district or lead agency determines that any degree of project-related increase in GHG emissions would contribute considerably to climate change and therefore would be a significant impact, it could adopt a zero-emission threshold to identify projects that would need to reduce their emissions. A lead agency may determine that a zero-emission threshold is justified even if other experts may disagree. A lead agency is not prevented from adopting any significance threshold it sees as appropriate, as long as it is based on substantial evidence.

If the zero threshold option is chosen, all projects subject to CEQA would be required to quantify and mitigate their GHG emissions, regardless of the size of the project or the availability of GHG reduction measures available to reduce the project's emissions. Projects that could not meet the zero-emission threshold would be required to prepare environmental impact reports to disclose the unmitigable significant impact, and develop the justification for a statement of overriding consideration to be adopted by the lead agency.

Implementing CEQA With a Zero Threshold for GHG

The scientific community overwhelmingly agrees that the earth's climate is becoming warmer, and that human activity is playing a role in climate change. Unlike other environmental impacts, climate change is a global phenomenon in that all GHG emissions generated throughout the earth contribute to it. Consequently, both large and small GHG generators cause the impact. While it may be true that many GHG sources are individually too small to make any noticeable difference to climate change, it is also true that the countless small sources around the globe combine to produce a very substantial portion of total GHG emissions.

A zero threshold approach is based on a belief that, 1) all GHG emissions contribute to global climate change and could be considered significant, and 2) not controlling emissions from smaller sources would be neglecting a major portion of the GHG inventory.

CEQA explicitly gives lead agencies the authority to choose thresholds of significance. CEQA defers to lead agency discretion when choosing thresholds. Consequently, a zero-emission threshold has merits.

The CEQA review process for evaluating a project's impact on global climate change under the zero threshold option would involve several components. Air quality sections would be written by lead agencies to include discussions on climate change in CEQA documents, GHG emissions would be calculated, and a determination of significance would be made. The local air districts would review and comment on the climate change discussions in environmental documents. Lead agencies may then revise final EIRs to accommodate air district comments. More than likely, mitigation measures will be specified for the project, and a mitigation monitoring program will need to be put in place to ensure that these measures are being implemented.

Since CEQA requires mitigation to a less than significant level, it is conceivable that many projects subjected to a zero threshold could only be deemed less than significant with offsite reductions or the opportunity to purchase greenhouse gas emission reduction credits. GHG emission reduction credits are becoming more readily available however the quality of the credits varies considerably. High quality credits are generated by actions or projects that have clearly demonstrated emission reductions that are real, permanent, verifiable, enforceable, and not otherwise required by law or regulation. When the pre- or post-project emissions are not well quantified or cannot be independently confirmed, they are considered to be of lesser quality. Similarly, if the reductions are temporary in nature, they are also considered to be poor quality. Adoption of a zero threshold should consider the near-term availability and the quality of potential offsets.

There are also environmental justice concerns about the effects of using offsite mitigations or emission reduction credits to offset, or mitigate, the impacts of a new project. Although GHGs are global pollutants, some of them are emitted with co-pollutants that have significant near-source or regional impacts. Any time that increases in emissions at a specific site will be mitigated at a remote location or using emission reduction credits, the agency evaluating the project should ensure that it does not create disproportionate impacts.

Administrative Considerations

If electing to pursue a zero threshold, an air district or lead agency should consider the administrative costs and the environmental review system capacity. Some projects that previously would have qualified for an exemption could require further substantial analysis, including preparation of a Negative Declaration (ND), a Mitigated Negative Declaration (MND) or an EIR. Moreover, the trade-offs between the volume of projects requiring review and the quality of consideration given to reviews should be considered. It may also be useful to consider whether meaningful mitigation can be achieved from smaller projects.

Consideration of Exemptions from CEQA

A practical concern about identifying GHG emissions as a broad cumulative impact is whether the zero threshold option will preclude a lead agency from approving a large set of otherwise qualified projects utilizing a Categorical Exemption, ND, or MND. The results could be a substantial increase in the number of EIR's. This is a valid and challenging concern, particularly for any threshold approach that is based on a zero threshold for net GHG emission increases.

CEQA has specified exceptions to the use of a categorical exception. Specifically, CEQA Guidelines §15300.2 includes the following exceptions:

"(b) Cumulative Impact. All exemptions for these classes are inapplicable when the cumulative impact of successive projects of the same type in the same place, over time is significant."

(c) Significant Effect. A categorical exemption shall not be used for an activity where there is a reasonable possibility that the activity will have a significant effect on the environment due to unusual circumstances."

These CEQA Guidelines sections could be argued to mean that any net increase in GHG emissions would preclude the use of a categorical exemption. However, as described below, if the following can be shown, then the exceptions above could be argued not to apply:

(1) Cumulative local, regional and/or state GHG emissions are being reduced or will be reduced by adopted, funded, and feasible measures in order to meet broader state targets.

(2) Mandatory state or local GHG reduction measures would apply to the project's emissions such that broader GHG reduction goals would still be met and the project contributions would not be cumulatively considerable.

(3) Project GHG emissions are below an adopted significance threshold designed to take into account the cumulative nature of GHG emissions.

A similar argument could be made relative to the use of a ND (provided no additional mitigation (beyond existing mandates) is required to control GHG emissions) and to the use of a MND instead of an EIR. However, due to the "fair argument" standard, which is discussed in Chapter 3, caution is recommended in use of a ND or MND unless all three elements above can be fully supported through substantial evidence and there is no substantial evidence to the contrary. Establishing a significance threshold of zero is likely to preclude the use of a categorical exemption.

Relevant Citations

The full text of relevant citations is in Appendix A.

Public Resources Code – §21004, Mitigating or Avoiding a Significant Effect; Powers of Public Agency.

State CEQA Guidelines – §15064, Determining the Significance of the Environmental Effects Caused by a Project.

State CEQA Guidelines – §15130, Discussion of Cumulative Impacts.

State CEQA Guidelines – §15064.7, Thresholds of Significance.

Introduction

A non-zero threshold could minimize the resources spent reviewing environmental analyses that do not result in real GHG reductions or to prevent the environmental review system from being overwhelmed. The practical advantages of considering non-zero thresholds for GHG significance determinations can fit into the concept regarding whether the project's GHG emissions represent a "considerable contribution to the cumulative impact" and therefore warrant analysis.

Specifying a non-zero threshold could be construed as setting a *de minimis* value for a cumulative impact. In effect, this would be indicating that there are certain GHG emission sources that are so small that they would not contribute substantially to the global GHG budget. This could be interpreted as allowing public agencies to approve certain projects without requiring any mitigation of their GHG. Any threshold framework should include a proper context to address the *de minimis* issue. However, the CEQA Guidelines recognize that there may be a point where a project's contribution, although above zero, would not be a *considerable contribution* to the cumulative impact and, therefore, not trigger the need for a significance determination.

GHG emissions from all sources are under the purview of CARB and as such may eventually be "regulated" no matter how small. Virtually all projects will result in some direct or indirect release of GHG. However, a decision by CARB to regulate a class of sources does not necessarily mean that an individual source in that class would constitute a project with significant GHG impacts under CEQA. For example, CARB has established criteria pollutant emission standards for automobiles, but the purchase and use of a single new car is not considered a project with significant impacts under CEQA. At the same time, it is important to note that it is likely that all meaningful sources of emissions, no matter how small are likely to be considered for regulation under AB 32. It is expected that projects will have to achieve some level of GHG reduction to comply with CARB's regulations meant to implement AB 32. As such all projects will have to play a part in reducing our GHG emissions budget and no project, however small, is truly being considered *de minimis* under CARB's regulations.

This chapter evaluates a range of conceptual approaches toward developing GHG significance criteria. The air districts retained the services of J&S an environmental consulting, firm to assist with the development of a Statute and Executive Order-based threshold (Approach 1) and a tiered threshold (Approach 2) based on a prescribed list of tasks and deliverables. Time and financial constraints limited the scope and depth of this analysis, however, the work presented here may be useful in developing interim guidance while AB 32 is being implemented. J&S recognized that approaches other than those described here could be used.

As directed, J&S explored some overarching issues, such as:

- what constitutes "new" emissions?

- how should "baseline emissions" be established?
- what is cumulatively "considerable" under CEQA?
- what is "business as usual" ? and
- should an analysis include "life-cycle" emissions?

The answers to these issues were key to evaluating each of the threshold concepts.

Approach 1 – Statute and Executive Order Approach

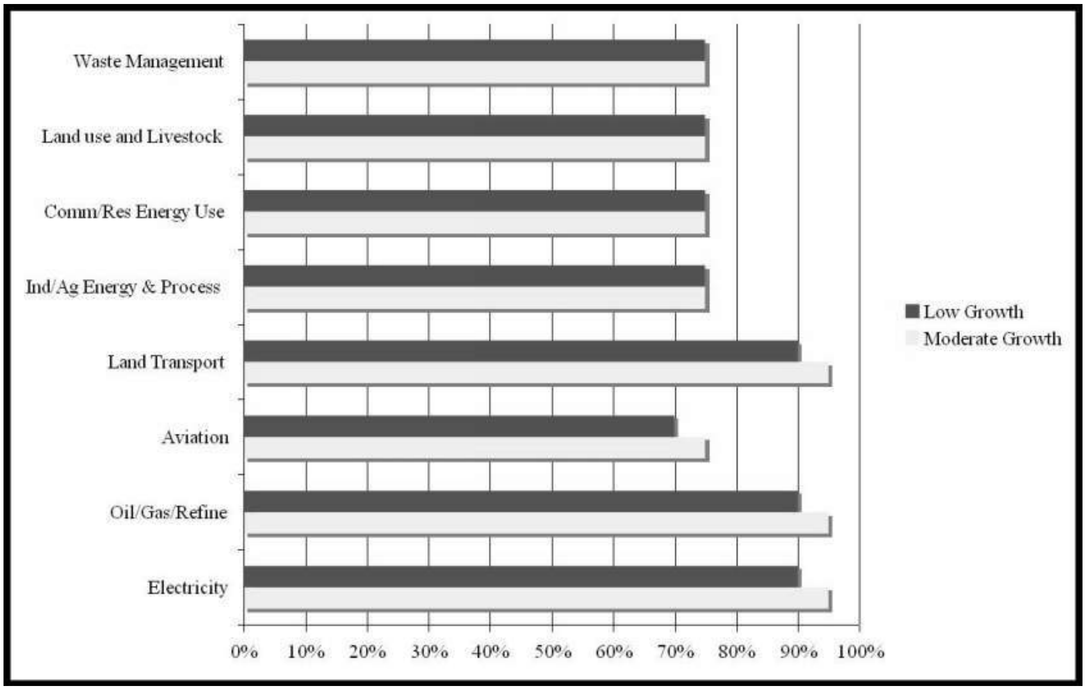
Thresholds could be grounded in existing mandates and their associated GHG emission reduction targets. A project would be required to meet the targets, or reduce GHG emissions to the targets, to be considered less than significant.

AB 32 and S-3-05 target the reduction of statewide emissions. It should be made clear that AB 32 and S-3-05 do not specify that the emissions reductions should be achieved through uniform reduction by geographic location or by emission source characteristics. For example, it is conceivable, although unlikely, that AB 32 goals could be achieved by new regulations that only apply to urban areas or that only apply to the transportation and/or energy sector. However, this approach to evaluating GHG under CEQA is based on the presumption that a new project must at least be consistent with AB 32 GHG emission reduction mandates.

The goal of AB 32 and S-3-05 is the significant reduction of future GHG emissions in a state that is expected to rapidly grow in both population and economic output. As such, there will have to be a significant reduction in the per capita GHG output for these goals to be met. CEQA is generally used to slow or zero the impact of new emissions, leaving the reduction of existing emission sources to be addressed by other regulatory means. With these concepts in mind, four options were identified for statute/executive order-based GHG significance thresholds and are described below.

<u>Threshold 1.1: AB 32/S-3-05 Derived Uniform Percentage-Based Reduction.</u> AB 32 requires the state to reduce California-wide GHG emissions to 1990 levels by 2020. Reducing greenhouse gas emission levels from 2020 to 1990 levels could require a 28 to 33 percent reduction of business-as-usual GHG emissions depending on the methodology used to determine the future emission inventories. The exact percent reduction may change slightly once CARB finalizes its 1990 and 2020 inventory estimates. In this context, business-as-usual means the emissions that would have occurred in the absence of the mandated reductions. The details of the business-as-usual scenario are established by CARB in the assumptions it uses to project what the state's GHG emissions would have been in 2020, and the difference between that level and the level that existed in 1990 constitutes the reductions that must be achieved if the mandated goals are to be met.

This threshold approach would require a project to meet a percent reduction target based on the average reductions needed from the business-as-usual emission from all GHG sources. Using the 2020 target, this approach would require all discretionary projects to achieve a 33 percent reduction from projected business-as-usual emissions in order to be considered less than significant. A more restrictive approach would use the 2050 targets. S-3-05 seeks to reduce GHG emissions to 80 percent below 1990 levels by 2050. To reach the 2050 milestone would require an estimated 90 percent reduction (effective immediately) of business-as-usual emissions. Using this goal as the basis for a significance threshold may be more appropriate to address the long-term adverse impacts associated with global climate change. Note that AB 32 and S-3-05 set emission inventory goals at milestone years; it is unclear how California will progress to these goals in non-milestone years.



SOURCE: ARB 2007

Threshold 1.2: Uniform Percentage-Based (e.g.50%) Reduction for New Development. This threshold is based on a presumption that new development should contribute a greater percent reduction from business-as-usual because greater reductions can be achieved at lower cost from new projects than can be achieved from existing sources. This approach would establish that new development emit 50 percent less GHG emissions than business-as-usual development. This reduction rate is greater than the recommended reduction rate for meeting the Threshold 1.1 2020 target (33 percent) but is significantly less restrictive than the Threshold 1.1 2050 target reduction rate (90 percent). If a 50 percent GHG reduction were achieved from new development, existing emissions would have to be reduced by 25 to 30 percent in order to meet the 2020 emissions goal depending on the year used to determine the baseline inventory. Although this reduction goal is reasonable for achieving the 2020 goal, it would not be possible to reach the 2050 emissions target with this approach even if existing emissions were 100 percent controlled.

Threshold 1.3: Uniform Percentage-Based Reduction by Economic Sector. This threshold would use a discrete GHG reduction goal specific to the economic sector associated with the project. There would be specific reduction goals for each economic sector, such as residential, commercial, and industrial development. Specifying different reduction thresholds for each market sector allows selection of the best regulatory goal for each sector taking into account available control technology and costs. This approach would avoid over-regulating projects (i.e. requiring emissions to be controlled in excess of existing technology) or under-regulating projects (i.e. discouraging the use of available technology to control emissions in excess of regulations). This approach requires extensive information on the emission inventories and best available control technology for each economic sector. This data will be compiled as CARB develops its scoping plan under AB 32 and its implementing regulations; as a result, this approach will be more viable in the long term.

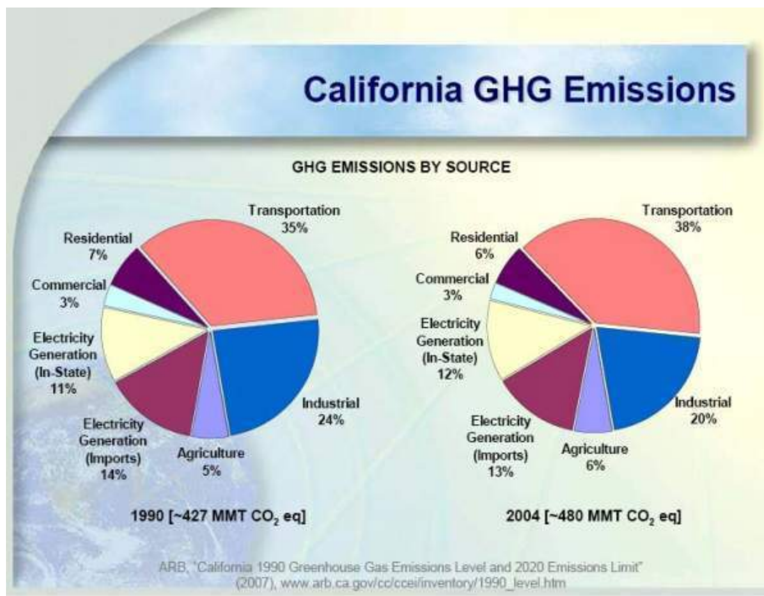
Threshold 1.4: Uniform Percentage-Based Reduction by Region. AB 32 and S-3-05 are written such that they apply to a geographic region (i.e. the entire state of California) rather than on a project or sector level. One could specify regions of the state such as the South Coast Air Basin, Sacramento Valley, or Bay Area which are required to plan (plans could be developed by regional governments, such as councils of governments) and demonstrate compliance with AB 32 and S-3-05 reduction goals at a regional level. To demonstrate that a project has less than significant emissions, one would have to show compliance with the appropriate regional GHG plan. Effectively this approach allows for analysis of GHG emissions at a landscape scale smaller than the state as a whole. Specifying regions in rough correlation to existing air basins or jurisdictional control allows for regional control of emissions and integration with regional emission reduction strategies for criteria and toxic air pollutants. Although differing GHG reduction controls for each region are possible, it is likely that all regions would be

required to achieve 1990 emission inventories by the year 2020 and 80 percent less emissions by 2050. Threshold 1.4 is considered viable long-term significance criteria that is unlikely to be used in the short term.

Implementing CEQA Thresholds Based on Emission Reduction Targets

Characterizing Baseline and Project Emissions

While the population and economy of California is expanding, all new projects can be considered to contribute new emissions. Furthermore, GHG impacts are exclusively cumulative impacts; there are no non-cumulative GHG emission impacts from a climate change perspective. "Business-as-usual" is the projection of GHG emissions at a future date based on current technologies and regulatory requirements in absence of other reductions. For example to determine the future emissions from a power plant for "business-as-usual" one would multiply the projected energy throughput by the current emission factor for that throughput. If adopted regulations (such as those that may be promulgated by CARB for AB 32) dictate that power plant emissions must be reduced at some time in the future, it is appropriate to consider these regulation standards as the new business-as-usual for a future date. In effect, business-as-usual will continue to evolve as regulations manifest. Note that "business-as-usual" defines the CEQA No Project conditions, but does not necessarily form the baseline under CEQA. For instance, it is common to subtract the future traffic with and without a project to determine the future cumulative contribution of a project on traffic conditions. However, existing conditions at the time of issuance of the notice of preparation is normally the baseline.



SOURCE: ARB 2007

Establishing Emission Reduction Targets

One of the obvious drawbacks to using a uniform percent reduction approach to GHG control is that it is difficult to allow for changes in the 1990 and future emission inventories estimates. To determine what emission reductions are required for new projects one would have to know accurately the 1990 budget and efficacy of other GHG promulgated regulations as a function of time. Since CARB will not outline its regulation strategy for several more years, it is difficult to determine accurately what the new project reductions should be in the short term. Future updates to the 1990 inventory could necessitate changes in thresholds that are based on that inventory. It is important to note that it is difficult to create near term guidance for a uniform reduction threshold strategy since it would require considerable speculation regarding the implementation and effectiveness of forthcoming CARB regulations.

Of greater importance are the assumptions used to make the projected 2020 emission inventories. Projecting future inventories over the next 15-50 years involves substantial uncertainty. Furthermore, there are likely to be federal climate change regulations and possibly additional international GHG emission treaties in the near future. To avoid such speculation, this paper defines all future emission inventories as hypothetical business-as-usual projections.

This white paper is intended to support local decisions about CEQA and GHG in the near term. During this period, it is unlikely that a threshold based on emission reduction targets would need to be changed. However, it is possible that future inventory updates will show that targets developed on the current inventory were not stringent enough, or were more stringent than was actually needed.

Approach 2 – Tiered Approach

The goal of a tiered threshold is to maximize reduction predictability while minimizing administrative burden and costs. This would be accomplished by prescribing feasible mitigation measures based on project size and type, and reserving the detailed review of an EIR for those projects of greater size and complexity. This approach may require inclusion in a General Plan, or adoption of specific rules or ordinances in order to fully and effectively implement it.

A tiered CEQA significance threshold could establish different levels at which to determine if a project would have a significant impact. The tiers could be established based on the gross GHG emission estimates for a project or could be based on the physical size and characteristics of the project. This approach would then prescribe a set of GHG mitigation strategies that would have to be incorporated into the project in order for the project to be considered less than significant.

The framework for a tiered threshold would include the following:

- disclosure of GHG emissions for all projects;
- support for city/county/regional GHG emissions reduction planning;
- creation and use of a “green list” to promote the construction of projects that have desirable GHG emission characteristics;
- a list of mitigation measures;

- a decision tree approach to tiering; and
- quantitative or qualitative thresholds.

Decision-Tree Approach to Tiering

CEQA guidance that allows multiple methodologies to demonstrate GHG significance will facilitate the determination of significance for a broad range of projects/plans that would otherwise be difficult to address with a single non-compound methodology. Even though there could be multiple ways that a project can determine GHG significance using a decision-tree approach, only one methodology need be included in any single CEQA document prepared by the applicant. The presence of multiple methodologies to determine significance is designed to promote flexibility rather than create additional analysis overhead. Figure 1 shows a conceptual approach to significance determination using a tiered approach that shows the multiple routes to significance determination.

Figure 1 Detail Description

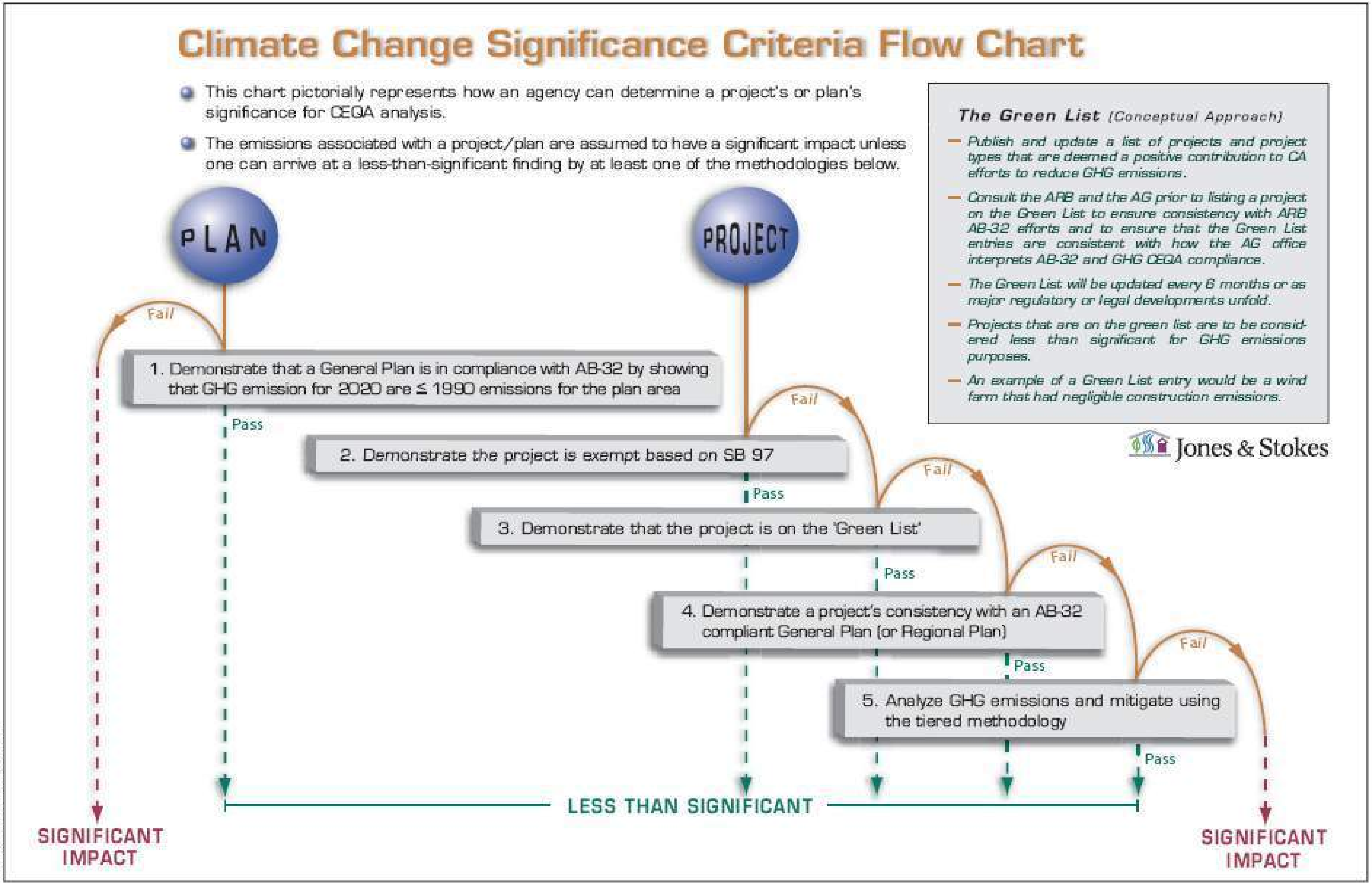
Figure 1 pictorially represents how an agency can determine a project's or plan's significance for CEQA analysis using the non-zero threshold methodology. The emissions associated with a project/plan are assumed to have a significant impact unless one can arrive at a less-than-significant finding by at least one of the methodologies below.

1. Demonstrate that a General Plan (GP) or Regional Plan is in Compliance with AB32

   - For most GPs or RPs this will require demonstration that projected 2020 emissions will be equal to or less than 1990 emissions.
   - GPs or RPs are expected to fully document 1990 and 2020 GHG emission inventories.
   - Projection of 2020 emissions is complicated by the fact that CARB is expected to promulgate emission reductions in the short term. Until explicit CARB regulations are in place, unmitigated GP 2020 emission inventories represent business-as-usual scenarios.
   - EIRs for GPs or RPs which demonstrate 2020 mitigated emissions are less than or equal to 1990 emissions are considered less than significant.

2. Demonstrate the Project is Exempt Based on SB 97

   - As specified in SB 97, projects that are funded under November 2006 Proposition 1B (Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act) and 1C (Disaster Preparedness and Flood Prevention Bond Act) may be exempt from analysis until January 1, 2010.



Jones & Stokes

Figure 1
Climate Change Significance Criteria Flow Chart

- An exemption can be used in an ND, MND, or EIR to support a less than significant finding for GHG impacts.

3. Demonstrate that the Project is on the 'Green List'

- This list would include projects that are deemed a positive contribution to California efforts to reduce GHG emissions. If the project is of the type described on the Green List it is considered less than significant.
- If the Green List entry description requires mitigation for impacts other than GHG, this methodology can be used in MNDs or EIRs; if the Green List entry does not require mitigation this methodology can be used in NDs, MNDs, or EIRs.

4. Demonstrate a Project's Compliance with a General Plan

- If a project is consistent with an appropriate General Plan's Greenhouse Gas Reduction Plan (GGRP), a project can be declared less than significant.
- Note that at this time there are no known jurisdictions that have a GGRP that has been fully subject to CEQA review. While Marin County has adopted a forward-thinking GGRP and it is described in the most recent GP update, the associated EIR does not analyze the secondary environmental impacts of some of the GGRP measures such as tidal energy. While one can reference GGRPs that have not been reviewed fully in CEQA, to attempt to show a project's compliance with such a plan as evidence that the project's GHG emission contributions are less than significant may not be supported by substantial evidence that cumulative emissions are being fully addressed in the particular jurisdiction.
- Compliance with a CEQA-vetted GGRP can be cited as evidence for all CEQA documents (Categorical Exemption, ND, MND, and EIR).

5. Analyze GHG Emissions and Mitigate using the Tiered Methodology

- Guidance and mitigation methodology for various development projects (residential, commercial, industrial) are listed in the form of tiered thresholds. If a project incorporates the mitigation measures specified in the tiered threshold tables the project is considered less than significant.
- All project emissions are considered less than significant if they are less than the threshold(s).
- If the tiered approach requires mitigation, this methodology can be used in MNDs or EIRs; if the tiered approach does not require mitigation this methodology can be used in NDs, MNDs, or EIRs.

The Green List

- The Green List would be a list of projects and project types that are deemed a positive contribution to California's efforts to reduce GHG emissions.
- If this approach is followed, it is suggested that CARB and the Attorney General (AG) are consulted prior to listing a project on the Green List to ensure consistency with CARB AB 32 efforts and to ensure that the Green List entries are consistent with how the AG office interprets AB 32 and GHG CEQA compliance.
- The Green List should be updated every 6 months or as major regulatory or legal developments unfold.
- Projects that are on the Green List are to be considered less than significant for GHG emissions purposes.
- A tentative list of potential Green List entries is presented below. Actual Green List entries should be far more specific and cover a broad range of project types and mitigation approaches. The list below is merely a proof-of-concept for the actual Green List.

1. Wind farm for the generation of wind-powered electricity
2. Extension of transit lines to currently developed but underserved communities
3. Development of high-density infill projects with easily accessible mass transit
4. Small hydroelectric power plants at existing facilities that generate 5 mw or less (as defined in Class 28 Categorical Exemption)
5. Cogeneration plants with a capacity of 50 mw or less at existing facilities (as defined in Class 29 Cat Exemption)
6. Increase in bus service or conversion to bus rapid transit service along an existing bus line
7. Projects with LEED "Platinum" rating
8. Expansion of recycling facilities within existing urban areas
9. Recycled water projects that reduce energy consumption related to water supplies that services existing development
10. Development of bicycle, pedestrian, or zero emission transportation infrastructure to serve existing regions

There are also several options for tiering and thresholds, as shown in Table 2 below. One could establish strictly numeric emissions thresholds and require mitigation to below the specific threshold to make a finding of less than significant. One could establish narrative emissions threshold that are based on a broader context of multiple approaches to GHG reductions and a presumption that projects of sufficiently low GHG intensity are less than significant.

In Concept 2A, a zero threshold would be applied to projects and thus only projects that result in a reduction of GHG emissions compared to baseline emissions would be less than significant absent mitigation. All projects would require quantified inventories. All projects that result in a net increase of GHG emissions would be required to mitigate their emissions to zero through direct mitigation or through fees or offsets or the impacts

Table 2: Approach 2 Tiering Options

	Concept 2A Zero	Concept 2B Quantitative	Concept 2C Qualitative
Tier 1	Project results in a net reduction of GHG emissions *Less than Significant*	Project in compliance with an AB 32-compliant General/Regional Plan, on the Green List, or below Tier 2 threshold. Level 1 Reductions (Could include such measures as: bike parking, transit stops for planned route, Energy Star roofs, Energy Star appliances, Title 24, water use efficiency, etc.) *Less than Significant*	Project in compliance with an AB 32-compliant General/Regional Plan, on the Green List, or below Tier 2 threshold. Level 1 Reductions (See measures under 2B) *Less than Significant*
Tier 2	Project results in net increase of GHG emissions Mitigation to zero (including offsets) *Mitigated to Less than Significant*	Above Tier 2 threshold Level 2 Mitigation (Could include such measures as: Parking reduction beyond code, solar roofs, LEED Silver or Gold Certification, exceed Title 24 by 20%, TDM measures, etc.) *Mitigated to Less than Significant*	Above Tier 2 threshold Level 2 Mitigation (See measures under 2B) *Mitigated to Less than Significant*
Tier 3	Mitigation infeasible to reduce emissions to zero (e.g., cost of offsets infeasible for project or offsets not available) *Significant and Unavoidable*	Above Tier 2 threshold With Level 1, 2 Mitigation Level 3 Mitigation: (Could include such measures as: On-site renewable energy systems, LEED Platinum certification, Exceed Title 24 by 40%, required recycled water use for irrigation, zero waste/high recycling requirements, mandatory transit passes, offsets/carbon impact fees) *Mitigated to Less than Significant*	Above Tier 3 thresholds Quantify Emissions, Level 3 Mitigation (see measures under 2B), and Offsets for 90% of remainder *Significance and Unavoidable*

would be identified as significant and unavoidable. This could be highly problematic and could eliminate the ability to use categorical exemptions and negative declarations for a wide range of projects.

In Concepts 2B and 2C, the first tier of a tiered threshold includes projects that are within a jurisdiction with an adopted greenhouse gas reduction plan (GGRP) and General Plan/Regional Plan that is consistent with AB 32 (and in line with S-3-05), or are on the Green List, or are below the Tier 2 threshold. All Tier 1 projects would be required to implement mandatory reductions required due to other legal authority (Level 1 reductions) such as AB 32, Title 24, or local policies and ordinances. With Level 1 reduction measures, qualifying Tier 1 projects would be considered less than significant without being required to demonstrate mitigation to zero.

In Concept 2B, the Tier 2 threshold would be quantitative, and quantified inventories would be required. Several quantitative threshold options are discussed below. A more comprehensive set of Level 2 mitigation would be required. If the project's emissions still exceed the Tier 2 threshold, an even more aggressive set of Level 3 mitigation measures would be required including offsets (when feasible) to reduce emissions below the Tier 2 threshold.

In Concept 2C, there would be two thresholds, a lower Tier 2 threshold (the "low bar") and a higher Tier 3 threshold (the "high bar"). The Tier 2 threshold would be the significance threshold for the purposes of CEQA and would be qualitative in terms of units (number of dwelling units, square feet of commercial space, etc.) or a per capita ratio. Projects above the Tier 2 threshold would be required to implement the comprehensive set of Level 2 mitigation. Projects below the Tier 2 threshold would not be required to quantify emissions or reductions. The Tier 3 threshold would be a threshold to distinguish the larger set of projects for which quantification of emissions would be required. Level 3 mitigation would be required and the project would be required to purchase offsets (when feasible) in the amount of 90 percent of the net emissions after application of Level 1 reductions and Level 2 and 3 mitigation. A variant on Concept 2C would be to require mandatory Level 3 mitigation without quantification and offsets.

Approach 2 Threshold Options

Seven threshold options were developed for this approach. The set of options are framed to capture different levels of new development in the CEQA process and thus allow different levels of mitigation. Options range from a zero first-tier threshold (Threshold 2.1) up to a threshold for GHG that would be equivalent to the capture level (i.e., number of units) of the current criteria pollutant thresholds used by some air districts (Threshold 2.4). The decision-based implementation approach discussed above could be used for any of these options. Table 3 below compares the results of each of the approaches discussed here.

Threshold 2.1: Zero First Tier Tiered Threshold.

This option would employ the decision tree concept and set the first tier cut-point at zero. The second tier cut-point could be one of the qualitative or quantitative thresholds discussed below. First-tier projects would be required to implement a list of very feasible and readily available mitigation measures.

Threshold 2.2: Quantitative Threshold Based on Market Capture

A single quantitative threshold was developed in order to ensure capture of 90 percent or more of likely future discretionary developments. The objective was to set the emission threshold low enough to capture a substantial fraction of future residential and non-residential development that will be constructed to accommodate future statewide population and job growth, while setting the emission threshold high enough to exclude small development projects that will contribute a relatively small fraction of the cumulative statewide GHG emissions.

The quantitative threshold was created by using the following steps:

- Reviewing data from four diverse cities (Los Angeles in southern California and Pleasanton, Dublin, and Livermore in northern California) on pending applications for development.

- Determining the unit (dwelling unit or square feet) threshold that would capture approximately 90 percent of the residential units or office space in the pending application lists.

- Based on the data from the four cities, the thresholds selected were 50 residential units and 30,000 square feet of commercial space.

- The GHG emissions associated with 50 single-family residential units and 30,000 square feet of office were estimated and were found to be 900 metric tons and 800 metric tons, respectively. Given the variance on individual projects, a single threshold of 900 metric tons was selected for residential and office projects.

- A 900 metric ton threshold was also selected for non-office commercial projects and industrial projects to provide equivalency for different projects in other economic sectors.

- If this threshold is preferred, it is suggested that a more robust data set be examined to increase the representativeness of the selected thresholds. At a minimum, a diverse set of at least 20 cities and/or counties from throughout the state should be examined in order to support the market capture goals of this threshold. Further, an investigation of market capture may need to be conducted for different commercial project types and for industrial projects in order to examine whether multiple quantitative emissions thresholds or different thresholds should be developed.

The 900-ton threshold corresponds to 50 residential units, which corresponds to the 84th percentile of projects in the City of Los Angeles, the 79th percentile in the City of Pleasanton, the 50th percentile in the City of Livermore and the 4th percentile in the City of Dublin. This is suggestive that the GHG reduction burden will fall on larger projects that will be a relatively small portion of overall projects within more developed central cities (Los Angeles) and suburban areas of slow growth (Pleasanton) but would be the higher portion of projects within moderately (Livermore) or more rapidly developing areas (Dublin). These conclusions are suggestive but not conclusive due to the small sample size. The proposed threshold would exclude the smallest proposed developments from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. While this would exclude perhaps 10 percent of new residential development, the capture of 90 percent of new residential development would establish a strong basis for demonstrating that cumulative reductions are being achieved across the state. It can certainly serve as an interim measure and could be revised if subsequent regulatory action by CARB shows that a different level or different approach altogether is called for.

The 900-ton threshold would correspond to office projects of approximately 35,000 square feet, retail projects of approximately 11,000 square feet, or supermarket space of approximately 6,300 square feet. 35,000 square feet would correspond to the 46th percentile of commercial projects in the City of Los Angeles, the 54th percentile in the City of Livermore, and the 35th percentile in the City of Dublin. However, the commercial data was not separated into office, retail, supermarket or other types, and thus the amount of capture for different commercial project types is not known. The proposed threshold would exclude smaller offices, small retail (like auto-parts stores), and small supermarkets (like convenience stores) from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA but would include many medium-scale retail and supermarket projects.

The industrial sector is less amenable to a unit-based approach given the diversity of projects within this sector. One option would be to adopt a quantitative GHG emissions threshold (900 tons) for industrial projects equivalent to that for the residential/commercial thresholds described above. Industrial emissions can result from both stationary and mobile sources. CARB estimates that their suggested reporting threshold for stationary sources of 25,000 metric tons accounts for more than 90 percent of the industrial sector GHG emissions (see Threshold 2.3 for 25,000 metric ton discussion). If the CARB rationale holds, then a 900 metric ton threshold would likely capture at least 90 percent (and likely more) of new industrial and manufacturing sources. If this approach is advanced, we suggest further examination of industrial project data to determine market capture.

This threshold would require the vast majority of new development emission sources to quantify their GHG emissions, apportion the forecast emissions to relevant source categories, and develop GHG mitigation measures to reduce their emissions.

Threshold 2.3: CARB Reporting Threshold

CARB has recently proposed to require mandatory reporting from cement plants, oil refineries, hydrogen plants, electric generating facilities and electric retail providers, cogeneration facilities, and stationary combustion sources emitting $\geq$ 25,000 MT CO_2e/yr. AB 32 requires CARB to adopt a regulation to require the mandatory reporting and verification of emissions. CARB issued a preliminary draft version of its proposed reporting requirements in August 2007 and estimates that it would capture 94 percent of the GHG emissions associated with stationary sources.

This threshold would use 25,000 metric tons per year of GHG as the CEQA significance level. CARB proposed to use the 25,000 metric tons/year value as a reporting threshold, not as a CEQA significance threshold that would be used to define mitigation requirements. CARB is proposing the reporting threshold to begin to compile a statewide emission inventory, applicable only for a limited category of sources (large industrial facilities using fossil fuel combustion).

A 25,000 metric ton significance threshold would correspond to the GHG emissions of approximately 1,400 residential units, 1 million square feet of office space, 300,000 square feet of retail, and 175,000 square feet of supermarket space. This threshold would capture far less than half of new residential or commercial development.

As noted above, CARB estimates the industrial-based criteria would account for greater than 90 percent of GHG emissions emanating from stationary sources. However, industrial and manufacturing projects can also include substantial GHG emissions from mobile sources that are associated with the transportation of materials and delivery of products. When all transportation-related emissions are included, it is unknown what portion of new industrial or manufacturing projects a 25,000-ton threshold would actually capture.

An alternative would be to use a potential threshold of 10,000 metric tons considered by the Market Advisory Committee for inclusion in a Greenhouse Gas Cap and Trade System in California. A 10,000 metric ton significance threshold would correspond to the GHG emissions of approximately 550 residential units, 400,000 square feet of office space, 120,000 square feet of retail, and 70,000 square feet of supermarket space. This threshold would capture roughly half of new residential or commercial development.

Threshold 2.4: Regulated Emissions Inventory Capture

Most California air districts have developed CEQA significance thresholds for NOx and ROG emissions to try to reduce emissions of ozone precursors from proposed sources that are not subject to NSR pre-construction air quality permitting. The historical management of ozone nonattainment issues in urbanized air districts is somewhat analogous to today's concerns with greenhouse gas emissions in that regional ozone concentrations are a cumulative air quality problem caused by relatively small amounts of NOx and ROG emissions from thousands of individual sources, none of which emits enough by themselves to cause elevated ozone concentrations. Those same conditions apply to global climate change where the environmental problem is caused by emissions from a countless number of individual sources, none of which is large enough by itself to cause the problem. Because establishment of NOx/ROG emissions CEQA significance thresholds has been a well-tested mechanism to ensure that individual projects address cumulative impacts and to force individual projects to reduce emissions under CEQA, this threshold presumes the analogy of NOx/ROG emission thresholds could be used to develop similar GHG thresholds.

The steps to develop a GHG emission threshold based on the NOx/ROG analogy were as follows:

- For each agency, define its NOx/ROG CEQA thresholds.

- For each agency, define the regional NOx/ROG emission inventory the agency is trying to regulate with its NOx/ROG thresholds.

- For each agency, calculate the percentage of the total emission inventory for NOx represented by that agency's CEQA emission threshold. That value represents the "minimum percentage of regulated inventory" for NOx.

- The current (2004) California-wide GHG emission inventory is 499 million metric tons per year of CO_2 equivalent (MMT CO_2e). Apply the typical "minimum percentage of regulated inventory" value to the statewide GHG inventory, to develop a range of analogous GHG CEQA thresholds.

The preceding methodology was applied to two different air quality districts: the Bay Area Air Quality Management District (BAAQMD), a mostly-urbanized agency within which most emissions are generated from urban areas; and the San Joaquin Valley Air Pollution Control District (SJVAPCD), which oversees emissions emanating in part from rural areas that are generated at dispersed agricultural sources and area sources. For example, in the Bay Area the NOx threshold is 15 tons/year. The total NOx inventory for 2006 was 192,000 tons/year (525 tons/day). The threshold represents 0.008 percent of the total NOx inventory. Applying that ratio to the total statewide GHG emissions inventory of 499 MMT CO_2e (2004) yields an equivalent GHG threshold of 39,000 MMT CO_2e.

The range of analogous CEQA GHG thresholds derived from those two agencies is tightly clustered, ranging from 39,000 to 46,000 tons/year. A 39,000 to 46,000 metric ton threshold would correspond to the GHG emissions of approximately 2,200 to 2,600 residential units, 1.5 to 1.8 million square feet of office space, 470,000 to 560,000 square feet of retail, and 275,000 to 320,000 square feet of supermarket space. This threshold would capture far less than half of new residential or commercial development. Similarly, this threshold would capture less of new industrial/manufacturing GHG emissions inventory than Thresholds 2.2 or 2.3.

<u>Threshold 2.5: Unit-Based Thresholds Based on Market Capture</u>

Unit thresholds were developed for residential and commercial developments in order to capture approximately 90 percent of future development. The objective was to set the unit thresholds low enough to capture a substantial fraction of future housing and commercial developments that will be constructed to accommodate future statewide population and job growth, while setting the unit thresholds high enough to exclude small development projects that will contribute a relatively small fraction of the cumulative statewide GHG emissions. Sector-based thresholds were created by using the same steps and data used to create Threshold 2.2- Quantitative Threshold Based on Market Capture above.

The distribution of pending application data suggests that the GHG reduction burden will fall on larger projects that will be a relatively small portion of overall projects within more developed central cities and suburban areas of slow growth but would be the higher portion of projects within moderately or rapidly developing areas. The proposed threshold would exclude the smallest proposed developments from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. While this would exclude perhaps 10 percent of new residential development, the capture of 90 percent of new residential development would establish a strong basis for demonstrating that cumulative reductions are being achieved across the state. It can certainly serve as an interim measure and could be revised if subsequent regulatory action by CARB shows that a different level or different approach altogether is called for.

A similar rationale can be applied to the development of a commercial threshold. Threshold 2.5 would exclude many smaller businesses from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. It should be noted that the GHG emissions of commercial projects vary substantially. For example, the carbon dioxide emissions associated with different commercial types were estimated as follows:

- 30,000 square-foot (SF) office = 800 metric tons/year CO_2
- 30,000 SF retail = 2,500 metric tons/year CO_2
- 30,000 SF supermarket = 4,300 metric tons/year CO_2

Thus, in order to assure appropriate market capture on an emissions inventory basis, it will be important to examine commercial project size by type, instead of in the aggregate (which has been done in this paper).

The industrial sector is less amenable to a unit-based approach given the diversity of projects within this sector. One option would be to use a quantitative threshold of 900 tons for industrial projects in order to provide for rough equivalency between different sectors. Industrial emissions can result from both stationary and mobile sources. However, if the CARB rationale for > 90 percent stationary source capture with a threshold of 25,000 metric tons holds, then a 900 metric ton threshold would likely capture at least 90 percent (and likely more) of new industrial sources. Further examination of unit-based industrial thresholds, such as the number of employees or manufacturing floor space or facility size, may provide support for a unit-based threshold based on market capture.

This threshold would require the vast majority of new development emission sources to quantify their GHG emissions, apportion the forecast emissions to relevant source categories, and develop GHG mitigation measures to reduce their emissions.

Threshold 2.6. Projects of Statewide, Regional, or Areawide Significance

For this threshold, a set of qualitative, tiered CEQA thresholds would be adopted based on the definitions of "projects with statewide, regional or areawide significance" under the Guidelines for California Environmental Quality Act, CCR Title 14, Division 6, Section 15206(b).

Project sizes defined under this guideline include the following:

- Proposed residential development of more than 500 dwelling units.
- Proposed shopping center or business establishment employing more than 1,000 persons or encompassing more than 500,000 square feet of floor space.
- Proposed commercial office building employing more than 1,000 persons or encompassing more than 250,000 square feet of floor space.
- Proposed hotel/motel development of more than 500 rooms.
- Proposed industrial, manufacturing or processing plant or industrial park planned to house more than 1,000 persons, or encompassing more than 600,000 square feet of floor space.

These thresholds would correspond to the GHG emissions of approximately 9,000 metric tons for residential projects, 13,000 metric tons for office projects, and 41,000 metric tons for retail projects. These thresholds would capture approximately half of new residential development and substantially less than half of new commercial development. It is unknown what portion of the new industrial or manufacturing GHG inventory would be captured by this approach.

Threshold 2.7 Efficiency-Based Thresholds

For this approach, thresholds would be based on measurements of efficiency. For planning efforts, the metric could be GHG emissions per capita or per job or some combination thereof. For projects, the metric could be GHG emission per housing unit or per square foot of commercial space. In theory, one could also develop metrics for GHG emissions per dollar of gross product to measure the efficiency of the economy.

This approach is attractive because it seeks to benchmark project GHG intensity against target levels of efficiency. The thresholds would need to be set such that there is reasonably foreseeable and sufficient reductions compared to business as usual to support meeting AB 32 and S-3-05 goals in time (in combination with command and control regulations). Because this approach would require substantial data and modeling to fully develop, this is a concept considered as a potential future threshold and not appropriate for interim guidance in the short term. Thus, it is not evaluated in the screening evaluation in the next section.

Table 3 compares the results for each of the approaches.

Table 3: Comparison of Approach 2 Tiered Threshold Options

Threshold	**GHG Emission Threshold (metric tons/year)**	**Future Development Captured by GHG Threshold**
2.1: Zero Threshold	0 tons/year	All
2.2: Quantitative Threshold Based on Market Capture	~900 tons/year	Residential development > 50 dwelling units Office space > 36,000 ft^2 Retail space >11,000 ft^2 Supermarkets >6.300 ft^2 small, medium, large industrial
2.3: CARB GHG Mandatory Reporting Threshold OR Potential Cap and Trade Entry Level	25,000 metric tons/year OR 10,000 metric tons/year	Residential development >1,400 dwelling units OR 550 dwelling units Office space >1 million ft^2 OR 400,000 ft^2 Retail space >300,000 ft^2 OR 120,000 ft^2 Supermarkets >175,000 ft^2 OR 70,000 ft^2 medium/larger industrial
2.4: Regulated Inventory Capture	40,000 – 50,000 metric tons/year	Residential development >2,200 to 2,600 dwelling units Office space >1.5 to 1.8 million ft^2 Retail space >470,000 to 560,000 ft^2 Supermarkets >270,000 to 320,000 ft^2 medium/larger industrial
2.5: Unit-Based Threshold Based on Market Capture	Not applicable.	Residential development >50 dwelling units Commercial space >50,000 ft^2 > small, medium, large industrial (with GHG emissions > 900 tonsCO2e)
2.6: Projects of Statewide, Regional, or Areawide Significance	Not applicable.	Residential development >500 dwelling units Office space >250,000 ft^2 Retail space >500,000 ft^2 Hotels >500 units Industrial project >1,000 employees Industrial project >40 acre or 650,000 ft^2
2.7: Efficiency-Based Thresholds	TBD tons/year/person TBD tons/year/unit	Depends on the efficiency measure selected.

Implementing CEQA With Tiered Thresholds

Several issues related to Approach 2 are addressed below:

1. *Some applications of this approach may need to be embodied in a duly approved General Plan, or in some other formal regulation or ordinance to be fully enforceable.* Because CEQA does not expressly provide that projects may be deemed insignificant based on implementation of a set of mitigations, this approach may need to be supported with specific and enforceable mechanisms adopted with due public process.

2. *How would this concept affect adoption of air district rules and regulations?* Proposed air district rules and regulations may be subject to CEQA like other projects and plans. Thus, if significance thresholds were adopted by an APCD or AQMD, then they could also apply to air district discretionary actions. If GHG emissions would be increased by a rule or regulation for another regulated pollutant, that would be a potential issue for review under CEQA.

3. *Mitigation measures may not be all-inclusive; better measures now or new future technology would make these measures obsolete.* The mandatory mitigation measures could be periodically updated to reflect current technology, feasibility, and efficiency.

4. *Total reduction may not be quantified or difficult to quantify.* CEQA only requires the adoption of feasible mitigation and thus the reduction effectiveness of required mitigation should not be in question. However, the precise reduction effectiveness may indeed be difficult to identify. As described above, if a quantitative threshold is selected as the measure of how much mitigation is mandated, then best available evidence will need to be used to estimate resultant GHG emissions with mitigation adoption. If a qualitative threshold is selected, then it may not be necessary to quantify reductions.

5. *Difficult to measure progress toward legislative program goals.* One could require reporting of project inventories to the Climate Action Registry, air district, or regional council of governments, or other suitable body. Collection of such data would allow estimates of the GHG intensity of new development over time, which could be used by CARB to monitor progress toward AB 32 goals.

6. *Measures may have adverse impacts on other programs.* The identification of mandatory mitigation will need to consider secondary environmental impacts, including those to air quality.

7. *Consideration of life-cycle emissions.* In many cases, only direct and indirect emissions may be addressed, rather than life-cycle emissions. A project applicant has traditionally been expected to only address emissions that are closely related and within the capacity of the project to control and/or influence. The long chain

8. of economic production resulting in materials manufacture, for example, involves numerous parties, each of which in turn is responsible for the GHG emissions associated with their particular activity. However, there are situations where a lead agency could reasonably determine that a larger set of upstream and downstream emissions should be considered because they are being caused by the project and feasible alternatives and mitigation measures may exist to lessen this impact.

Approach 2 Tiered Threshold with Mandatory Mitigation

As shown in Table 2, due to the cumulative nature of GHG emissions and climate change impacts, there could be a level of mandatory reductions and/or mitigation for all projects integrated into a tiered threshold approach. In order to meet AB 32 mandates by 2020 and S-3-05 goals, there will need to be adoption of GHG reduction measures across a large portion of the existing economy and new development. As such, in an effort to support a determination under CEQA that a project has a less than considerable contribution to significant cumulative GHG emissions, mitigation could be required on a progressively more comprehensive basis depending on the level of emissions.

- Level 1 Reductions – These reduction measures would apply to all projects and would only consist of AB 32 and other local/state mandates. They would be applied to a project from other legal authority (not CEQA). Level 1 reductions could include such measures as bike parking, transit stops for planned routes, Energy Star roofs, Energy Star appliances, Title 24 compliance, water use efficiency, and other measures. All measures would have to be mandated by CARB or local regulations and ordinances.

- Level 2 Mitigation – Projects that exceed the determined threshold would be required to first implement readily available technologies and methodologies with widespread availability. Level 2 Mitigation could include such measures as: parking reduction below code minimum levels, solar roofs, LEED Silver or Gold Certification, exceed Title 24 building standards by 20 percent, Traffic Demand Management (TDM) measures, and other requirements.

- Level 3 Mitigation - If necessary to reduce emissions to the thresholds, more extensive mitigation measures that represent the top tier of feasible efficiency design would also be required. Level 3 Mitigation could include such measures as: on-site renewable energy systems, LEED Platinum certification, exceed Title 24 building requirements by 40 percent, required recycled water use for irrigation, zero waste/high recycling requirements, mandatory transit pass provision, and other measures.

- Offset Mitigation – If, after adoption of all feasible on-site mitigation, the project is still found to exceed a Tier 2 quantitative threshold, or exceed a Tier 3 qualitative threshold, or if a project cannot feasibly implement the mandatory on-site mitigation, then purchases of offsets could be used for mitigation. In the case of a quantitative threshold, the amount of purchase would be to offset below the Tier 2 significance threshold. In the case of a qualitative threshold, the amount of purchase could be to offset GHG emissions overall to below the lowest equivalent GHG emissions among the Tier 2 qualitative thresholds. With Threshold 2.5, this would be approximately 900 tons of GHG emissions (corresponding to 50 residential units). With Threshold 2.6, this would be approximately 9,000 tons (corresponding to 500 residential units). Alternatively, one could require purchase of offsets in the amount of a set percentage (such as 90% or 50% for example) of the residual GHG emissions (after other mitigation). As discussed earlier, any decision to include or require the use of emission reduction credits (or offsets) must consider issues of availability, quality, and environmental justice.

Substantial Evidence Supporting Different Thresholds

If a project can be shown by substantial evidence not to increase GHG emissions relative to baseline emissions, then no fair argument will be available that the project contributes considerably to a significant cumulative climate change impact.

It is more challenging to show that a project that increases GHG emissions above baseline emissions does not contribute considerably to a significant cumulative climate change impact. It is critical therefore, to establish an appropriate cumulative context, in which, although an individual project may increase GHG emissions, broader efforts will result in net GHG reductions.

Approach 1-based thresholds that by default will require an equal level of GHG reductions from the existing economy (Thresholds 1.1, 1.3, and 1.4) may be less supportable in the short run (especially before 2012) than Approach 1.2 (which requires new development to be relatively more efficient than a retrofitted existing economy). This is because, prior to 2012, there will only be limited mandatory regulations implementing AB 32 that could address the existing economy in a truly systematic way that can be relied upon to demonstrate that overall GHG reduction goals can be achieved by 2020. Approach 1.2 will still rely on substantial reductions in the existing economy but to a lesser degree.

Approach 1-based thresholds that would spread the mitigation burden across a sector (Threshold 1.3) or across a region (Threshold 1.4) will allow for tradeoffs between projects or even between municipalities. In order to demonstrate that a sector or a region is achieving net reductions overall, there would need to be feasible, funded, and mandatory requirements in place promoting an overall reduction scheme, in order for a project to result in nominal net increased GHG emissions.

Approach 2-based thresholds that capture larger portions of the new development GHG inventory (Thresholds 2.2 and 2.5) would promote growth that results in a smaller increase in GHG emissions; they may therefore be more supportable than thresholds that do not and that have a greater reliance on reductions in the existing economy (Thresholds

2.3, 2.4, and 2.6), especially in the next three to five years. With an established cumulative context that demonstrates overall net reductions, all threshold approaches could be effective in ensuring growth and development that significantly mitigates GHG emissions growth in a manner that will allow the CARB to achieve the emission reductions necessary to meet AB 32 targets. In that respect, all of these thresholds are supported by substantial evidence.

Evaluation of Non-Zero Threshold Options

Overarching issues concerning threshold development are reviewed below. Where appropriate, different features or application of the two conceptual approaches and the various options for thresholds under each conceptual approach described above are analyzed. The screening evaluation is summarized in Tables 4 (Approach 1) and 5 (Approach 2). The summary tables rate each threshold for the issues discussed below based on the level of confidence (low, medium or high) ascribed by J&S. The confidence levels relate to whether a threshold could achieve a particular attribute, such as emission reduction effectiveness. For example, a low emission reduction effectiveness rating means the threshold is not expected to capture a relatively large portion of the new development inventory.

As described above, Threshold 2.7 is not included in this evaluation because the data to develop an efficiency-based threshold has not been reviewed at this time and because this threshold is not considered feasible as an interim approach until more detailed inventory information is available across the California economy.

<u>What is the GHG Emissions Effectiveness of Different Thresholds?</u>

Effectiveness was evaluated in terms of whether a threshold would capture a large portion of the GHG emissions inventory and thus require mitigation under CEQA to control such emissions within the larger framework of AB 32. In addition, effectiveness was also evaluated in terms of whether a threshold would require relatively more or less GHG emissions reductions from the existing economy verses new development. This is presumptive that gains from the existing economy (through retrofits, etc.) will be more difficult and inefficient relative to requirements for new development.

Approach 1-based thresholds that require equivalent reductions relative to business-as-usual (Thresholds 1.1, 1.3, and 1.4) for both the existing and new economy will be less effective than thresholds that support lower-GHG intensity new development (Approach 1.2). However, since Approach 1-based thresholds do not establish a quantitative threshold below which projects do not have to mitigate, the market capture for new development is complete.

Approach 2-based thresholds can be more or less effective at capturing substantial portions of the GHG inventory associated with new development depending on where the quantitative or qualitative thresholds are set. Lower thresholds will capture a broader range of projects and result in greater mitigation. Based on the review of project data for the select municipalities described in the Approach 2 section above, thresholds based on the CARB Reporting Threshold/Cap and Trade Entry Level (Threshold 2.4) or CEQA definitions of "Statewide, Regional or Areawide" projects (Threshold 2.6) will result in a limited capture of the GHG inventory. Lower quantitative or qualitative thresholds (Thresholds 2.1, 2.2 and 2.5) could result in capture of greater than 90 percent of new development.

Are the Different Thresholds Consistent with AB 32 and S-3-05?

Thresholds that require reductions compared to business-as-usual for all projects or for a large portion of new development would be consistent with regulatory mandates. In time, the required reductions will need to be adjusted from 2020 (AB 32) to 2050 (S-3-05) horizons, but conceptually broad identification of significance for projects would be consistent with both of these mandates. Thresholds that exclude a substantial portion of new development would likely not be consistent, unless it could be shown that other more effective means of GHG reductions have already been, or will be adopted, within a defined timeframe.

All Approach 1-based thresholds would be consistent with AB 32 and S-3-05 if it can be demonstrated that other regulations and programs are effective in achieving the necessary GHG reduction from the existing economy to meet the overall state goals.

Approach 2-based thresholds that include substantive parts of the new development GHG inventory (Thresholds 2.1, 2.2 and 2.5) will be more consistent with AB 32 and S-3-05 than those that do not (Thresholds 2.3, 2.4, and 2.6) unless it can be demonstrated that other regulations and programs are effective in achieving the necessary GHG reduction from the existing economy to meet the overall state goals.

What are the Uncertainties Associated with Different Thresholds?

All thresholds have medium to high uncertainties associated with them due to the uncertainty associated with the effectiveness of AB 32 implementation overall, the new character of GHG reduction strategies on a project basis, the immaturity of GHG reduction technologies or infrastructure (such as widespread biodiesel availability), and the uncertainty of GHG reduction effectiveness of certain technologies (such as scientific debate concerning the relative lifecycle GHG emissions of certain biofuels, for example).

In general, Approach 1-based thresholds have higher uncertainties than Approach 2 thresholds because they rely on a constantly changing definition of business-as-usual. Threshold 1.2, with its relatively smaller reliance on the existing economy for GHG reductions has relatively less uncertainty than other Approach 1 thresholds. Thresholds that spread mitigation more broadly (Thresholds 1.3 and 1.4) have less uncertainty by avoiding the need for every project to mitigate equally.

Approach 2 thresholds with lower quantitative (2.1 and 2.2) or qualitative (2.5) thresholds will have uncertainties associated with the ability to achieve GHG reductions from small to medium projects. Approach 2 thresholds with higher quantitative (2.3, 2.4) or qualitative (2.6) thresholds will have uncertainties associated with the ability to achieve relatively larger GHG reductions from the existing economy.

What are Other Advantages/Disadvantages of the Different Thresholds?

Thresholds with a single project metric (Thresholds 1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 2.5, and 2.6) will be easier to apply to individual projects and more easily understood by project applicants and lead agencies broadly. Thresholds that spread mitigation across sectors (1.3) or regions (1.4), while simple in concept, will require adoption of more complicated cross-jurisdictional reduction plans or evaluation of broad sector-based trends in GHG intensity reduction over time. Approach 1 options would require all projects to quantify emissions in order to determine needed reductions relative to business-as-usual (which will change over time as described above). Concepts that are unit-based (Threshold 2.5 and 2.6) will not result in thresholds that have equal amount of GHG emissions, and thus equity issues may arise.

Table 4: Non-Zero Threshold Evaluation Matrix – Approach 1

Approach 1	**1.1**	**1.2**	**1.3**	**1.4**
	28% - 33% Reduction from BAU by 2020 by Project	**50% Reduction from BAU by 2020 by Project**	**28% - 33% Reduction by 2020 by Sector**	**28% - 33% Reduction by 2020 by Region**
GHG Emissions Reduction Effectiveness	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.	**Medium** - Captures all new projects and has a more realistic level of reductions from the existing economy.	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.
Economic Feasibility	**Low** - Some projects will not be able to afford this level of reduction without effective market-based mechanisms like offsets.	**Low** - Some projects will not be able to afford this level of reduction without effective market-based mechanisms like offsets.	**Medium** - Sectors as a whole will be better able to achieve reductions than individual projects.	**Low** - Some regions and newly developed areas may not be able to afford this level of reduction without effective market-based mechanisms like offsets.
Technical Feasibility	**Medium** - Some projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**Low** - Relatively larger set of projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**High** - Some projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**Medium** - Some regions and newly developed areas may not be able to afford this level of reduction without effective market-based mechanisms like offsets.
Logistical Feasibility	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.
Consistency with AB-32 and S-03-05	**Medium** - Would require heavy reliance on command and control gains.	**High**	**Medium-High** - Would rely on command and control gains, but would allow sectoral flexibility.	**Medium-High** - Would rely on command and control gains, but would allow regional flexibility.
Cost Effectiveness	**Low** - Will require all types of projects to reduce the same regardless of the cost/ton of GHG reductions.	**Low** - Will require all types of projects to reduce the same regardless of the cost/ton of GHG reductions.	**Low/Medium** - Allows tradeoffs within sector between high and low cost reduction possibilities but not between sectors.	**Low/Medium** - Allows tradeoffs within region between high and low cost reduction possibilities, but not between regions.
Uncertainties	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.	**Medium/High** - BAU changes over time. Ability to limit GHG emissions from other new development will take years to demonstrate.	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.
Other Advantages	Simple/easy to explain.	Simple/easy to explain.	Spreads mitigation broadly	Spreads mitigation broadly
Other Disadvantages	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.

Table 5: Non-Zero Threshold Evaluation Matrix – Approach 2

Approach 2	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**
	Zero Threshold	**Quantitative (900 tons)**	**Quantitative CARB Reporting Threshold/Cap and Trade (25,000 tons/ 10,000 tons)**	**Quantitative Regulated Inventory Capture (~40,000 - 50,000 tons)**	**Qualitative Unit-Based Thresholds**	**Statewide, Regional or Areawide (CEQA Guidelines 15206(b)).**
GHG Emissions Reduction Effectiveness	**High** - Captures all sources.	**High** - Market capture at >90%. Captures diverse sources.	**Medium** - Moderate market capture.	**Low** - Low market capture.	**High** - Market capture at ~90%. Captures diverse sources; excl. smallest proj.	**Medium** - Moderate market capture. Excludes small and med. projects.
Economic Feasibility	**Low** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**High** - Large projects have greater ability to absorb cost.	**High** - Large projects have greater ability to absorb cost.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**High** - Large projects have greater ability to absorb cost.
Technical Feasibility	**Low** - Early phases will be substantial change in BAU, esp. for smaller projects; may be inefasible to mitigate.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be inefficient to mitigate.	**High** - Greater opportunities for multiple reduction approaches.	**High** - Greater opportunities for multiple reduction approaches.	**Medium** - Early phases will be substantial change in BAU, particularly for smaller projects may be inefficient to mitigate.	**High** - Greater opportunities for multiple reduction approaches.
Logistical Feasibility	**Low** - Unless fee or offset basis,very difficult to mitigate all projects.	**Medium** - BMPs broadly written to allow diversity; new req. will take time to integrate into new dev.	**High** - Less mitigation.	**High** - Less mitigation.	**Medium** - BMPs broadly written to allow diversity; new req. will take time to integrate into new dev.	**High** - Less mitigation.
Consistency with AB-32 and S-03-05	**High** - Market capture.	**High** - Market capture at >90%.	**Low** - Would rely on command and control success heavily.	**Low** - Would rely on command and control success heavily.	**Medium** - Need to demonstrate adequate market capture over time.	**Low** - Would rely on command and control success heavily.
Cost Effectiveness	**Low** - Will result in inefficient mitigation approaches. Efficiency will improve in time.	**Medium** - Emphasis is on new dev., req. for mitigation will result in inefficient mitigation approaches in early phases. Efficiency will improve in time.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.	**Medium** - Emphasis is on new dev.; req. for mitigation will result in inefficient mitigation approaches in early phases. Efficiency will improve in time.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.
Uncertainties	**High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects unlikely.	**Medium/High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects uncertain.	**High** - Gains from command and control likely longer to be realized.	**High** - Gains from command and control likely longer to be realized.	**Medium/High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects uncertain.	**High** - Gains from command and control likely longer to be realized.
Other Advantages	Single threshold.	Single threshold. BMPs can be updated. Greenlist can be updated.	Single threshold. Does not change CEQA processing for most projects. CARB inventory = project inv.. All projects treated same.	Single threshold. Does not change CEQA processing for most projects. Follows established SIP practice.	BMPs can be updated. Greenlist can be updated. Unit-Based thresholds can be updated.	Existing guideline. Does not change CEQA processing for most projects. Endorsed by Cal. Chapter of the APA.
Other Disadvantages	Requires all projects to quantify emissions.	Requires nearly all projects to quantify emissions.			Sectoral projects have different GHG emis. Only largest projects to quantify emis.	Sectoral projects have different GHG emissions.

Introduction

This chapter evaluates the availability of various analytical methods and modeling tools that can be applied to estimate the greenhouse gas emissions from different project types subject to CEQA. This chapter will also provide comments on the suitability of the methods and tools to accurately characterize a projects emissions and offer recommendations for the most favorable methodologies and tools available. Some sample projects will be run through the methodologies and modeling tools to demonstrate what a typical GHG analysis might look like for a lead agency to meet its CEQA obligations. The air districts retained the services of EDAW environmental consultants to assist with this effort.

Methodologies/Modeling Tools

There are wide varieties of discretionary projects that fall under the purview of CEQA. Projects can range from simple residential developments to complex expansions of petroleum refineries to land use or transportation planning documents. It is more probably than not, that a number of different methodologies would be required by any one project to estimate its direct and indirect GHG emissions. Table 10 contains a summary of numerous modeling tools that can be used to estimate GHG emissions associated with various emission sources for numerous types of project's subject to CEQA. The table also contains information about the models availability for public use, applicability, scope, data requirements and its advantages and disadvantages for estimating GHG emissions.

In general, there is currently not one model that is capable of estimating all of a project's direct and indirect GHG emissions. However, one of the models identified in Table 9 would probably be the most consistently used model to estimate a projects direct GHG emissions based on the majority of projects reviewed in the CEQA process. The Urban Emissions Model (URBEMIS) is designed to model emissions associated with development of urban land uses. URBEMIS attempts to summarize criteria air pollutants and CO_2 emissions that would occur during construction and operation of new development. URBEMIS is publicly available and already widely used by CEQA practitioners and air districts to evaluate criteria air pollutants emissions against air district-adopted significance thresholds. URBEMIS is developed and approved for statewide use by CARB. The administrative reasons for using URBEMIS are less important than the fact that this model would ensure consistency statewide in how CO_2 emissions are modeled and reported from various project types.

One of the shortfalls of URBEMIS is that the model does not contain emission factors for GHGs other than CO_2, except for methane (CH_4) from mobile-sources, which is converted to CO_2e. This may not be a major problem since CO_2 is the most important GHG from land development projects. Although the other GHGs have a higher global warming potential, a metric used to normalize other GHGs to CO_2e, they are emitted in far fewer quantities. URBEMIS does not calculate other GHG emissions associated with off-site waste disposal, wastewater treatment, emissions associated with goods and services consumed by the residents and workers supported by a project. Nor does URBEMIS calculate GHGs associated with consumption of energy produced off-site. (For that matter, URBEMIS does not report criteria air pollutant emissions from these sources either).

Importantly, URBEMIS does not fully account for interaction between land uses in its estimation of mobile source operational emissions. Vehicle trip rates are defaults derived from the Institute of Transportation Engineers trip generation manuals. The trip rates are widely used and are generally considered worst-case or conservative. URBEMIS does not reflect "internalization" of trips between land uses, or in other words, the concept that a residential trip and a commercial trip are quite possibly the same trip, and, thus, URBEMIS counts the trips separately. There are some internal correction settings that the modeler can select in URBEMIS to correct for "double counting"; however, a project-specific "double-counting correction" is often not available. URBEMIS does allow the user to overwrite the default trip rates and characteristics with more project-specific data from a traffic study prepared for a project.

Residential, Commercial, Mixed-Use Type Projects/ Specific Plans

Direct Emissions

URBEMIS can be used to conduct a project-specific model run and obtain CO_2e emissions for area and mobile sources from the project, and convert to metric tons CO_2e. When a project-specific traffic study is not available, the user should consult with their local air district for guidance. Many air district staff are experienced practitioners of URBEMIS and can advise the lead agency or the modeler on how to best tailor URBEMIS default input parameters to conduct a project-specific model run. When a traffic study has been prepared for the project, the user must overwrite default trip length and trip rates in URBEMIS to match the total number of trips and vehicle miles traveled (VMT) contained in the traffic study to successfully conduct a project-specific model run. URBEMIS is recommended as a calculation tool to combine the transportation study (if available) and EMFAC emission factors for mobile-sources. Use of a project-specific traffic study gets around the main shortfall of URBEMIS: the lack of trip internalization. URBEMIS also provides the added feature of quantifying direct area-source GHG emissions.

Important steps for running URBEMIS

1. Without a traffic study prepared for the project, the user should consult with the local air district for direction on which default options should be used in the modeling exercise. Some air districts have recommendations in the CEQA guidelines.

2. If a traffic study was prepared specifically for the project, the following information must be provided:

a. Total number of average daily vehicle trips *or* trip-generation rates by land use type per number of units; and,

b. Average VMT per residential *and* nonresidential trip.

c. The user overwrites the "Trip Rate (per day)" fields for each land use in URBEMIS such that the resultant "Total Trips" and the "Total VMT" match the number of total trips and total VMT contained in the traffic study.

d. Overwrite "Trip Length" fields for residential and nonresidential trips in UBEMIS with the project-specific lengths obtained form the traffic study.

3. Calculate results and obtain the CO_2 emissions from the URBEMIS output file (units of tons per year [TPY]).

<u>Indirect Emissions</u>

URBEMIS does estimate indirect emissions from landscape maintenance equipment, hot water heaters, etc. URBEMIS does not however, provide modeled emissions from indirect sources of emissions, such as those emissions that would occur off-site at utility providers associated with the project's energy demands. The California Climate Action Registry (CCAR) Protocol v.2.2 includes methodology, which could be used to quantify and disclose a project's increase in indirect GHG emissions from energy use. Some assumptions must be made for electrical demand per household or per square foot of commercial space, and would vary based on size, orientation, and various attributes of a given structure. An average rate of electrical consumption for residential uses is 7,000 kilowatt hours per year per household and 16,750 kilowatt hours per thousand square feet of commercial floor space. Commercial floor space includes offices, retail uses, warehouses, and schools. These values have been increasing steadily over the last 20 years. Energy consumption from residential uses has increased due to factors such as construction and occupation of larger homes, prices of electricity and natural gas, and increased personal income allowing residents to purchase more electronic appliances. Commercial energy consumption is linked to factors such as vacancy rates, population, and sales.

The modeler will look up the estimated energy consumption for the project's proposed land uses under year of project buildout, or use the values given in the previous paragraph for a general estimate. The CCAR Protocol contains emission factors for CO_2, CH_4, and nitrous oxide. The "CALI" region grid serves most of the State of California. If a user has information about a specific utility provider's contribution from renewable sources, the protocol contains methodology to reflect that, rather than relying on the statewide average grid. The incremental increase in energy production associated with project operation should be accounted for in the project's total GHG emissions for inclusion in the environmental document.

The incremental increase in energy production associated with project operation should be accounted for in the project's total GHG emissions, but it should be noted that these emissions would be closely controlled by stationary-source control-based regulations and additional regulations are expected under AB 32. However, in the interest of disclosing project-generated GHG emissions and mitigating to the extent feasible, the indirect emissions from off-site electricity generation can be easily calculated for inclusion in the environmental document.

Example Project Estimates for GHG Emissions

Residential Project

Project Attributes:

- 68 detached dwelling units
- 15.9 acres
- 179 residents
- 0 jobs
- Located in unincorporated Placer County (PCAPCD jurisdiction)
- Analysis year 2009

As shown in Table 6, the project's direct GHG emissions per service population (SP) would be approximately 8 metric tons CO_2e/SP/year.

Table 6: Residential Project Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	251	Residents	179
Mobile-source emissions	1,044	Jobs	0
Indirect emissions (from CCAR Protocol)	174		
Total operational emissions	**1,469**	Service population	179
Operational emissions/SP	**8.2**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population(see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Commercial Project

Project Attributes:

- Free Standing Discount Superstore: 241 thousand square feet (ksf)
- 0 residents

- 400 jobs
- Located in the San Joaquin Valley Air Pollution Control District's (SJVAPCD) jurisdiction
- Analysis year 2009

Table 7: Commercial Project Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	**Metric Tons/Year CO_2e**	**Demographic Data**	
Area-source emissions	464	Residents	0
Mobile-source emissions	13,889	Jobs	400
Indirect emissions (from CCAR Protocol)	1,477		
Total operational emissions	**15,830**	Service population	400
Operational emissions/SP	**39.6**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Specific Plan

If used traditionally with default trip rates and lengths, rather than project-specific (Traffic Analysis Zone-specific) trip rates and lengths, URBEMIS does not work well for specific plan or general plan-sized projects with multiple land use types proposed. However, in all instances, projects of these sizes (several hundred or thousand acres) would be accompanied by a traffic study. Thus, for large planning-level projects, URBEMIS can be used as a calculation tool to easily obtain project-specific mobile-source emissions. The user should follow the steps discussed above; wherein he/she overwrites the default ITE trip rates for each land use type with that needed to make total VMT match that contained in the traffic study. The URBEMIS interface is a simple calculator to combine the traffic study and EMFAC emissions factors for mobile-source CO_2.

Project Attributes:

- 985 acres
- Total dwelling units: 5,634
- Commercial/Mixed Use: 429 ksf
- Educational: 2,565 ksf
- 14,648 residents
- 3,743 jobs
- Located in Sacramento County (SMAQMD jurisdiction)
- Analysis year 2009

Table 8: Specific Plan Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	23,273	Residents	14,648
Mobile-source emissions	73,691	Jobs	3,743
Indirect emissions (from CCAR Protocol)	32,744		
Total operational emissions	**129,708**	Service population	18,391
Operational emissions/SP	**7.1**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

The specific plan example, when compared to the residential or commercial examples, illustrates the benefit of a mixed-use development when you look at CO_2e emissions per resident or job (service population) metric (see definition of service population below in discussion of Normalization/Service Population Metric). Though this particular specific plan is not an example of a true jobs/housing balance, the trend is clear: accommodating residents and jobs in a project is more efficient than residents or jobs alone.

Stationary- and Area-Source Project Types

GHG emissions from stationary or area sources that require a permit to operate from the air district also contain both direct and indirect sources of emissions. Examples of these types of sources would be fossil fuel power plants, cement plants, landfills, wastewater treatment plants, gas stations, dry cleaners and industrial boilers. All air districts have established procedures and methodologies for projects subject to air district permits to calculate their regulated pollutants. It is anticipated that these same procedures and methodologies could be extended to estimate a permitted facility's GHG calculations. For stationary and area sources that do not require air district permits, the same methodologies used for permitted sources could be used in addition to URBEMIS and CCAR GRP to calculate GHG emissions from these facilities.

Wastewater Treatment Facilities

Direct GHG emissions associated with a proposed waste water treatment plant can be calculated using AP-42 emission factors from Chapter 4.3.5 Evaporative Loss Sources: Waste Water-Greenhouse Gases and the CCAR methodology. In general, most wastewater operations recover CH_4 for energy, or use a flare to convert the CH_4 to CO_2. There are many types of wastewater treatment processes and the potential for GHG emissions from different types of plants varies substantially. There is not one standard set of emission factors that could be used to quantify GHG emissions for a state "average" treatment plant. Thus, research will need to be conducted on a case-by-case basis to determine the "Fraction Anaerobically Digested" which is a function of the type of treatment process. Indirect emissions from these facilities can be calculated using the CCAR energy use protocols and URBEMIS model for transportation emissions.

Solid Waste Disposal Facilities

Air districts will have emission estimate methodologies established for methane emissions at permitted landfills. In addition, EPA's Landfill Gas Emissions Model (LandGem) and the CCAR methodology could also be used to quantify GHG emissions from landfill off gassing; however, this model requires substantial detail be input. The model uses a decomposition rate equation, where the rate of decay is dependent on the quantity of waste in place and the rate of change over time. This modeling tool is free to the public, but substantial project detail about the operation of the landfill is needed to run the model. Indirect emissions from these facilities can be calculated using the CCAR energy use protocols and URBEMIS model for transportation emissions.

Construction Emissions

GHG emissions would occur during project construction, over a finite time. In addition, a project could result in the loss of GHG sequestration opportunity due primarily to the vegetation removed for construction. URBEMIS should be used to quantify the mass of CO_2 that would occur during the construction of a project for land development projects. Some construction projects would occur over an extended period (up to 20–30 years on a planning horizon for general plan buildout, or 5–10 years to construct a dam, for example). OFFROAD emission factors are contained in URBEMIS for CO_2 emissions from construction equipment. For other types of construction projects, such as roadway construction projects or levee improvement projects, SMAQMD's spreadsheet modeling tool, the Road Construction Emissions Model (RoadMod), should be used. This tool is currently being updated to include CO_2 emissions factors from OFFROAD.

The full life-cycle of GHG emissions from construction activities is not accounted for in the modeling tools available, and the information needed to characterize GHG emissions from manufacture, transport, and end-of-life of construction materials would be speculative at the CEQA analysis level. The emissions disclosed will be from construction equipment and worker commutes during the duration of construction activities. Thus, the mass emissions in units of metric tons CO_2e/year should be reported in the environmental document as new emissions.

General Plans

In the short-term, URBEMIS can be used as a calculation tool to model GHG emissions from proposed general plans, but only if data from the traffic study is incorporated into model input. The same methodology applied above in the specific plan example applies to general plans. The CCAR GRP can be used to approximate indirect emissions from increased energy consumption associated with the proposed plan area. The same models and methodologies discussed previously for wastewater, water supply and solid waste would be used to estimate indirect emissions resulting from buildout of the general plan.

In the longer-term, more complex modeling tools are needed, which would integrate GHG emission sources from land use interaction, such as I-PLACE^{3}S or CTG Energetics' Sustainable Communities Custom Model attempt to do. These models are not currently available to the public and only have applicability in certain areas of the state. It is important that a tool with statewide applicability be used to allow for consistency in project treatment, consideration, and approval under CEQA.

Scenarios

At the general plan level, the baseline used for analyzing most environmental impacts of a general plan update is typically no different from the baseline for other projects. The baseline for most impacts represents the existing conditions, normally on the date the Notice of Preparation is released. Several comparative scenarios could be relevant, depending on the exact methodological approach and significance criteria used for GHG assessment:

- Existing Conditions. The GHG emissions associated with the existing, on-the-ground conditions within the planning area.

- 1990 conditions. The GHG emissions associated with the general plan area in 1990. This is relevant due to the state's AB 32 GHG emission reduction goals' benchmark year of 1990. The GHG-efficiency of 1990 development patterns could be compared to that of the general plan buildout.

- Buildout of the Existing General Plan. The GHG emissions associated with buildout of the existing general plan (without the subject update). This is the no project alternative for the purposes of general plan CEQA analysis.

- Buildout of the Updated General Plan. The GHG emissions associated with buildout of the general plan, as proposed as a part of the subject update. This would include analysis of any changes included as a part of the general plan update for the existing developed portions of the planning area. Many communities include redevelopment and revitalization strategies as a part of the general plan update. The general plan EIR can include assumptions regarding what level and type of land use change could be facilitated by infill and redevelopment. Many jurisdictions wish to provide future projects consistent with these land use change assumptions with some environmental review streamlining. In addition, many communities include transit expansions, pedestrian/bicycle pathway improvements, multi-modal facility construction, travel demand policies, energy efficiency policies, or other measures that could apply to the existing developed area, just as they may apply to any new growth areas. Such policies could affect the overall GHG emissions of the built out general plan area.

- Increment between Buildout of Updated General Plan and Existing General Plan Area. There are many important considerations associated with the characterization of the impact of the General Plan update. The actual GHG emissions impact could be described as the difference between buildout under the existing and proposed land use plan (No-Build Alternative). However, the courts have held that an EIR should also analyze the difference between the proposed General Plan and the existing environment (*Environmental Planning & Information Council v. County of El Dorado* (EPIC) (1982) 131 Cal.App.3d 350). At the General Plan level, over the course of buildout, some new land uses are introduced, which could potentially add operational GHG emissions and potentially remove existing sequestration potential. Some properties become vacant and are not redeveloped. Other properties become vacant and then are redeveloped. Communities cannot pretend to understand fully in advance each component of land use change. The programmatic document is the preferred method of environmental analysis. Through this programmatic framework, communities develop buildout assumptions as a part of the General Plan that are normally used as a basis of environmental analysis. For certain aspects of the impact analysis, it becomes important not just to understand how much "new stuff" could be accommodated under the updated General Plan, but also the altered interactions between both "new" and "existing" land uses within the planning area. As addressed elsewhere, there are tools available for use in understanding land use/transportation interactions at the General Plan level. Without the GHG targets established by AB 32, a simple mass comparison of existing conditions to General Plan buildout might be appropriate.

However, within the current legal context, the GHG efficiency of the updated General Plan becomes the focus of analysis. Some options in this regard include:

- Estimate the GHG emissions associated with all the land uses included within the planning area upon buildout of the General Plan using no project specific information (regional, countywide, or statewide defaults). Estimate GHG emissions using project specific information from the transportation engineer, transportation demand policies, community design elements, energy efficiency requirements, wastewater treatment and other public infrastructure design changes, and other components. Compare these two calculations. Is the second calculation reduced by the percent needed to meet AB 32 goals compared to the first calculation?

- Estimate the GHG emissions associated with the 1990 planning area and the per-capita or per-service population GHG associated with the 1990 planning area. (Many communities are establishing GHG inventories using different tools). Estimate the GHG emissions associated with buildout of the proposed General Plan update and the resulting per-capita or per-service population GHG emissions. Compare the two calculations. Is the General Plan buildout per-capita or per-service population level greater than the 1990 estimate?

Example General Plan Update: Proposed new growth area

Project Attributes:

- 10,050 single family dwelling units
- 652 multi-family dwelling units
- 136 acres parks
- 2,047 ksf commercial (regional shopping center)
- 2,113 ksf office
- 383 acres industrial park
- 31,293 new residents
- 4,945 new jobs
- Located in Stanislaus County (SJVAPCD jurisdiction)
- Analysis year 2025

Table 9: General Plan Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	**Metric CO_2e**	**Tons/Year**	**Demographic Data**	
Construction emissions	12,083*		Residents	31,293
Area-source emissions	45,708			
Mobile-source emissions	263,954		Jobs	4,945
Indirect emissions (from CCAR Protocol)	78,385			
Total operational emissions	**388,046**		Service population	36,238
Operational emissions/SP	**10.7**			

* Approximately 241,656 metric tons CO_2e total at general plan buildout (assumes 20-year buildout period). Construction emissions were not included in total operational emissions.
Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).
Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Due to the programmatic level of analysis that often occurs at the general plan level, and potential for many relevant GHG emission quantities, it could be preferable to use a qualitative approach. Such an analysis could address the presence of GHG-reducing policy language in the general plan.

Three possible tiers of approaches to addressing GHG mitigation strategies, either as general plan policy, general plan EIR mitigation measures, or both, include:

- Forward planning
- Project toolbox
- Defer to GHG reductions plan

The three basic approaches are described below.

1. Bring reduction strategies into the plan itself. The most effective way for local jurisdictions to achieve GHG emissions reductions in the medium- and long-term is through land use and transportation policies that are built directly into the community planning document. This involves creating land use diagrams and circulation diagrams, along with corresponding descriptive standards, that enable and encourage alternatives to travel and goods movement via cars and trucks. The land use and circulation diagrams provide a general framework for a community where people can conduct their everyday business without necessarily using their cars. The overall community layout expressed as a part of the land use and circulation diagrams is accompanied by a policy and regulatory scheme designed to achieve this community layout. Impact fees, public agency spending, regulations, administrative procedures, incentives, and other techniques are designed to facilitate land use change consistent with the communities' overall vision, as expressed in policy and in the land use diagram. There are many widely used design principles that can be depicted in land use and circulation diagrams and implemented according to narrative objectives, standards, and policies:

- Connectivity. A finely-connected transportation network shortens trip lengths and creates the framework for a community where homes and destinations can be placed close in proximity and along direct routes. A hierarchical or circuitous transportation network can increase trip lengths and create obstacles for walking, bicycling, and transit access. This policy language would likely be found in the Circulation Element.

- Compactness. Compact development, by its nature, can increase the efficiency of infrastructure provision and enable travel modes other than the car. If communities can place the same level of activity in a smaller space, GHG emissions would be reduced concurrently with VMT and avoid unnecessary conversion of open space. This policy language would likely be found in the Land Use Element.

- Diversity. Multiple land use types mixed in proximity around central "nodes" of higher-activity land uses can accommodate travel through means other than a car. The character and overall design of this land use mix is, of course, different from community to community. This policy language would likely be found in the Land Use Element.

- Facilities. Pedestrian, bicycle, and public transportation improvements, planning, and programming are sometimes an afterthought. To get a more GHG-efficient mode share, safe and convenient bike lanes, pedestrian pathways, transit shelters, and other facilities are required to be planned along with the vehicular travel network. This policy language would likely be found in the Circulation Element.

- Redevelopment. One way to avoid GHG emissions is to facilitate more efficient and economic use of the lands in already-developed portions of a community. Reinvestment in existing neighborhoods and retrofit of existing buildings is appreciably more GHG efficient than greenfield development, and can even result in a net reduction in GHG emissions. This policy language would likely be found in the Conservation or Land Use Element.

- Housing and Employment. Most communities assess current and future economic prospects along with long-range land use planning. Part of the objective for many communities is to encourage the coalescence of a labor force with locally available and appropriate job opportunities. This concept is best known as "jobs-housing balance." This policy language would likely be found in the Housing Element.

- Planning Level Versus Project Level. For transportation-related GHG emissions that local governments can mitigate through land use entitlement authority, the overall community land use strategy and the overall transportation network are the most fruitful areas of focus. The reduction capacity of project-specific mitigation measures is greatly limited if supportive land use and transportation policies are lacking at the community planning level. The regional economic context, of course, provides an important backdrop for land use and transportation policy to address GHG emissions. Within this context, the general plan is the readily available tool for local governments to establish such land use and transportation strategies. This policy language would likely be found in the Land Use and Circulation Elements.

- Shipping Mode Shift. Locate shipping-intensive land uses in areas with rail access. Some modes of shipping are more GHG-intensive than others. Rail, for example, requires only about 15 to 25 percent of the energy used by trucks to ship freight equivalent distances and involves reduced transportation-related GHG emissions. Cities and counties have little direct control over the method of shipment that any business may choose. Nevertheless, as a part of the general planning process, cities and counties can address constraints on the use of rail for transporting goods. This policy language would likely be found in the Land Use and Circulation Elements.

2. Provide a "toolbox" of strategies after the project site has been selected. In addition to the examples of design principles that are built into the community planning process, communities can offer project applicants a range of tools to reduce GHG emissions. Mitigation strategies are elaborated in detail in Chapter 9.

3. Defer to General Plan implementation measure. Develop and implement a GHG Emissions Reduction Plan. Another option for local governments would be development of an implementation measure as a part of the general plan that outlines an enforceable GHG reduction program. Perhaps the most well known example of this approach is the result of California's Attorney General settlement of the lawsuit brought against San

Bernardino County. The County has agreed to create a 1990 GHG inventory and develop measures to reduce such emissions according to the state's overall goals. Other communities have pursued similar programs (i.e., the City of San Diego, Marin County). Along with the inventories, targets, and example reduction measures, these programs would include quantitative standards for new development; targets for reductions from retrofitting existing development; targets for government operations; fee and spending program for GHG reduction programs; monitoring and reporting; and other elements. The local government itself should serve as a model for GHG reduction plan implementation, by inventorying emissions from government operations and achieving emission reductions in accordance with the plan's standards. An optional climate change element could be added to contain goals, policies, and this implementation strategy, or this could belong in an optional air quality element.

Other Project Types

Air District Rules, Regulations and Air Quality Plans

Air district air quality plans, rules and regulations could have the potential to increase or decrease GHG emissions within their respective jurisdiction. In general, air district air quality plans, rules and regulations act to reduce ozone precursors, criteria air pollutant and toxic air contaminant emissions, which would almost always act to reduce GHG emissions simultaneously. However, this may not always be the case.

Air Quality Plans

Air districts will have to include GHG emissions analysis as part of their criteria air pollutant and toxic air contaminant air pollutant analysis when considering the adoption of air quality plans and their subsequent rules and regulations needed to implement the plans. Multiple models and methodologies will be needed to accomplish this analysis.

Regional Transportation Plans

Regional transportation plans would also need to be evaluated on a case-by-case basis to determine if a net increase or decrease in GHG emissions would occur. Complex interactions between the roadway network, operating conditions, alternative transportation availability (such as public transit, bicycle pathways, and pedestrian infrastructure), and many other independent parameters specific to a region should be considered. Regional transportation models exist to estimate vehicular emissions associated with regional transportation plans, which includes the ability to estimate GHG emissions.

Normalization/Service Population Metric

The above methodology would provide an estimate of the mass GHG emissions generated by a proposed project, which could be compared to a mass emission threshold. EDAW developed a methodology that would measure a project's overall GHG efficiency in order to determine if a project is more efficient than the existing statewide average for per capita GHG emissions. The following steps could be employed to estimate the GHG-"efficiency," which may be more directly correlated to the project's ability to help obtain objectives outlined in AB 32, although it relies on establishment of an efficiency-based significance threshold. The subcommittee believes this methodology may eventually be appropriate to evaluate the long-term GHG emissions from a project in the context of meeting AB 32 goals. However, this methodology will need substantially more work and is not considered viable for the interim guidance presented in this white paper.

- Divide the total operational GHG emissions by the Service Population (SP) supported by the project (where SP is defined as the sum of the number of residents and the number of jobs supported by the project). This value should be compared to that of the projected statewide GHG emissions inventory from the applicable end-use sectors (electricity generation, residential, commercial/institutional, and mobile-source) in 1990 divided by the projected statewide SP for the year 2020 (i.e., AB 32 requirements), to determine if the project would conflict with legislative goals.
    - If the project's operational GHG/SP falls below AB 32 requirements, then the project's GHG emissions are less than cumulatively considerable.
    - If the project's operational GHG/SP exceed AB 32 requirements (a substantial contribution), then the project's GHG emissions would conflict with legislative requirements, and the impact would be cumulatively considerable and mitigation would be required where feasible.
- New stationary and area sources/facilities: calculate GHG emissions using the CCAR GRP. All GHG emissions associated with new stationary or area sources should be treated as a net increase in emissions, and if deemed significant, should be mitigated where feasible.
- Road or levee construction projects or other construction-only projects: calculate GHG emissions using the RoadMod, which will be updated to contain GHG emission factors from EMFAC and OFFROAD. All construction-generated GHG emissions should be treated as a net increase, and if deemed significant, should be mitigated to the extent feasible.
- Air District rulemaking or air quality management plan-type projects should be evaluated on a case-by-case basis for secondary impacts of increased GHG emissions generation. In most cases, the types of projects that act to reduce regional air pollution simultaneously act to reduce GHG emissions, and would be beneficial, but should be evaluated for secondary effects from GHG emissions.
- Regional transportation plans should also be evaluated on a case-by-case basis for potential to either reduce or increase GHG emissions from the transportation sector. EMFAC can be utilized to determine the net change in GHG emissions

associated with projected vehicle VMT and from operating speed changes associated with additional or alleviated congestion.

To achieve the goals of AB 32, which are tied to GHG emission rates of specific benchmark years (i.e., 1990), California would have to achieve a lower rate of emissions per unit of population and per unit of economic activity than it has now. Further, in order to accommodate future population and economic growth, the state would have to achieve an even lower rate of emissions per unit than was generated in 1990. (The goal to achieve 1990 quantities of GHG emissions by 2020 means that this will need to be accomplished in light of 30 years of population and economic growth in place beyond 1990.) Thus, future planning efforts that would not encourage new development to achieve its fair share of reductions in GHG emissions would conflict with the spirit of the policy decisions contained in AB 32, thus impeding California's ability to comply with the mandate.

Thus, if a statewide context for GHG emissions were pursued, any net increase in GHG emissions within state boundaries would be considered "new" emissions. For example, a land development project, such as a specific plan, does not necessarily create "new" emitters of GHG, but would theoretically accommodate a greater number of residents in the state. Some of the residents that move to the project could already be California residents, while some may be from out of state (or would 'take the place' of in-state residents who 'vacate' their current residences to move to the new project). Some may also be associated with new births over deaths (net population growth) in the state. The out-of-state residents would be contributing new emissions in a statewide context, but would not necessarily be generating new emissions in a global context. Given the California context established by AB 32, the project would need to accommodate an increase in population in a manner that would not inhibit the state's ability to achieve the goals of lower total mass of emissions.

The average net influx of new residents to California is approximately 1.4 percent per year (this value represents the net increase in population, including the net contribution from births and deaths). With population growth, California also anticipates economic growth. Average statewide employment has grown by approximately 1.1 percent over the last 15 years. The average percentage of population employed over the last 15 years is 46 percent. Population is expected to continue growing at a projected rate of approximately 1.5 percent per year through 2050. Long-range employment projection data is not available from the California Department of Finance (DOF) and can be extrapolated in different ways (e.g., linear extrapolation by percentage rate of change, percentage of population employed, mathematical series expansion, more complex extrapolation based on further research of demographic projections such as age distribution). Further study would be needed to refine accurate employment projections from the present to 2050. For developing this framework, employment is assumed to have a constant proportionate relationship with the state's population. The projected number of jobs is assumed to be roughly 46 percent of the projected population.

In light of the statewide context established by California law, consistency is most important for evaluating GHG emissions from projects. Thus, URBEMIS and the CCAR GRP are the recommended tools for quantification of GHG emissions from most project types in the short term. Over the long term, more sophisticated models that integrate the relationship between GHG emissions and land use, transportation, energy, water, waste, and other resources, and have similar application statewide would have better application to the problem, but may not currently be as accessible or as easily operable. I-PLACE^{3}S and CTG Energetics' Sustainable Communities Model (SCM) are two examples of such models that contain emission factors for GHGs, which could be refined to have applicability statewide and made available to CEQA practitioners. Other models are likely to be developed, given the importance of this issue.

Short-Term and Long-Term Methodologies

The following tools can be used to quantify a project's GHG emissions until tools that are more comprehensive become available statewide:

1. Land development projects: URBEMIS 2007 v. 9.2 and the CCAR GRP v. 2.2 (short-term); further development of I-PLACE^{3}S or CTG's Sustainable Communities Model (long-term).
2. New stationary and area sources/facilities: AP-42 Chapter 4.3, LandGem v. 3.02, and/or CCAR GRP v. 2.2.
3. Road or levee construction projects or other construction-only projects: RoadMod/OFFROAD 2007.

Ideally, I-PLACE^{3}S or CTG's Sustainable Communities Model would be expanded to apply to all regions of the state. These types of models use an integrated approach, which is the best approach for reasonably approximating the emissions that result from interaction between land uses, but neither is available to the public and would create consistency problems in reporting emissions from projects across the state if these were used today. However, a similar model with statewide applicability will likely be developed due to the importance of the issue.Table 10 Summary of Modeling Tools for Estimating GHG Emissions and Project Applicability

Table 10: Summary of Modeling Tools for GHG Emissions

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
URBEMIS 2007	*Public domain -Download (www.urbemis.com) free of charge*	*Land development and construction projects (construction, mobile- and area-source emissions)*	*Local*	*Fairly Easy*	*Land use information, construction and operational data and assumptions (e.g., jurisdiction, acres of land use type, year of operation, etc.)*	*Mobile-source Construction & Operational CO_2 (lb/day or tons/year)*	*-Recommended for land use development and construction projects -Also recommended for net change in land use (zoning changes)*	*-Does not quantify indirect emissions from energy consumption or other GHGs (except methane from mobile-sources) -Free, available to public, and applicable statewide -Widely used for assessment of other air quality impacts*
California Climate Action Registry General Reporting Protocol v. 2.2	*Public guidance document*	*Indirect emissions from land development projects, stationary- and area-source facilities regulated under AB 32*	*State*	*Easy*	*Energy consumption*	*CO_2e (Metric tons/year)*	*-Recommended for indirect emissions from energy consumption for land use development projects, and for new stationary- or area- sources to be regulated*	*-Contains emission factors for CH_4 and N_2O in addition to CO_2 -Does not contain emission factors broken down by utility provider (statewide average grid only)*
Clean Air and Climate Projection (CACP) Software	*Public agencies (members of ICLEI, NACAA, or similar)*	*Local governments used for emissions inventories*	*Local*	*N/A*	*Energy usage, waste generation/disposal transportation*	*CO_2e (tons/year)*	*-Recommended for inventories of local government entities activities (must be a member of affiliated agency or group)*	*-Not available to public*
CTG Sustainable Communities Model	*Custom model*	*Land development*	*Regional, scalable*	*N/A*	*Land use information, operational (mobile, energy, economic, infrastructure) assumptions*	*CO_2e (tons/year)*	*-An integrated and comprehensive modeling tool, but cannot obtain*	*-Not available to public*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
I-PLACE[3]S	*Access fee through local COG* *Only available for eight California counties*	*Land use change*	*Regional, scalable*	*Fairly Easy*	*Parcel information*	*CO_2 (lb/day or tons/year)*	*-Recommended for land use development projects and land use changes* *-Especially good for general plans*	*-Not freely available to public* *-Not applicable statewide* *-Actually provides insight into land use interaction* *-Can include very specific project attributes* *-Trip rates are from behavioral survey data, instead of ITE*
EMFAC 2007	*Public domain*	*On-road mobile-sources*	*Statewide, regional*	*Fairly Easy*	*Vehicle fleet information*	*CO_2 (grams/mile)*	*-Not recommended for most projects (URBEMIS preferred)* *-Could be used for certain Air District Rulemaking applications*	*-Can compare emissions based on speed-distribution* *-Emission factors contained in URBEMIS* *-Not a stand-alone model*
OFFROAD 2007	*Public domain*	*Off-road mobile sources (construction equipment)*	*Statewide, regional*	*Fairly Easy*	*Construction fleet information*	*CO_2 (lb/day)*	*-Not recommended (URBEMIS preferred)* *-could be used for certain Air District Rulemaking applications (re: construction equipment)*	*-Emission factors contained in URBEMIS*
RoadMod (to be updated to include CO_2)	*Public domain*	*Off-road and on-road mobile sources (construction equipment and material haul trucks)*	*Statewide*	*Easy*	*Construction information*	*CO_2 (lb/day or tons/project)*	*-Recommended for construction-only projects (linear in nature; i.e., levees, roads, pipelines)*	*-To be updated to support emissions factors from OFFROAD 2007*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
DTIM	*Public domain*	*On-road mobile-sources*	*Statewide, regional*	*Difficult (consists of a series of three programs and requires input files from traffic and emissions modeling)*	*-EMFAC files* *-Traffic model output files (e.g., link, interzonal, and trip end data)* *-User options file* *-Optional files*	*CO_2 (tons/year)*	*-Not recommended*	*-Not updated to support EMFAC 2007 emission factors* *-Input files include output files from regional transportation models which more accurately reflect VMT*
Southeast Climate Change Partnership Spreadsheet Model (UK)	*Public domain http://www.climatesoutheast.org.uk/*	*UK Local government/ agencies/ organizations used for emissions inventories*	*Local, county, regional*	*Fairly easy*	*Energy usage, waste generation/disposal, transportation*	*CO_2 (tonnes/year)*	*-Not recommended for use in California, but could be a valuable source for building an applicable spreadsheet model*	*-Applicability for UK, but could be updated with CA-specific emission factors*
EPA AP-42; Evaporation Loss Sources Chapter 4.3.5	*Public reference document*	*GHG emissions from waste water treatment facilities*	*Facility level*	*Easy equation; substantial research needed to use*	*Biochemical oxygen demand (BOD) loading, Fraction anaerobically digested*	*CH4 (lb/year)*	*-Recommended for Publicly owned treatment works (POTW) projects*	*-Substantial research needed to determine the "fraction anaerobically digested" parameter, which is dependent on the type of treatment plant/process*
LandGem v. 3.02	*Public domain http://www.epa.gov/ttn/catc/dir1/landgem-v302.xls*	*GHG emissions from anaerobic decomposition associated with landfills*	*Facility Level*	*Moderate*	*Solid waste processing, year of analysis, lifetime of waste in place*	*CO_2, CH_4 (Mega grams/year)*	*-Recommended for landfill emissions*	*-Emission rates change dependent on years of decomposition, waste in place rates of change.* *-Complex decomposition rate equation, but good first approximation*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
CARROT	*Registry members*	*Stationary source emissions, vehicle fleet mobile sources*	*Facility level*	*Moderate*	*Facility-specific information*	*All GHGs*	*-Recommended for reporting facilities under AB 32 and for indirect emissions from energy consumption (CCAR Protocol)*	*-Estimates all GHGs and normalizes to CO_2e* *-Not publicly available*

Notes:

GHG = greenhouse gas; AB = assembly bill; CO_2e = carbon dioxide equivalent; CH_4 = methane; N_2O = nitrous oxide; COG = council of governments ; ITE = Institute of Transportation Engineers; CCAR = California Climate Action Registry

Source: Data compiled by EDAW and the California Air Pollution Control Officers Association in 2007

Introduction

This chapter (and Appendix B) identifies existing and potential mitigation measures that could be applied to projects during the CEQA process to reduce a project's GHG emissions that would be identified using the analytical methodologies included in this white paper. The Subcommittee retained the services of EDAW to assist with this effort. EDAW performed a global search of mitigation measures currently in practice and under study that would reduce GHG emissions.

Table 16 (Appendix B) provides a brief description of each measure along with an assessment of their feasibility (from a standpoint of economical, technological, and logistical feasibility, and emission reduction effectiveness), and identifies their potential for secondary impacts to air quality. During the global search performed, EDAW also took note of GHG reduction strategies being implemented as rules and regulation (e.g., early action items under AB 32), which are summarized in Table 18 (Appendix C). It is important to note that though compliance with such would be required by regulation for some sources, such strategies may be applicable to other project and source types.

The recurring theme that echoes throughout a majority of these measures is the shift toward New Urbanism, and research has consistently shown that implementation of Neotraditional Development techniques reduces VMT and associated emissions. The material reviewed assessed reductions from transportation-related measures (e.g., bicycle, pedestrian, transit, and parking) as a single comprehensive approach to land use. This comprehensive approach focuses on development design criteria conducive to enhancing alternate modes of transportation, including transit, walking, and bicycling. Transportation Demand Management (TDM) programs are viewed as a mechanism to implement specific measures. TDM responsibilities may include offering incentives to potential users of alternative modes of transportation and monitoring and reporting mode split changes.

The comprehensive approach makes it more difficult to assess reductions attributable to each measure. Nevertheless, there is a strong interrelationship between many of the measures, which justifies a combined approach. Consider the relationship between bike parking nonresidential, bike parking residential, endtrip facilities, and proximity to bike path/bike lane measures. In reality, these measures combined act as incentives for one individual to bike to work, while implementation of a single measure without the others reduces effectiveness.

The global nature of GHG emissions is an important feature that enables unique mitigation: abatement. When designing a project subject to CEQA, the preferred practice is first to avoid, then to minimize, and finally to compensate for impacts. Where the impact cannot be mitigated on-site, off-site mitigation is often and effectively implemented in several resource areas, either in the form of offsetting the same impact or preserving the resource elsewhere in the region. Frequently, mitigation fee programs or funds are established, where the proponent pays into the program and fees collected throughout the region or state are used to implement projects that, in turn, proportionately offset the impacts of the projects to the given resource. It may be more cost-effective to reduce as much GHG on-site as feasible (economically and technologically). Then the proponent would pay into a "GHG retrofit fund" to reduce equivalent GHG emissions off-site. In contrast to regional air pollutant offset programs such as the Carl Moyer Program, it matters greatly where reductions of ozone precursors occur, as ozone affects regional air quality. The GHG retrofit fund could be used to provide incentives to upgrade older buildings and make them more energy efficient. This would reduce demand on the energy sector and reduce stationary source emissions associated with utilities. This program has been successfully implemented in the United Kingdom where developments advertise "carbon neutrality." Of course, some GHG emissions occur associated with operation of the development, but the development would offset the remainder of emissions through off-site retrofit. Avoiding emissions that would otherwise continue to occur at existing development would be a unique opportunity for mitigation of GHG emissions. Reduction of GHG emissions also may have important side benefits including reduction of other forms of pollution.

Depending on the significance threshold concept adopted, projects subject to the CEQA process would either qualitatively or quantitatively identify the amount of GHG emissions associated with their project using the analytical methodologies identified in the previous chapter. The analysis would then apply the appropriate number of mitigation measures listed in Appendix B to their project to reduce their GHG emissions below the significance level. Calculating the amount of GHG emission reductions attributable to a given mitigation measure would require additional research. The examples below illustrate how a project would be mitigated using this approach.

Residential Project Example

Project Attributes:

- 68 detached dwelling units
- 15.9 acres
- Located in unincorporated Placer County PCAPCD jurisdiction)
- Assume URBEMIS defaults for a rural project in Placer County, in absence of a traffic study (This is contrary to the recommendations contained under Task 1; a traffic study is necessary to asses project-specific GHG emissions).
- Analysis year 2009

Table 11: Residential Project Example GHG Emissions Estimates with Mitigation

URBEMIS Output (Unmitigated)	Metric Tons/Year CO_2e	URBEMIS Output (Mitigated)	Metric Tons/Year CO_2e	Percent Reduction
Area-source emissions	252	Area-source emissions	215	14.6
Mobile-source emissions	1,047	Mobile-source emissions	916	12.5
Total direct operational emissions (area + mobile)	1,299	Total operational emissions (area + mobile)	1,131	12.9

Notes:
CO_2e = carbon dioxide equivalent

Sources: Data compiled by EDAW in 2007

Using URBEMIS 2007 and assuming the project would implement the mitigation measures listed below, yearly project-generated emissions of CO_2e would be reduced by approximately 13 percent. Implementation of the following mitigation measures is assumed:

- 100 housing units within one-half-mile radius of project's center, including this project's 68 residential units;
- provision of 80 jobs in the study area;
- retail uses present with one-half-mile radius of project's center;
- 10 intersections per square mile;
- 100% of streets with sidewalks on one side;
- 50% of streets with sidewalks on both sides;
- 30% of collectors and arterials with bike lanes, or where suitable, direct parallel routes exist;
- 15% of housing units deed restricted below market rate;
- 20% energy efficiency increase beyond Title 24; and
- 100% of landscape maintenance equipment electrically powered and electrical outlets in front and rear of units.

Example Project Methodology and Mitigation

Table 12 –Residential Projects Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	URBEMIS (EMFAC emission factors)	MM T-3→MM T-8, MM T-10→ MM T-14, MM T-16, MM T-19→ MM T-21 MM D-2→MM D-8, MM D-10→ MM D-15, MM D-17 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	URBEMIS	MM D-13→MM D-15, MM D-17
Indirect Emissions		
Energy Consumption	CCAR GRP & CEC	MM E-1→MM E-8, MM E-10, MM E-12→MM E-23 MM S-1→MM S-2 MM M-1→MM M-2

Table 13 –Commercial Projects Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	URBEMIS (EMFAC emission factors)	MM T-1→MM T-2, MM T-4→ MM T-15, MM T-17→MM T-21 MM D-1→MM D-3, MM D-5→ MM D-6, MM D-10, MM D-12, MM D-14→MM D-17 MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	URBEMIS	MM D-14→MM D-17
Indirect Emissions		
Energy Consumption	CCAR GRP & CEC	MM E-1, MM E-4→MM E-13, MM E-16→MM E-24 MM S-1→MM S-2 MM M-1→MM M-2

Table 14 –Specific Plans Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MM T-1→MM T-21 MM D-1→MM D-12, MM D-18→MM D-19 MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MM D-13→MM D-19 MM E-1→MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Indirect Emissions		
Energy Consumption	Short-term: CCAR GRP & CEC. Long-term: I-PLACE^{3}S/CTG SCM	

General Plans

- Include a general plan policy to reduce emissions within planning area to a level consistent with legislative requirements.
- Implementation strategies include preparation of a GHG reduction plan.
- Projects consistent with a general plan could be responsible for complying with such a policy.

Table 15 –General Plans Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors).	MS G-1 MM G-15
Mobile Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MS G-1 MS G-2→MS C-7, MS G-9, MS G-12, MS-13→MS-14, MS-16→MS-23
Area Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MS G-1 MS G-8→MS C-11, MS G-134, MS G-12, MS-15, MS-17, MS-22
Indirect Emissions		
Energy Consumption	Short-term: CCAR GRP & CEC. Long-term: I-PLACE^{3}S/CTG SCM	

Other Project Types

Air District Rules and Regulations

Air district rules and regulations could have the potential to increase or decrease GHG emissions within the respective jurisdiction. In general, air district rules and regulations act to decrease criteria air pollutant or toxic air contaminant emissions, which would usually act to reduce GHG emissions simultaneously. However, this may not always be the case and air district rules and regulations could address emissions from a large variety of different source types. Reductions of GHG emissions associated with implementation of applicable mitigation, which could also vary greatly, would need to be evaluated on a case-by-case basis. However, once applicable mitigation measures are identified, percent reductions based on the best available research to date, such as those specified in Table 15, could be applied to determine mitigated emissions.

Air Quality Plans

Similarly to air district rules and regulations, air quality plans could have the potential to increase or decrease GHG emissions because of criteria air pollutant reduction strategies. In general, strategies implemented by air districts to reduce criteria air pollutants also act to reduce GHG emissions. However, this may not always be the case. Reductions of GHG emissions associated with implementation of applicable mitigation would need to be evaluated on a case-by-case basis. The methodology identified above for determining whether the strategies contained within the GHG reduction plan would adhere to the level specified in general plan policy could also be used to determine the reductions associated with CAP strategies.

Regional Transportation Plans

Regional transportation plans and reductions of GHG emissions associated with implementation of applicable mitigation would also need to be evaluated on a case-by-case basis to determine if a net increase or decrease in GHG emissions would occur. Complex interactions between the roadway network, operating conditions, alternative transportation availability (such as public transit, bicycle pathways, and pedestrian infrastructure), and many other independent parameters specific to a region should be considered. EMFAC 2007 can be used with VMT from the RTP to create an inventory of GHG emissions. Reductions associated with implementation of applicable measures contained in Table 16 could be accomplished by accounting for VMT reductions in the traffic model.

Many states, counties, and cities have developed policies and regulations concerning greenhouse gas emissions that seek to require or promote reductions in GHG emissions through standards for vehicle emissions, fuels, electricity production/renewables, building efficiency, and other means. However, we could only identify three public agencies in the United States that are considering formally requiring the analysis of greenhouse gas emissions and climate change for development projects during their associated environmental processes. There may be others, but they were not identified during research conducted during preparation of this paper.

The following is a summary of those three efforts.

Commonwealth of Massachusetts - MEPA Greenhouse Gas Emissions Policy and Protocol

The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) has determined that the phrase "damage to the environment" as used in the Massachusetts Environmental Policy Act (MEPA) includes the emission of greenhouse gases caused by projects subjects to MEPA Review. EEA has published a Greenhouse Gas Emissions Policy (GGEP) to fulfill the statutory obligation to take all feasible measurers to avoid, minimize or mitigate damage to the environment.

The GGEP concerns the following projects only:

- The Commonwealth or a state agency is the proponent;
- The Commonwealth or a state agency is providing financial assistance;
- The project is privately funded, but requires an Air Quality Permit from the department of Environmental Protection;
- The project is privately funded, but will generate:
    - 3,000 or more new vehicle trips per day for office projects;
    - 6,000 or more new vehicle trips per day for mixed use projects that are 25% or more office space; or
    - 10,000 or more new vehicle trips per day for other projects.

As a comparison, the trip generation amounts correspond as follows:

- 3,000 vehicle trips per day = approximately 250,000 square foot office development;
- 6,000 or more new vehicle trips per day for mixed use projects that are 25% or more office space = if 25% office space, then equivalent to approximately 130,000 square feet of office and either 100,000 square feet of retail or 450 single-family residential units or some combination thereof.
- 10,000 or more new vehicle trips per day = approximately 1,000 single family residential units or 250,000 square feet retail.

The draft policy states it is not intended to create a numerical GHG emission limit or a numerical GHG emissions reduction target, but rather to ensure that project proponents and reviewers have considered the GHG emissions impacts of their projects and taken all feasible means and measure to reduce those impacts.

The draft policy notes that some projects within these categories will have little or no greenhouse gas emission and the policy will not apply to such projects. EEA intends to identify in the scoping certificate whether a project falls within this *de minimis* exception.

The GGEP requires qualifying projects to do the following:

- to quantify their GHG emissions;
- identify measures to minimize or mitigate such emissions;
- quantify the reduction in emissions and energy savings from mitigation.

Emissions inventories are intended to focus on carbon dioxide, but analysis of other GHGs may be required for certain projects. EEA will require analysis of direct GGH emissions and indirect (electricity and transportation) emissions. The GGEP references the protocols prepared by the World Resource Institute as guidance for inventory preparation.

The policy is still in draft form, but the comment period closed on August 10, 2007.

King County, Washington - Executive Order on the Evaluation of Climate Change Impacts through the State Environmental Policy Act (SEPA)

On June 27, 2007, the King County Executive Ron Sims directed all King County Departments, as follows:

> *"…effective September 1, 2007 to require that climate impacts, including, but not limited to those pertaining to greenhouse gases, be appropriately identified and evaluated when such Departments are acting as the lead agency in reviewing the environmental impacts of private or public proposals pursuant to the State Environmental Policy Act".*

The Executive Order does not define what a "climate impact" is. Based on statements of the County Deputy Chief of Staff[*]

- County agencies will ask project proponents to supply information on transportation, energy usage and other impacts of proposed projects using the County's existing SEPA checklist.

[*] Marten Law Group: Environmental News, August 1, 2007, "King County (WA) First in Nation to Require Climate Change Impacts to be Considered During Environmental Review of New Projects".

- There is no current plan to require project proponents to take action to mitigate the impacts identifies.
- Development of emissions thresholds and mitigation requirements will be undertaken in connection with the County's upcoming 2008 update of its Comprehensive Plan.

Sacramento Metropolitan Air Quality Management District

The Sacramento Metropolitan Air Quality Management District released an interim guidance on addressing climate change in CEQA documents on September 6, 2007. While very general in nature, the District recommends that CEQA environmental documents include a discussion of anticipated GHG emissions during both the construction and operation phases of the project. This includes assessing the GHG emissions from projects (using readily available models) to determine whether a project may have a significant impact. If so, then the District recommends addressing all of the District's GHG mitigation measures (drawn from comments made by the California Attorney General) – with explanations on how the mitigation will be implemented or providing rationale for why a measure would be considered infeasible. The District provides assistance to agencies in their analysis of GHG emissions and the applicability of specific mitigation measures. The District's guidance can be found at: http://64.143.64.21/climatechange/ClimateChangeCEQAguidance.pdf

Mendocino Air Quality Management District – CEQA Guidelines

The Mendocino AQMD updated its "Guidelines for Use During Preparation of Air Quality Impacts in EIRs or Mitigated Negative Declarations" in May 2007. The guidelines call for preparing estimates of the increased emissions of air contaminations (including GHG) for projects.

The guidelines state that GHG emissions should be presumed to have a significant impact if CO emissions from District-approved modeling exceed either of the following:

- 80% of the level defined as significant for stationary sources in Regulation1, Rule 130 (s2) of the District (which is 550 lbs/day for CO, meaning a threshold of 440 lbs/day for CO for stationary sources); or
- levels established in District Regulation 1 Rule 130 (i2) for indirect sources (which is 690 lbs/day for CO for indirect sources).

If an average passenger vehicle emits 22 grams of CO/mile and 0.8 lb/mile of CO_2, then the 690-lb/day threshold for CO corresponds to approximately 11,400 lb/day CO_2 threshold for passenger vehicle-related emissions. If one assumes that the average passenger vehicle goes 12,500 miles/year (about 35 miles/day), then this is a threshold equivalent to about 420 vehicles. Using an average in California of about 1.77 vehicles/household, this would correspond to about 250 households/dwelling units.

Appendix A

Relevant Citations

Citations from the Public Resources Code (Division 13, §21000 et seq.) as amended through January 1, 2005.

Public Resources Code – Section 21004, MITIGATING OR AVOIDING A SIGNIFICANT EFFECT; POWERS OF PUBLIC AGENCY:
"In mitigating or avoiding a significant effect of a project on the environment, a public agency may exercise only those express or implied powers provided by law other than this division. However, a public agency may use discretionary powers provided by such other law for the purpose of mitigating or avoiding a significant effect on the environment subject to the express or implied constraints or limitations that may be provided by law."

Public Resources Code – Section 21082.2, SIGNIFICANT EFFECT ON ENVIRONMENT; DETERMINATION; ENVIRONMENTAL IMPACT REPORT PREPARATION:
(a) The lead agency shall determine whether a project may have a significant effect on the environment based on substantial evidence in light of the whole record.
(b) The existence of public controversy over the environmental effects of a project shall not require preparation of an environmental impact report if there is no substantial evidence in light of the whole record before the lead agency that the project may have a significant effect on the environment.
(c) Argument, speculation, unsubstantiated opinion or narrative, evidence which is clearly inaccurate or erroneous, or evidence of social or economic impacts which do not contribute to, or are not caused by, physical impacts on the environment, is not substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion supported by facts.
(d) If there is substantial evidence, in light of the whole record before the lead agency, that a project may have a significant effect on the environment, an environmental impact report shall be prepared.
(e) Statements in an environmental impact report and comments with respect to an environmental impact report shall not be deemed determinative of whether the project may have a significant effect on the environment.

Citations from the Guidelines for California Environmental Quality Act, CCR, Title 14, Division 6 (§15000 et seq.) as amended through July 27, 2007.

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

State CEQA Guidelines – Section 15064, DETERMINING THE SIGNIFICANCE OF THE ENVIRONMENTAL EFFECTS CAUSED BY A PROJECT:

(a) Determining whether a project may have a significant effect plays a critical role in the CEQA process.

(1) If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, the agency shall prepare a draft EIR.

(2) When a final EIR identifies one or more significant effects, the Lead Agency and each Responsible Agency shall make a finding under Section 15091 for each significant effect and may need to make a statement of overriding considerations under Section 15093 for the project.

(b) The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data. An ironclad definition of significant effect is not always possible because the significance of an activity may vary with the setting. For example, an activity which may not be significant in an urban area may be significant in a rural area.

(c) In determining whether an effect will be adverse or beneficial, the Lead Agency shall consider the views held by members of the public in all areas affected as expressed in the whole record before the lead agency. Before requiring the preparation of an EIR, the Lead Agency must still determine whether environmental change itself might be substantial.

(d) In evaluating the significance of the environmental effect of a project, the Lead Agency shall consider direct physical changes in the environment which may be caused by the project and reasonably foreseeable indirect physical changes in the environment which may be caused by the project.

(1) A direct physical change in the environment is a physical change in the environment which is caused by and immediately related to the project. Examples of direct physical changes in the environment are the dust, noise, and traffic of heavy equipment that would result from construction of a sewage treatment plant and possible odors from operation of the plant.

(2) An indirect physical change in the environment is a physical change in the environment which is not immediately related to the project, but which is caused indirectly by the project. If a direct physical change in the environment in turn causes another change in the environment, then the other change is an indirect physical change in the environment. For example, the construction of a new sewage treatment plant may facilitate population growth in the service area due to the increase in sewage treatment capacity and may lead to an increase in air pollution.

(3) An indirect physical change is to be considered only if that change is a reasonably foreseeable impact which may be caused by the project. A change which is speculative or unlikely to occur is not reasonably foreseeable.

(e) Economic and social changes resulting from a project shall not be treated as significant effects on the environment. Economic or social changes may be used, however, to determine that a physical change shall be regarded as a significant effect on the environment. Where a physical change is caused by economic or social effects of a

project, the physical change may be regarded as a significant effect in the same manner as any other physical change resulting from the project. Alternatively, economic and social effects of a physical change may be used to determine that the physical change is a significant effect on the environment. If the physical change causes adverse economic or social effects on people, those adverse effects may be used as a factor in determining whether the physical change is significant. For example, if a project would cause overcrowding of a public facility and the overcrowding causes an adverse effect on people, the overcrowding would be regarded as a significant effect.
(f) The decision as to whether a project may have one or more significant effects shall be based on substantial evidence in the record of the lead agency.
(1) If the lead agency determines there is substantial evidence in the record that the project may have a significant effect on the environment, the lead agency shall prepare an EIR (Friends of B Street v. City of Hayward (1980) 106 Cal.App.3d 988). Said another way, if a lead agency is presented with a fair argument that a project may have a significant effect on the environment, the lead agency shall prepare an EIR even though it may also be presented with other substantial evidence that the project will not have a significant effect (No Oil, Inc. v. City of Los Angeles (1974) 13 Cal.3d 68).
(2) If the lead agency determines there is substantial evidence in the record that the project may have a significant effect on the environment but the lead agency determines that revisions in the project plans or proposals made by, or agreed to by, the applicant would avoid the effects or mitigate the effects to a point where clearly no significant effect on the environment would occur and there is no substantial evidence in light of the whole record before the public agency that the project, as revised, may have a significant effect on the environment then a mitigated negative declaration shall be prepared.
(3) If the lead agency determines there is no substantial evidence that the project may have a significant effect on the environment, the lead agency shall prepare a negative declaration (Friends of B Street v. City of Hayward (1980) 106 Cal.App. 3d 988).
(4) The existence of public controversy over the environmental effects of a project will not require preparation of an EIR if there is no substantial evidence before the agency that the project may have a significant effect on the environment.
(5) Argument, speculation, unsubstantiated opinion or narrative, or evidence that is clearly inaccurate or erroneous, or evidence that is not credible, shall not constitute substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion support by facts.
(6) Evidence of economic and social impacts that do not contribute to or are not caused by physical changes in the environment is not substantial evidence that the project may have a significant effect on the environment.
(7) The provisions of sections 15162, 15163, and 15164 apply when the project being analyzed is a change to, or further approval for, a project for which an EIR or negative declaration was previously certified or adopted (e.g. a tentative subdivision, conditional use permit). Under case law, the fair argument standard does not apply to determinations of significance pursuant to sections 15162, 15163, and 15164.
(g) After application of the principles set forth above in Section 15064(f)(g), and in marginal cases where it is not clear whether there is substantial evidence that a project may have a significant effect on the environment, the lead agency shall be guided by the following principle: If there is disagreement among expert opinion supported by facts

over the significance of an effect on the environment, the Lead Agency shall treat the effect as significant and shall prepare an EIR.
(h)(1) When assessing whether a cumulative effect requires an EIR, the lead agency shall consider whether the cumulative impact is significant and whether the effects of the project are cumulatively considerable. An EIR must be prepared if the cumulative impact may be significant and the project's incremental effect, though individually limited, is cumulatively considerable. "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.
(2) A lead agency may determine in an initial study that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and thus is not significant. When a project might contribute to a significant cumulative impact, but the contribution will be rendered less than cumulatively considerable through mitigation measures set forth in a mitigated negative declaration, the initial study shall briefly indicate and explain how the contribution has been rendered less than cumulatively considerable.
(3) A lead agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project will comply with the requirements in a previously approved plan or mitigation program which provides specific requirements that will avoid or substantially lessen the cumulative problem (e.g., water quality control plan, air quality plan, integrated waste management plan) within the geographic area in which the project is located. Such plans or programs must be specified in law or adopted by the public agency with jurisdiction over the affected resources through a public review process to implement, interpret, or make specific the law enforced or administered by the public agency. If there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding that the project complies with the specified plan or mitigation program addressing the cumulative problem, an EIR must be prepared for the project.
(4) The mere existence of significant cumulative impacts caused by other projects alone shall not constitute substantial evidence that the proposed project's incremental effects are cumulatively considerable.

State CEQA Guidelines – Section 15130, DISCUSSION OF CUMULATIVE IMPACTS:
(a)(3). "An EIR may determine that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and thus is not significant. A project's contribution is less than cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact. The lead agency shall identify facts and analysis supporting its conclusion that the contribution will be rendered less than cumulatively considerable.

State CEQA Guidelines – Section 15064.7, THRESHOLDS OF SIGNIFICANCE:
"Each public agency is encouraged to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is an identifiable quantitative, qualitative or performance level

of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which means the effect normally will be determined to be less than significant."

Appendix B

Mitigation Measure Summary

Table 16
Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Transportation								
Bicycle/Pedestrian/Transit Measures								
MM T-1: Bike Parking	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	1%-5%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates combined reductions among individual measures (e.g., 2.5% reduction for all bicycle-related measures and one-quarter of 2.5% for each individual measure) (TIAX 2005, EDAW 2006, SMAQMD 2007). VTPI presents % reductions for showers and combined measures in the TDM encyclopedia (VTPI	Yes: Lockers ($1,200-$2,950, $700/bike on average), Racks ($70-$2,000, $70/bike on average).	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	Caltrans, Portland Bicycle Master Plan (City of Portland 1998), CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Nonresidential projects provide plentiful short- and long-term bicycle parking facilities to meet peak season maximum demand (e.g., one bike rack space per 20 vehicle/employee parking spaces.
MM T-2: End of Trip Facilities	LD (C, M), I, SP, TP, AQP, RR, P/Mobile		Yes	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Nonresidential projects provide “end-of-trip” facilities including showers, lockers, and changing space (e.g., four clothes lockers and one shower provided for every 80 employee parking spaces, separate facilities for each gender for projects with 160 or more employee parking spaces).
MM T-3: Bike-Parking at Multi-	LD (R, M), SP, AQP, RR,		Yes: Lockers ($1,200-	Yes (Caltrans 2005,	Yes (Caltrans	Adverse: No Beneficial:		Long-term bicycle parking is provided at apartment

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Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Unit Residential	P/Mobile	2007). JSA bases estimates on CCAP information (JSA 2004).	$2,950, $700/bike on average), Racks ($70-$2,000, $70/bike on average).	Dierkers et al. 2007, VTPI 2007)	2005, Dierkers et al. 2007, VTPI 2007)	CAPs, TACs		complexes or condominiums without garages (e.g., one long-term bicycle parking space for each unit without a garage). Long-term facilities shall consist of one of the following: a bicycle locker, a locked room with standard racks and access limited to bicyclists only, or a standard rack in a location that is staffed and/or monitored by video surveillance 24 hours per day.
MM T-4: Proximity to Bike Path/Bike Lanes	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile		Yes	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Entire project is located within one-half mile of an existing/planned Class I or Class II bike lane and project design includes a comparable network that connects the project uses to the existing offsite facility. Project design includes a designated bicycle route connecting all units, on-site bicycle parking facilities, offsite bicycle facilities, site entrances, and primary building entrances to existing Class I or Class II bike lane(s) within one-half mile. Bicycle route connects to all streets contiguous with project site. Bicycle route has minimum conflicts with automobile parking and circulation

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								facilities. All streets internal to the project wider than 75 feet have Class II bicycle lanes on both sides.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-5: Pedestrian Network	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-10%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates 1% for each individual measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	The project provides a pedestrian access network that internally links all uses and connects to all existing/planned external streets and pedestrian facilities contiguous with the project site. Project design includes a designated pedestrian route interconnecting all internal uses, site entrances, primary building entrances, public facilities, and adjacent uses to existing external pedestrian facilities and streets. Route has minimal conflict with parking and automobile circulation facilities. Streets (with the exception of alleys) within the project have sidewalks on both sides. All sidewalks internal and adjacent to project site are minimum of five feet wide. All sidewalks feature vertical curbs. Pedestrian facilities and improvements such as grade separation, wider sidewalks, and traffic calming are implemented wherever feasible to minimize pedestrian barriers. All site entrances provide pedestrian access.
MM T-6: Pedestrian	LD (R, C, M), I, SP, TP,		Yes	Yes (Dierkers et al. 2007,	Yes (Dierkers et	Adverse: No Beneficial:		Site design and building placement minimize barriers to

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Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
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Barriers Minimized	AQP, RR, P/Mobile			VTPI 2007)	al. 2007, VTPI 2007)	CAPs, TACs		pedestrian access and interconnectivity. Physical barriers such as walls, berms, landscaping, and slopes between residential and nonresidential uses that impede bicycle or pedestrian circulation are eliminated.
MM T-7: Bus Shelter for Existing/Planned Transit Service	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-2%/High: CCAP presents these % reductions (Dierkers et al., 2007). SMAQMD assigns from .25%-1%, depending on headway frequency (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes: $15,000-$70,000.	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, City of Calgary (City of Calgary 2004), CA air quality management and control districts, and cities/counties.	Bus or streetcar service provides headways of one hour or less for stops within one-quarter mile; project provides safe and convenient bicycle/pedestrian access to transit stop(s) and provides essential transit stop improvements (i.e., shelters, route information, benches, and lighting).

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-8: Traffic Calming	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-10%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates .25%-1.0% for each individual measure depending on percent of intersections and streets with improvements (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Project design includes pedestrian/bicycle safety and traffic calming measures in excess of jurisdiction requirements. Roadways are designed to reduce motor vehicle speeds and encourage pedestrian and bicycle trips by featuring traffic calming features. All sidewalks internal and adjacent to project site are minimum of five feet wide. All sidewalks feature vertical curbs. Roadways that converge internally within the project are routed in such a way as to avoid "skewed intersections;" which are intersections that meet at acute, rather than right, angles. Intersections internal and adjacent to the project feature one or more of the following pedestrian safety/traffic calming design techniques: marked crosswalks, count-down signal timers, curb extensions, speed tables, raised crosswalks, raised intersections, median islands, tight corner radii, and roundabouts or mini-circles. Streets internal and adjacent to the project feature pedestrian safety/traffic calming measures such as on-street parking, planter strips with street trees,

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								and chicanes/chokers (variations in road width to discourage high-speed travel).
Parking Measures								
MM T-9: Paid Parking (Parking Cash Out)	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a range of 1.0%-7.2%, depending on cost/day and distance to transit (TIAX 2005, EDAW 2006, SMAQMD 2007). Shoupe presents a 21% reduction [$5/day for commuters to downtown LA, with elasticity of -0.18 (e.g., if price increases 10%, then solo driving goes down by 1.8% more)] (Shoupe 2005). Urban Transit Institute	Yes: Vary by location and project size.	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Project provides employee and/or customer paid parking system. Project must have a permanent and enforceable method of maintaining user fees for all parking facilities. The facility may not provide customer or employee validations. Daily charge for parking must be equal to or greater than the cost of a transit day/monthly pass plus 20%.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
		presents a range of 1%-10% reduction in trips to central city sites, and 2%-4% in suburban sites (VTPI 2007).						
MM T-10: Minimum Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a maximum of 6% (Nelson/Nygaard Consulting Associates, 2005, TIAX 2005, EDAW 2006).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007), Note that in certain areas of the state, the minimum parking required by code is greater than the peak period parking demand for most land uses. Simply meeting minimum code requirements in these areas would not result in an emissions reduction.	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, Governor's Office of Smart Growth (Annapolis, Maryland) (Zimbler), CA air quality management and control districts, and cities/counties.	Provide minimum amount of parking required. Once land uses are determined, the trip reduction factor associated with this measure can be determined by utilizing the ITE parking generation publication. The reduction in trips can be computed as shown below by the ratio of the difference of minimum parking required by code and ITE peak parking demand to ITE peak parking demand for the land uses multiplied by 50%. Percent Trip Reduction = 50 * [(min parking required by code – ITE peak parking demand)/ (ITE peak parking demand)]

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Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective: Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Feasible (Yes/No): Technical[4]	Feasible (Yes/No): Logistical[5]	Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
MM T-11: Parking Reduction Beyond Code/Shared Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a maximum of 12% (Nelson/Nygaard, 2005, TIAX 2005, EDAW 2006).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Provide parking reduction less than code. This measure can be readily implemented through a shared parking strategy, wherein parking is utilized jointly among different land uses, buildings, and facilities in an area that experience peak parking needs at different times of day and day of the week.
MM T-12: Pedestrian Pathway Through Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-4%/Moderate: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates 0.5% reduction for this measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Provide a parking lot design that includes clearly marked and shaded pedestrian pathways between transit facilities and building entrances.

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MM T-13: Off - Street Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-4%/Moderate: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates a range of 0.1%-1.5% for this measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Parking facilities are not adjacent to street frontage.
MM T-14: Parking Area Tree Cover	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	Annual net CO_2 reduction of 3.1 kg/m^2 canopy cover/Moderate (McPherson 2001).	Yes: $19 per new tree for CA, cost varies for maintenance, removal and replacement (McPherson 2001).	Yes	Yes	Adverse: VOCs Beneficial: CAPs, TACs	AG, State of CA Department of Justice (Goldberg 2007) and cities/counties (e.g., parking lot ordinances in Sacramento, Davis, and Los Angeles, CA).	Provide parking lot areas with 50% tree cover within 10 years of construction, in particular low emitting, low maintenance, native drought resistant trees. Reduces urban heat island effect and requirement for air conditioning, effective when combined with other measures (e.g., electrical maintenance equipment and reflective paving material).
MM T-15: Valet Bicycle Parking	LD (C, M), SP, AQP, TP, RR, P/Mobile	NA/Low	Yes	Yes	Yes: Raley Field (Sacramento, CA)	Adverse: No Beneficial: CAPs, TACs	Raley Field (Sacramento, CA).	Provide spaces for the operation of valet bicycle parking at community event "centers" such as amphitheaters, theaters, and stadiums.
MM T-16: Garage Bicycle Storage	LD (R, M), SP, AQP, TP, RR, P/Mobile	NA/Low	Yes: Less than $200/multiple bike rack.	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	City of Fairview, OR	Provide storage space in one-car garages for bicycles and bicycle trailers.

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MM T-17: Preferential Parking for EVs/CNG Vehicles	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	USGBC, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Provide preferential parking space locations for EVs/CNG vehicles.
MM T-18: Reduced/No Parking Fee for EVs/CNG Vehicles	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	Hotels (e.g., Argonaut in San Francisco, CA)	Provide a reduced/no parking fee for EVs/CNG vehicles.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Miscellaneous Measure								
MM T-19: TMA Membership	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-28%/High: CCAP presents a range of 3%-25% for TDMs with complementary transit and land use measures (Dierkers et al. 2007). VTPI presents a range of 6%-7% in the TDM encyclopedia (VTPI 2007). URBEMIS offers a 2%-10% range in reductions for a TDM that has 5 elements that are pedestrian and transit friendly and 1%-5% for 3 elements. SMAQMD presents a reduction of 5% (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Include permanent TMA membership and funding requirement. Funding to be provided by Community Facilities District or County Service Area or other nonrevocable funding mechanism. TDMs have been shown to reduce employee vehicle trips up to 28% with the largest reductions achieved through parking pricing and transit passes. The impact depends on the travel alternatives.
MM T-20: ULEV	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes: Higher than corresponding gasoline models.	Yes	Yes: Fueling stations might not be readily available depending on location. More than 900 E85 fueling	Adverse: No Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Use of and/or provide ULEV that are 50% cleaner than average new model cars (e.g., natural gas, ethanol, electric).

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
					stations in the U.S., 5 in CA. Vehicles available in select regions only			
MM T-21: Flex Fuel Vehicles	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	5466.97 lb GHG/year/Low (DOE Fuel Economy)	Yes: E85 costs less than gasoline per gallon, but results in lower fuel economy.	Yes	Yes: More than 900 E85 fueling stations in the U.S., 5 in CA. Vehicles available in select regions only	Adverse: Yes Issues with the energy intensive ethanol production process (e.g., wastewater treatment requirements). Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., SJVAPCD).	Use of and/or provide vehicles that utilize gasoline/ethanol blends (e.g., E85).
Design								
Commercial & Residential Building Design Measures								
MM D-1: Office/Mixed Use Density	LD (C, M), SP, TP, AQP, RR, P/Mobile	0.05%-2%/Moderate: This range is from SMAQMD, depending	Yes	Yes (VTPI 2007)	Yes (VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties	Project provides high density office or mixed-use proximate to transit. Project must provide

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
		on FAR and headway frequencies (Nelson/Nygaard Consulting Associates 2005, EDAW 2006, SMAQMD 2007).					(e.g., SMAQMD).	safe and convenient pedestrian and bicycle access to all transit stops within one-quarter mile.
MM D-2: Orientation to Existing/Planned Transit, Bikeway, or Pedestrian Corridor	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	0.4%-1%/Moderate: CCAP attributes a 0.5% reduction per 1% improvement in transit frequency (Dierkers et al. 2007). SMAQMD presents a range of 0.25%-5% (JSA 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007)	Yes (Dierkers et al. 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project is oriented towards existing transit, bicycle, or pedestrian corridor. Setback distance between project and existing or planned adjacent uses is minimized or nonexistent. Setback distance between different buildings on project site is minimized. Setbacks between project buildings and planned or existing sidewalks are minimized. Buildings are oriented towards existing or planned street frontage. Primary entrances to buildings are located along planned or existing public street frontage. Project provides bicycle access to any planned bicycle corridor(s). Project provides pedestrian access to any planned pedestrian corridor(s).
MM D-3: Services Operational	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	0.5%-5%/Moderate	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides on-site shops and services for employees.

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MM D-4: Residential Density (Employ Sufficient Density for New Residential Development to Support the Use of Public Transit)	LD (R, M), SP, TP, AQP, RR, P/Mobile	1%-40%/High: #7, EPA presents a range of 32%-40% (EPA 2006). SMAQMD presents a range of 1%-12% depending on density and headway frequencies (Nelson/Nygaard Consulting Associates 2005, JSA 2005, EDAW 2006, SMAQMD 2007). Nelson/Nygaard presents a trip reduction formula: Trip Reduction = 0.6*(1-(19749*((4.814+ households per residential acre)/(4.814+7.14))^-06.39)/25914).	Yes	Yes (VTPI 2007, Holtzclaw 2007)	Yes (VTPI 2007, Holtzclaw 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides high-density residential development. Transit facilities must be within one-quarter mile of project border. Project provides safe and convenient bicycle/pedestrian access to all transit stop(s) within one-quarter mile of project border.
MM D-5: Street Grid	LD (R, C, M), I, SP, TP, AQP, RR,	1%/Moderate: SMAQMD presents this % reduction (JSA	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007,	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties	Multiple and direct street routing (grid style). This measure only applies to projects

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	P/Mobile	2005, EDAW 2006, SMAQMD 2007).			VTPI 2007)		(e.g., SMAQMD).	with an internal CF >/= 0.80, and average of one-quarter mile or less between external connections along perimeter of project. [CF= # of intersections / (# of cul-de-sacs + intersections)]. Cul-de-sacs with bicycle/pedestrian through access may be considered "complete intersections" when calculating the project's internal connectivity factor. External connections are bike/pedestrian pathways and access points, or streets with safe and convenient bicycle and pedestrian access that connect the project to adjacent streets, sidewalks, and uses. If project site is adjacent to undeveloped land; streets, pathways, access points, and right-of-ways that provide for future access to adjacent uses may count for up to 50% of the external connections. Block perimeter (the sum of the measurement of the length of all block sides) is limited to no more than 1,350 feet. Streets internal to the project should connect to streets external to the project whenever possible.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM D-6: NEV Access	LD (R, C, M), SP, TP, AQP, RR, P/Mobile	0.5%-1.5%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (Litman 1999, Sperling 1994)	Yes (Litman 1999, Sperling 1994)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Make physical development consistent with requirements for neighborhood electric vehicles. Current studies show that for most trips, NEVs do not replace gas-fueled vehicles as the primary vehicle.
MM D-7: Affordable Housing Component	LD (R, M), SP, TP, AQP, RR, P/Mobile	0.4%-6%/Moderate: SMAQMD presents this % reduction (Nelson/Nygaard Consulting Associates 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Residential development projects of five or more dwelling units provide a deed-restricted low-income housing component on-site (or as defined in the code). Developers who pay into In-Lieu Fee Programs are not considered eligible to receive credit for this measure. The award of emission reduction credit shall be based only on the proportion of affordable housing developed on-site because in-lieu programs simply induce a net increase in development. Percentage reduction shall be calculated according to the following formula:

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								% reduction = % units deed-restricted below market rate housing * 0.04
MM D-8: Recharging Area	LD (R, M), SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Provide residential buildings with a "utility" room or space for recharging batteries, whether for use in a car, electric lawnmower, other electric landscaping equipment, or even batteries for small items such as flashlights.
Mixed-Use Development Measures								
MM D-9: Urban Mixed-Use	LD (M), SP, TP, AQP, RR, P/Mobile	3%-9%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Development of projects predominantly characterized by properties on which various uses, such as office, commercial, institutional, and residential, are combined in a single building or on a single site in an integrated development project with functional interrelationships and a coherent physical design.
MM D-10: Suburban Mixed-Use	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	3%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Have at least three of the following on site and/or offsite within one-quarter mile: Residential Development, Retail Development, Park, Open Space, or Office.
MM D-11: Other Mixed-Use	LD (R, M), SP, TP, AQP, RR, P/Mobile	1%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	All residential units are within one-quarter mile of parks, schools or other civic uses.

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		2006, SMAQMD 2007).						
MM D-12: Infill Development	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	3%-30%/High: Infill development reduces vehicle trips and VMT by 3% and 20%, respectively (Fehr & Peers 2007). CCAP identifies a site level VMT reduction range of 20%-30% (Dierkers et al. 2007).	Yes	Yes (Dierkers et al. 2007)	Yes (Dierkers et al. 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project site is on a vacant infill site, redevelopment area, or brownfield or greyfield lot that is highly accessible to regional destinations, where the destinations rating of the development site (measured as the weighted average travel time to all other regional destinations) is improved by 100% when compared to an alternate greenfield site.
Miscellaneous Measures								
MM D-13: Electric Lawnmower	LD (R, M), SP, AQP, RR, P/Area	1%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Provide a complimentary electric lawnmower to each residential buyer.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM D-14: Enhanced Recycling/Waste Reduction, Reuse, Composting	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Low	Yes	Yes	Yes: Association with social awareness.	Adverse: No Beneficial: CAPs, TACs	CIWMB	Provide infrastructure/education that promotes the avoidance of products with excessive packaging, recycle, buying of refills, separating of food and yard waste for composting, and using rechargeable batteries.
MM D-15: LEED Certification	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Moderate	Yes: Receive tax rebates, incentives (e.g., EDAW San Diego office interior remodel cost $1,700,000 for 32,500 square feet) (USGBC 2007)	Yes	Yes: More than 700 buildings of different certifications in CA (USGBC 2007).	Adverse: No Beneficial: CAPs, TACs	USGBC, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.
MM D-16: Retro-Commissioning	LD (C, M), I, SP, AQP, RR, P/Stationary & Area	8%-10% reduction in energy usage/Moderate: (Mills et al. 2004)	Yes: Average $0.28/square feet, varies with building size (Haasl and Sharp 1999).	Yes	Yes: 27 projects underway in CA, 21 more to be completed in 2007, mostly state buildings owned by DGS (DGS 2007).	Adverse: No Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	The process ensures that all building systems perform interactively according to the contract documents, the design intent and the owner's operational needs to optimize energy performance.
MM D-17 Landscaping	LD (R, C, M), I, SP, AQP, RR,	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	Alliance for the Chesapeake Bay, EPA Green Landscaping	Project shall use drought resistant native trees, trees with low emissions and high carbon

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	P/Stationary & Area						Resources	sequestration potential. Evergreen trees on the north and west sides afford the best protection from the setting summer sun and cold winter winds. Additional considerations include the use of deciduous trees on the south side of the house that will admit summer sun; evergreen plantings on the north side will slow cold winter winds; constructing a natural planted channel to funnel summer cooling breezes into the house. Neighborhood CCR's not requiring that front and side yards of single family homes be planted with turf grass. Vegetable gardens, bunch grass, and low-water landscaping shall also be permitted, or even encouraged.
MM D-18: Local Farmers' Market	LD (M), SP/Mobile, Stationary, &	NA/Low	Yes	Yes	Yes: Associated with social	Adverse: No Beneficial: CAPs, TACs	Cities/counties (e.g., Davis, Sacramento)	Project shall dedicate space in a centralized, accessible location for a weekly farmers' market.

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	Area				choice and public awareness.			
MM D-19: Community Gardens	LD (M), SP/Mobile, Stationary, & Area	NA/Low	Yes	Yes	Yes: Associated with social choice and public awareness.	Adverse: No Beneficial: CAPs, TACs	Cities/counties (e.g., Davis)	Project shall dedicate space for community gardens.
Energy Efficiency/Building Component								
MM E-1: High-Efficiency Pumps	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Project shall use high-efficiency pumps.
MM E-2: Wood Burning Fireplaces/Stoves	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low: EDAW 2006	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project does not feature fireplaces or wood burning stoves.
MM E-3: Natural Gas Stove	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low: EDAW 2006	Yes: Cost of stove—$350 (gas) and $360 (electric) same brand, total yearly cost of $42.17 as opposed to $56.65 for electric (Saving Electricity 2006).	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project features only natural gas or electric stoves in residences.

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MM E-4: Energy Star Roof	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	0.5%-1%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes: 866 Energy Star labeled buildings in California (Energy Star 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project installs Energy Star labeled roof materials.
MM E-5: On-site Renewable Energy System	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	1%-3%/Moderate: SMAQMD presents this % reduction (USGBC 2002 and 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides onsite renewable energy system(s). Nonpolluting and renewable energy potential includes solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies. When applying these strategies, projects may take advantage of net metering with the local utility.

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Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM E-6: Exceed Title 24	LD (R, C, M), I, GSP, AQP, RR, P/Stationary & Area	1%/Moderate: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (PG&E 2002, SMUD 2006)	Yes (PG&E 2002, SMUD 2006)	Adverse: No Beneficial: CAPs, TACs	PG&E, SMUD, CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project exceeds title 24 requirements by 20%.
MM E-7: Solar Orientation	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	0.5%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project orients 75% or more of homes and/or buildings to face either north or south (within 30° of N/S). Building design includes roof overhangs that are sufficient to block the high summer sun, but not the lower winter sun, from penetrating south facing windows. Trees, other landscaping features and other buildings are sited in such a way as to maximize shade in the summer and maximize solar access to walls and windows in the winter.
MM E-8: Nonroof Surfaces	LD (R, C, M), I, GSP, AQP, RR, P/Stationary & Area	1.0%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Provide shade (within 5 years) and/or use light-colored/high-albedo materials (reflectance of at least 0.3) and/or open grid pavement for at least 30% of the site's nonroof impervious surfaces, including parking lots, walkways, plazas, etc.; OR place a minimum of 50% of parking spaces underground or covered by structured parking; OR use an open-grid pavement system (less than 50% impervious) for a minimum of

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Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								50% of the parking lot area. The mitigation measure reduces heat islands (thermal gradient differences between developed and undeveloped areas to minimize impact on microclimate and human and wildlife habitats. This measure requires the use of patented or copyright protected methodologies created by the ASTM. The SRI is a measure of the constructed surface's ability to reflect solar heat, as shown by a small rise in temperature. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is "0" and a standard white (reflectance 0.80, emittance 0.90) is 100. To calculate SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980-01. Reflectance is measured

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Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371. Default values for some materials will be available in the LEED-NC v2.2 Reference Guide.
MM E-9: Low-Energy Cooling	LD (C, M), I, SP, AQP, RR, P/Stationary & Area	1%-10%/Low: EDAW presents this percent reduction range (EDAW 2006).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project optimizes building's thermal distribution by separating ventilation and thermal conditioning systems.
MM E-10: Green Roof	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	1.0%/Moderate: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: Increased Water Consumption Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Install a vegetated roof that covers at least 50% of roof area. The reduction assumes that a vegetated roof is installed on a least 50% of the roof area or that a combination high albedo and vegetated roof surface is installed that meets the following standard: (Area of SRI Roof/0.75)+(Area of vegetated roof/0.5) >= Total Roof Area. Water consumption reduction measures shall be considered in the design of the green roof.
MM E-11: EV Charging Facilities	LD (C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: $500-$5000/ vehicle site (PG&E 1999)	Yes	Yes: 381 facilities in CA (Clean Air Maps 2007).	Adverse: No Beneficial: CAPs, TACs	DOE, EERE, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Project installs EV charging facilities.
MM E-12:	LD (R, C, M),	NA/Low: Increasing	Yes: Light	Yes	Yes: Apply	Adverse: No		Project provides light-colored

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Light-Colored Paving	I, SP, AQP, RR, P/Stationary & Area	the albedo of 1,250 km of pavement by 0.25 would save cooling energy worth $15M per year.	colored aggregates and white cement are more expensive than gray cement. Certain blended cements are very light in color and may reflect similarly to white cement at an equivalent cost to normal gray cement.		natural sand or gravel colored single surface treatments to asphalt (EOE 2007).	Beneficial: CAPs, TACs		paving (e.g., increased albedo pavement).
MM E-13: Cool Roofs	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: 0.75–1.5/square feet coating (EPA 2007a)	Yes	Yes: Over 90% of the roofs in the United States are dark colored	Adverse: No Beneficial: CAPs, TACs	CEC	Project provides cool roofs. Highly reflective, highly emissive roofing materials that stay 50-60°F cooler than a normal roof under a hot summer sun. CA's Cool Savings

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Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
					(EPA 2007a).			Program provided rebates to building owners for installing roofing materials with high solar reflectance and thermal emittance. The highest rebate went to roofs on air conditioned buildings, while buildings with rooftop ducts and other nonresidential buildings were eligible for slightly less. The program aimed to reduce peak summer electricity demand and was administered by the CEC.
MM E-14: Solar Water Heaters	LD (R, M), SP, AQP, RR, P/Stationary & Area	20%–70% reduction in cooling energy needs/Moderate	Yes: $1675/20 square feet, requires a 50 gallon tank, annual operating cost of $176 (DOE 2007).	Yes	Yes: Based on solar orientation, building codes, zoning ordinances.	Adverse: No Beneficial: CAPs, TACs	Europe	Project provides solar water heaters.
MM E-15: Electric Yard Equipment Compatibility	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: $75–$250/outlet from existing circuit (Cost Helper 2007).	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Project provides electrical outlets at building exterior areas.
MM E-16: Energy Efficient Appliance Standards	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: Varies for each appliance—higher capital costs, lower operating costs (Energy	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Project uses energy efficient appliances (e.g., Energy Star).

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Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
			Star 2007).					
MM E-17: Green Building Materials	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low: 25-30% more efficient on average.	Yes	Yes: BEES software allows users to balance the environmental and economic performance of building products; developed by NIST (NIST 2007).	Yes	Adverse: No Beneficial: CAPs, TACs		Project uses materials which are resource efficient, recycled, with long life cycles and manufactured in an environmentally friendly way.
MM E-18: Shading Mechanisms	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: Up to $450 annual energy savings (Energy Star 2007).	Yes: Higher capital costs, lower operating and maintenance costs (Energy Star 2007).	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing shading mechanisms for windows, porch, patio and walkway overhangs.

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Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM E-19: Ceiling/Whole-House Fans	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: 50% more efficient than conventional fans (Energy Star 2007).	Yes: $45-$200/fan, installation extra (Lowe's 2007).	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing ceiling/whole-house fans.
MM E-20: Programmable Thermostats	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: $100 annual savings in energy costs (Energy Star 2007).	Yes: $60/LCD display and 4 settings for typical residential use (Lowe's 2007).	Yes	Yes: Major retail stores.	Adverse: Yes, Mercury Beneficial: CAPs, TACs		Install energy-reducing programmable thermostats that automatically adjust temperature settings.
MM E-21: Passive Heating and Cooling Systems	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low	Yes: $800 (wall heaters) to $4,000+ (central systems)	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing passive heating and cooling systems (e.g., insulation and ventilation).
MM E-22: Day Lighting Systems	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low	Yes: $1,300 to $1,500 depending upon the kind of roof (Barrier 1995), installation extra.	Yes	Yes: Work well only for space near the roof of the building, little benefit in multi-floor buildings.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing day lighting systems (e.g., skylights, light shelves and interior transom windows).
MM E-23: Low-Water Use Appliances	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: Avoided water agency cost for using water-efficient kitchen pre-rinse spray valves of $65.18 per acre-foot.	Yes: Can return their cost through reduction in water consumption,	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Require the installation of low-water use appliances.

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Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
			pumping, and treatment.					
MM E-24: Goods Transport by Rail	LD (C, M), I, SP, AQP, RR, P/Mobile	NA/Moderate	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	ARB Goods Movement Plan (ARB 2007)	Provide a spur at nonresidential projects to use nearby rail for goods movement.
Social Awareness/Education								
MM S-1: GHG Emissions Reductions Education	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Mobile	NA/Low	Yes	Yes	Yes: Similar programs currently exist in CA.	Adverse: No Beneficial: CAPs, TACs		Provide local governments, businesses, and residents with guidance/protocols/information on how to reduce GHG emissions (e.g., energy saving, food miles).
MM S-2: School Curriculum	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Mobile	NA/Low	Yes	Yes	Yes: Similar programs currently exist in CA.	Adverse: No Beneficial: CAPs, TACs		Include how to reduce GHG emissions (e.g., energy saving, food miles) in the school curriculum.
Construction								
MM C-1: ARB-Certified Diesel Construction Equipment	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes: Oxidation Catalysts, \$1,000-	Yes	Yes	Adverse: Yes, NO_x Beneficial: CAPs, TACs	AG, EPA, ARB, and CA air quality management and pollution control districts.	Use ARB-certified diesel construction equipment. Increases CO_2 emissions when trapped CO and carbon particles

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
			$2,000. DPF, $5000-$10,000; installation extra (EPA 2007b).					are oxidized (Catalyst Products 2007, ETC 2007).
MM C-2: Alternative Fuel Construction Equipment	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: Yes, THC, NO_x Beneficial: CO, PM, SO_x	AG, EPA, ARB, and CA air quality management and pollution control districts.	Use alternative fuel types for construction equipment. At the tailpipe biodiesel emits 10% more CO_2 than petroleum diesel. Overall lifecycle emissions of CO_2 from 100% biodiesel are 78% lower than those of petroleum diesel (NREL 1998, EPA 2007b).
MM C-3: Local Building Materials	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes: Depends on location of building material manufacture sites.	Adverse: No Beneficial: CAPs, TACs		Use locally made building materials for construction of the project and associated infrastructure.
MM C-4: Recycle Demolished Construction Material	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Recycle/Reuse demolished construction material. Use locally made building materials for construction of the project and associated infrastructure.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Miscellaneous								
MM M-1: Off-Site Mitigation Fee Program	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile & Area	NA/Moderate-High: Though there is currently no program in place, the potential for real and quantifiable reductions of GHG emissions could be high if a defensible fee program were designed.	Yes	Yes	No: Program does not exist in CA, but similar programs currently exist (e.g., Carl Moyer Program, SJVAPCD Rule 9510, SMAQMD Off-Site Construction Mitigation Fee Program).	Adverse: No Beneficial: CAPs, TACs		Provide/Pay into an off-site mitigation fee program, which focuses primarily on reducing emissions from existing development and buildings through retro-fit (e.g., increased insulation).
MM M-2: Offset Purchase	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Area	NA/Low	Yes	Yes	No: ARB has not adopted official program, but similar programs	No		Provide/purchase offsets for additional emissions by acquiring carbon credits or engaging in other market "cap and trade" systems.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
					currently exist.			
Regional Transportation Plan Measures								
MM RTP-1: Dedicate High Occupancy Vehicle (HOV) lanes prior to adding capacity to existing highways.	RTP		Yes	Yes	Yes	Adverse: possible local CO Beneficial: regional CAPs, TACs	Caltrans, local government	Evaluate the trip reduction (and GHG reduction) potential of adding HOV lanes prior to adding standard lanes.
MM RTP-2: Implement toll/user fee programs prior to adding capacity to existing highways.	RTP		Yes	Yes	Yes	Adverse: possible local CO. Beneficial: regional CAPs, TACs	Caltrans	Evaluate price elasticity and associated trip reduction (and GHG reduction) potential with adding or increasing tolls prior to adding capacity to existing highways.

Note:
[1] Where LD (R, C, M) =Land Development (Residential, Commercial, Mixed-Use), I=Industrial, GP=General Plan, SP=Specific Plan, TP=Transportation Plans, AQP=Air Quality Plans, RR=Rules/Regulations, and P=Policy. It is important to note that listed project types may not be directly specific to the mitigation measure (e.g., TP, AQP, RR, and P) as such could apply to a variety of source types, especially RR and P.
[2] This score system entails ratings of high, moderate, and low that refer to the level of the measure to provide a substantive, reasonably certain (e.g., documented emission reductions with proven technologies), and long-term reduction of GHG emissions.
[3] Refers to whether the measure would provide a cost-effective reduction of GHG emissions based on available documentation.
[4] Refers to whether the measure is based on currently, readily available technology based on available documentation.
[5] Refers to whether the measure could be implemented without extraordinary effort based on available documentation.
[6] List is not meant to be all inclusive.
Source: Data complied by EDAW in 2007

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-1: Adopt a GHG reduction plan	GP/ Mobile, Stationary, & Area	City of San Bernardino	- Adopt GHG reduction targets for the planning area, based on the current legislation providing direction for state-wide targets, and update the plan as necessary. -The local government agency should serve as a model by inventorying its GHG emissions from agency operations, and implementing those reduction goals.
Circulation			
MS G-2: Provide for convenient and safe local travel	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Create a gridded street pattern with small block sizes. This promotes walkability through direct routing and ease of navigation. -Maintain a high level of connectivity of the roadway network. Minimize cul-de-sacs and incomplete roadway segments. -Plan and maintain an integrated, hierarchical and multi-modal system of roadways, pedestrian walks, and bicycle paths throughout the area. -Apply creative traffic management approaches to address congestion in areas with unique problems, particularly on roadways and intersections in the vicinity of schools in the morning and afternoon peak hours, and near churches, parks and community centers. -Work with adjacent jurisdictions to address the impacts of regional development patterns (e.g. residential development in surrounding communities, regional universities, employment centers, and commercial developments) on the circulation system. -Actively promote walking as a safe mode of local travel, particularly for children attending local schools. -Employ traffic calming methods such as median landscaping and provision of bike or transit lanes to slow traffic, improve roadway capacity, and address safety issues.
MS G-3: Enhance the regional transportation network and maintain effectiveness	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage the transportation authority to reduce fees for short distance trips. -Ensure that improvements to the traffic corridors do not negatively impact the operation of local roadways and land uses.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			-Cooperate with adjacent jurisdictions to maintain adequate service levels at shared intersections and to provide adequate capacity on regional routes for through traffic. -Support initiatives to provide better public transportation. Work actively to ensure that public transportation is part of every regional transportation corridor. - Coordinate the different modes of travel to enable users to transfer easily from one mode to another. -Work to provide a strong paratransit system that promotes the mobility of all residents and educate residents about local mobility choices. - Promote transit-oriented development to facilitate the use of the community's transit services.
MS G-4: Promote and support an efficient public transportation network connecting activity centers in the area to each other and the region.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Promote increased use of public transportation and support efforts to increase bus service range and frequency within the area as appropriate. -Enhance and encourage provision of attractive and appropriate transit amenities, including shaded bus stops, to encourage use of public transportation. -Encourage the school districts, private schools and other operators to coordinate local bussing and to expand ride-sharing programs. All bussing options should be fully considered before substantial roadway improvements are made in the vicinity of schools to ease congestion.
MS G-5: Establish and maintain a comprehensive system, which is safe and convenient, of pedestrian ways and bicycle routes that provide viable options to travel by automobile.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Improve area sidewalks and rights-of-way to make them efficient and appealing for walking and bicycling safely. Coordinate with adjacent jurisdictions and regional agencies to improve pedestrian and bicycle trails, facilities, signage, and amenities. -Provide safe and convenient pedestrian and bicycle connections to and from town centers, other commercial districts, office complexes, neighborhoods, schools, other major activity centers, and surrounding communities. -Work with neighboring jurisdictions to provide well-designed pedestrian and bicycle crossings of major roadways. -Promote walking throughout the community. Install sidewalks where missing and make improvements

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			to existing sidewalks for accessibility purposes. Particular attention should be given to needed sidewalk improvement near schools and activity centers. -Encourage businesses or residents to sponsor street furniture and landscaped areas. - Strive to provide pedestrian pathways that are well shaded and pleasantly landscaped to encourage use. - Attract bicyclists from neighboring communities to ride their bicycles or to bring their bicycles on the train to enjoy bicycling around the community and to support local businesses. - Meet guidelines to become nationally recognized as a Bicycle-Friendly community. - Provide for an education program and stepped up code enforcement to address and minimize vegetation that degrades access along public rights-of-way. -Engage in discussions with transit providers to increase the number of bicycles that can be accommodated on buses
MS G-6: Achieve optimum use of regional rail transit.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Support regional rail and work with rail authority to expand services. - Achieve better integration of all transit options. -Work with regional transportation planning agencies to finance and provide incentives for multimodal transportation systems. - Promote activity centers and transit-oriented development projects around the transit station.
MS G-7: Expand and optimize use of local and regional bus and transit systems.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage convenient public transit service between area and airports. -Support the establishment of a local shuttle to serve commercial centers. -Promote convenient, clean, efficient, and accessible public transit that serves transit-dependent riders and attracts discretionary riders as an alternative to reliance on single-occupant automobiles.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			- Empower seniors and those with physical disabilities who desire maximum personal freedom and independence of lifestyle with unimpeded access to public transportation. -Integrate transit service and amenities with surrounding land uses and buildings.
Conservation, Open Space			
MS G-8: Emphasize the importance of water conservation and maximizing the use of native, low-water landscaping.	GP/Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Reduce the amount of water used for landscaping and increase use of native and low water plants. Maximize use of native, low-water plants for landscaping of areas adjacent to sidewalks or other impermeable surfaces. -Encourage the production, distribution and use of recycled and reclaimed water for landscaping projects throughout the community, while maintaining urban runoff water quality objectives. -Promote water conservation measures, reduce urban runoff, and prevent groundwater pollution within development projects, property maintenance, area operations and all activities requiring approval. -Educate the public about the importance of water conservation and avoiding wasteful water habits. -Work with water provider in exploring water conservation programs, and encourage the water provider to offer incentives for water conservation.
MS G-9: Improve air quality within the region.	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Integrate air quality planning with area land use, economic development and transportation planning efforts. -Support programs that reduce air quality emissions related to vehicular travel. -Support alternative transportation modes and technologies, and develop bike- and pedestrian-friendly neighborhoods to reduce emissions associated with automobile use. -Encourage the use of clean fuel vehicles. -Promote the use of fuel-efficient heating and cooling equipment and other appliances, such as water

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			heaters, swimming pool heaters, cooking equipment, refrigerators, furnaces, and boiler units. - Promote the use of clean air technologies such as fuel cell technologies, renewable energy sources. UV coatings, and alternative, non-fossil fuels. -Require the planting of street trees along streets and inclusion of trees and landscaping for all development projects to help improve airshed and minimize urban heat island effects. - Encourage small businesses to utilize clean, innovative technologies to reduce air pollution. - Implement principles of green building. - Support jobs/housing balance within the community so more people can both live and work within the community. To reduce vehicle trips, encourage people to telecommute or work out of home or in local satellite offices.
MS G-10: Encourage and maximize energy conservation and identification of alternative energy sources.	GP/ Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage green building designs for new construction and renovation projects within the area. -Coordinate with regional and local energy suppliers to ensure adequate supplies of energy to meet community needs, implement energy conservation and public education programs, and identify alternative energy sources where appropriate. -Encourage building orientations and landscaping that enhance natural lighting and sun exposure. -Encourage expansion of neighborhood-level products and services and public transit opportunities throughout the area to reduce automobile use. - Incorporate the use of energy conservation strategies in area projects. - Promote energy-efficient design features, including appropriate site orientation, use of light color roofing and building materials, and use of evergreen trees and wind-break trees to reduce fuel consumption for heating and cooling.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			-Explore and consider the cost/benefits of alternative fuel vehicles including hybrid, natural gas, and hydrogen powered vehicles when purchasing new vehicles. -Continue to promote the use of solar power and other energy conservation measures. - Encourage residents to consider the cost/benefits of alternative fuel vehicles. - Promote the use of different technologies that reduce use of non-renewable energy resources. -Facilitate the use of green building standards and LEED in both private and public projects. -Promote sustainable building practices that go beyond the requirements of Title 24 of the California Administrative Code, and encourage energy-efficient design elements, as appropriate. -Support sustainable building practices that integrate building materials and methods that promote environmental quality, economic vitality, and social benefit through the design, construction, and operation of the built environment. - Investigate the feasibility of using solar (photovoltaic) street lights instead of conventional street lights that are powered by electricity in an effort to conserve energy. - Encourage cooperation between neighboring development to facilitate on-site renewable energy supplies or combined heat and power co-generation facilities that can serve the energy demand of contiguous development.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-11: Preserve unique community forests, and provide for sustainable increase and maintenance of this valuable resource.	GP/Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Develop a tree planting policy that strives to accomplish specific % shading of constructed paved and concrete surfaces within five years of construction. -Provide adequate funding to manage and maintain the existing forest, including sufficient funds for tree planting, pest control, scheduled pruning, and removal and replacement of dead trees. -Coordinate with local and regional plant experts in selecting tree species that respect the natural region in which Claremont is located, to help create a healthier, more sustainable urban forest. - Continue to plant new trees (in particular native tree species where appropriate), and work to preserve mature native trees. -Increase the awareness of the benefits of street trees and the community forest through a area wide education effort. -Encourage residents to properly care for and preserve large and beautiful trees on their own private property.
Housing			
MS G-12: Provide affordability levels to meet the needs of community residents.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage development of affordable housing opportunities throughout the community, as well as development of housing for elderly and low and moderate income households near public transportation services. -Ensure a portion of future residential development is affordable to low and very low income households.
Land Use			
MS G-13: Promote a visually-cohesive urban form and establish connections between the urban core and outlying portions of the	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Preserve the current pattern of development that encourages more intense and higher density development at the core of the community and less intense uses radiating from the central core. -Create and enhance landscaped greenway, trail and sidewalk connections between neighborhoods and to commercial areas, town centers, and parks.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
community.			-Identify ways to visually identify and physically connect all portions of the community, focusing on enhanced gateways and unifying isolated and/or outlying areas with the rest of the area. -Study and create a diverse plant identity with emphasis on drought-resistant native species.
MS G-14: Provide a diverse mix of land uses to meet the future needs of all residents and the business community.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Attract a broad range of additional retail, medical, and office uses providing employment at all income levels. -Support efforts to provide beneficial civic, religious, recreational, cultural and educational opportunities and public services to the entire community. -Coordinate with public and private organizations to maximize the availability and use of parks and recreational facilities in the community. -Support development of hotel and recreational commercial land uses to provide these amenities to local residents and businesses.
MS G-15: Collaborate with providers of solid waste collection, disposal and recycling services to ensure a level of service that promotes a clean community and environment.	GP/ Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Require recycling, composting, source reduction and education efforts throughout the community, including residential, businesses, industries, and institutions, within the construction industry, and in all sponsored activities.
MS G-16: Promote construction, maintenance and active use of publicly- and privately-operated parks, recreation programs, and a community center.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Work to expand and improve community recreation amenities including parks, pedestrian trails and connections to regional trail facilities. -As a condition upon new development, require payment of park fees and/or dedication and provision of parkland, recreation facilities and/or multi-use trails that improve the public and private recreation system. -Research options or opportunities to provide necessary or desired community facilities.

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-17: Promote the application of sustainable development practices.	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Encourage sustainable development that incorporates green building best practices and involves the reuse of previously developed property and/or vacant sites within a built-up area. - Encourage the conservation, maintenance, and rehabilitation of the existing housing stock. -Encourage development that incorporates green building practices to conserve natural resources as part of sustainable development practices. -Avoid development of isolated residential areas in the hillsides or other areas where such development would require significant infrastructure investment, adversely impact biotic resources. - Provide land area zoned for commercial and industrial uses to support a mix of retail, office, professional, service, and manufacturing businesses.
MS G-18: Create activity nodes as important destination areas, with an emphasis on public life within the community.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide pedestrian amenities, traffic-calming features, plazas and public areas, attractive streetscapes, shade trees, lighting, and retail stores at activity nodes. -Provide for a mixture of complementary retail uses to be located together to create activity nodes to serve adjacent neighborhoods and to draw visitors from other neighborhoods and from outside the area.
MS G-19: Make roads comfortable, safe, accessible, and attractive for use day and night.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide crosswalks and sidewalks along streets that are accessible for people with disabilities and people who are physically challenged. -Provide lighting for walking and nighttime activities, where appropriate. -Provide transit shelters that are comfortable, attractive, and accommodate transit riders.
MS G-20: Maintain and expand where possible the system of neighborhood connections that attach neighborhoods to larger roadways.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Provide sidewalks where they are missing, and provide wide sidewalks where appropriate with buffers and shade so that people can walk comfortably. -Make walking comfortable at intersections through traffic-calming, landscaping, and designated crosswalks.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			-Look for opportunities for connections along easements & other areas where vehicles not permitted.
MS G-21: Create distinctive places throughout the area.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide benches, streetlights, public art, and other amenities in public areas to attract pedestrian activities. -Encourage new developments to incorporate drought tolerant and native landscaping that is pedestrian friendly, attractive, and consistent with the landscaped character of area. -Encourage all new development to preserve existing mature trees. -Encourage streetscape design programs for commercial frontages that create vibrant places which support walking, bicycling, transit, and sustainable economic development. -Encourage the design and placement of buildings on lots to provide opportunities for natural systems such as solar heating and passive cooling. - Ensure that all new industrial development projects are positive additions to the community setting, provide amenities for the comfort of the employees such as outdoor seating area for breaks or lunch, and have adequate landscape buffers.
MS G-22: Reinvest in existing neighborhoods and promote infill development as a preference over new, greenfield development	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Identify all underused properties in the plan area and focus development in these opportunity sites prior to designating new growth areas for development. - Implement programs to retro-fit existing structures to make them more energy-efficient. -Encourage compact development, by placing the desired activity areas in smaller spaces.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
Public Safety			
MS G-23: Promote a safe community in which residents can live, work, shop, and play.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Foster an environment of trust by ensuring non-biased policing, and by adopting policies and encouraging collaboration that creates transparency. - Facilitate traffic safety for motorists and pedestrians through proper street design and traffic monitoring.

Note:
[1] Where GP=General Plan.
[2] List is not meant to be all inclusive.
Source: Data complied by EDAW in 2007

Appendix C

Rule and Regulation Summary

Table 18
Rule and Regulation Summary

Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Low Carbon Fuel Standard	10-20 MMT CO_2e by 2020	January 1, 2010	ARB	This rule/regulation will require fuel providers (e.g., producers, importers, refiners and blenders) to ensure that the mix of fuels they sell in CA meets the statewide goal to reduce the carbon intensity of CA's transportation fuels by at least 10% by the 2020 target.	ARB Early Action Measure
Reduction of HFC-134a Emissions from Nonprofessional Servicing of Motor Vehicle Air Conditioning Systems	1-2 MMT CO_2e by 2020	January 1, 2010	ARB	This rule/regulation will restrict the use of high GWP refrigerants for nonprofessional recharging of leaky automotive air conditioning systems.	ARB Early Action Measure
Landfill Gas Recovery	2-4 MMT CO_2e by 2020	January 1, 2010	IWMB, ARB	This rule/regulation will require landfill gas recovery systems on small to medium landfills that do not have them and upgrade the requirements at landfills with existing systems to represent best capture and destruction efficiencies.	ARB Early Action Measure
Vehicle Climate Change Standards (AB 1493 Pavley, Chapter 200, Statutes of 2002)	30 MMT CO_2e by 2020	2009	ARB	This rule/regulation will require ARB to achieve the maximum feasible and cost effective reduction of GHG emissions from passenger vehicles and light-duty trucks.	ARB Early Action Measure
Reduction of PFCs from the Semiconductor Industry	0.5 MMT CO_2e by 2020	2007–2009	ARB	This rule/regulation will reduce GHG emissions by process improvements/source reduction, alternative chemicals capture and beneficial reuse, and destruction technologies	Underway or to be initiated by CAT members in 2007-2009 period

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Table 18
Rule and Regulation Summary

Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Restrictions on High GWP Refrigerants	9 MMT CO_2e by 2020	2010	ARB	This rule/regulation will expand and enforce the national ban on release of high GWP refrigerants during appliance lifetime.	ARB Early Action Measure
Cement Manufacture	<1 MMT CO_2e per year (based on 2004 production levels)	2010	Caltrans	This rule/regulation will allow 2.5% interground limestone concrete mix in cement use.	CAT Early Action Measure
Hydrogen Fuel Standards (SB 76 of 2005)	TBD	By 2008	CDFA	This rule/regulation will develop hydrogen fuel standards for use in combustion systems and fuel cells.	CAT Early Action Measure
Regulation of GHG from Load Serving Entities (SB 1368)	15 MMT CO_2e by 2020	May 23, 2007	CEC, CPUC	This rule/regulation will establish a GHG emission performance standard for baseload generation of local publicly owned electric utilities that is no higher than the rate of emissions of GHG for combined-cycle natural gas baseload generation.	CAT Early Action Measure
Energy Efficient Building Standards	TBD	In 2008	CEC	This rule/regulation will update of Title 24 standards.	CAT Early Action Measure
Energy Efficient Appliance Standards	TBD	January 1, 2010	CEC	This rule/regulation will regulate light bulb efficiency	CAT Early Action Measure
Tire Efficiency (Chapter 8.7 Division 15 of the Public Resources Code)	<1 MMT CO_2e by 2020	January 1, 2010	CEC & IWMB	This rule/regulation will ensure that replacement tires sold in CA are at least as energy efficient, on average, as tires sold in the state as original equipment on these vehicles.	CAT Early Action Measure
New Solar Homes Partnership	TBD	January 2007	CEC	Under this rule/regulation, approved solar systems will receive incentive funds based on system performance above building standards.	CAT Early Action Measure

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Water Use Efficiency	1 MMT CO_2e by 2020	2010	DWR	This rule/regulation will adopt standards for projects and programs funded through water bonds that would require consideration of water use efficiency in construction and operation.	CAT Early Action Measure
State Water Project	TBD	2010	DWR	This rule/regulation will include feasible and cost effective renewable energy in the SWP's portfolio.	CAT Early Action Measure
Cleaner Energy for Water Supply	TBD	2010	DWR	Under this rule/regulation, energy supply contracts with conventional coal power plants will not be renewed.	CAT Early Action Measure
IOU Energy Efficiency Programs	4 MMT CO_2e by 2020	2010	CPUC	This rule/regulation will provide a risk/reward incentive mechanism for utilities to encourage additional investment in energy efficiency; evaluate new technologies and new measures like encouraging compact fluorescent lighting in residential and commercial buildings	CAT Early Action Measure
Solar Generation	TBD	2007–2009	DGS	3 MW of clean solar power generation implemented in CA last year, with another 1 MW coming up. The second round is anticipated to total additional 10 MW and may include UC/CSU campuses and state fairgrounds.	Underway or to be initiated by CAT members in 2007-2009 period

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Table 18
Rule and Regulation Summary

Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Transportation Efficiency	9 MMT CO_2e by 2020	2007–2009	Caltrans	This rule/regulation will reduce congestion, improve travel time in congested corridors, and promote coordinated, integrated land use.	Underway or to be initiated by CAT members in 2007-2009 period
Smart Land Use and Intelligent Transportation	10 MMT CO_2e by 2020	2007–2009	Caltrans	This rule/regulation will integrate consideration of GHG reduction measures and energy efficiency factors into RTPs, project development etc.	Underway or to be initiated by CAT members in 2007-2009 period
Cool Automobile Paints	1.2 to 2.0 MMT CO_2e by 2020	2009	ARB	Cool paints would reduce the solar heat gain in a vehicle and reduce air conditioning needs.	ARB Early Action Measure
Tire Inflation Program	TBD	2009	ARB	This rule/regulation will require tires to be checked and inflated at regular intervals to improve fuel economy.	ARB Early Action Measure
Electrification of Stationary Agricultural Engines	0.1 MMT CO_2e by 2020	2010	ARB	This rule/regulation will provide incentive funding opportunities for replacing diesel engines with electric motors.	ARB Early Action Measure
Desktop Power Management	Reduce energy use by 50%	2007–2009	DGS, ARB	This rule/regulation will provide software to reduce electricity use by desktop computers by up to 40%.	Currently deployed in DGS
Reducing CH_4 Venting/Leaking from Oil and Gas Systems (EJAC-3/ARB 2-12)	1 MMT CO_2e by 2020	2010	ARB	This rule/regulation will reduce fugitive CH_4 emissions from production, processing, transmission, and distribution of natural gas and oil.	ARB Early Action Measure
Replacement of High GWP Gases Used in Fire Protection Systems with Alternate Chemical (ARB 2-10)	0.1 MMT CO_2e by 2020	2011	ARB	This rule/regulation will require the use of lower GWP substances in fire protection systems.	ARB Early Action Measure
Contracting for Environmentally Preferable Products	NA	2007–2009	DGS	New state contracts have been or are being created for more energy and resource efficient IT goods, copiers, low mercury fluorescent lamps, the CA Gold Carpet Standard and office furniture.	Underway or to be initiated by CAT members in 2007-2009 period
Hydrogen Fuel Cells	NA	2007–2009	DGS	This rule/regulation will incorporate clean hydrogen fuel cells in stationary applications	Underway or to be initiated by CAT members in 2007-2009

Table 18
Rule and Regulation Summary

Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
				at State facilities and as back-up generation for emergency radio services.	period
High Performance Schools	NA	2007–2009	DGS	New guidelines adopted for energy and resource efficient schools; up to $100 million in bond money for construction of sustainable, high performance schools.	Underway or to be initiated by CAT members in 2007-2009 period
Urban Forestry	1 MMT CO_2e by 2020	2007–2009	Calfire, CUFR	This rule/regulation will provide five million additional trees in urban areas by 2020.	Underway or to be initiated by CAT members in 2007-2009 period
Fuels Management/Biomass	3 MMT CO_2e by 2020	2007–2009	Calfire	This rule/regulation will provide biomass from forest fuel treatments to existing biomass utilization facilities.	Underway or to be initiated by CAT members in 2007-2009 period
Forest Conservation and Forest Management	10 MMT CO_2e by 2020	2007–2009	Calfire, WCB	This rule/regulation will provide opportunities for carbon sequestration in Proposition 84 forest land conservation program to conserve an additional 75,000 acres of forest landscape by 2010.	Underway or to be initiated by CAT members in 2007-2009 period
Afforestation/Reforestation	2 MMT CO_2e by 2020	2007–2009	Calfire	This rule/regulation will subsidize tree planting.	Underway or to be initiated by CAT members in 2007-2009 period
Dairy Digesters	TBD	January 1, 2010	CDFA	This rule/regulation will develop a dairy digester protocol to document GHG emission reductions from these facilities.	ARB Early Action Measure

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Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Conservation Tillage and Enteric Fermentation	1 MMT CO_2e by 2020	2007–2009	CDFA	This rule/regulation will develop and implement actions to quantify and reduce enteric fermentation emissions from livestock and sequester soil carbon using cover crops and conservation tillage.	Underway or to be initiated by CAT members in 2007-2009 period
ULEV	TBD	2007–2009	DGS	A new long term commercial rental contract was released in March 2007 requiring a minimum ULEV standard for gasoline vehicles and requires alternative fuel and hybrid-electric vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Flex Fuel Vehicles	370 metric tons CO_2, 0.85 metric tons of CH_4, and 1.14 metric tons of N_2O	2007–2009	DGS	Under this rule/regulation, DGS is replacing 800 vehicles with new, more efficient vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Climate Registry	TBD	2007–2009	DGS	Benchmarking and reduction of GHG emissions for state owned buildings, leased buildings and light duty vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Municipal Utilities Electricity Sector Carbon Policy	Included in SB 1368 reductions	2007–2009	CEC, CPUC, ARB	Under this rule/regulation, GHG emissions cap policy guidelines for CA's electricity sector (IOUs and POUs).	Underway or to be initiated by CAT members in 2007-2009 period
Alternative Fuels: Nonpetroleum Fuels	TBD	2007–2009	CEC	State plan to increase the use of alternative fuels for transportation; full fuel cycle assessment.	Underway or to be initiated by CAT members in 2007-2009 period
Zero Waste/High Recycling Strategy	5 MMT CO_2e by 2020	2007–2009	IWMB	This rule/regulation will identify materials to focus on to achieve GHG reduction at the lowest possible cost; Builds on the success of 50% Statewide Recycling Goal.	Underway or to be initiated by CAT members in 2007-2009 period
Organic Materials Management	TBD	2007–2009	IWMB	This rule/regulation will develop a market incentive program to increase organics diversion to the agricultural industry.	Underway or to be initiated by CAT members in 2007-2009 period
Landfill Gas Energy	TBD	2007–2009	IWMB	Landfill Gas to Energy & LNG/biofuels	Underway or to be initiated by CAT members in 2007-2009 period

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Target Recycling	TBD	2007–2009	IWMB	This rule/regulation will focus on industry/public sectors with high GHG components to implement targeted commodity recycling programs.	Underway or to be initiated by CAT members in 2007-2009 period
Accelerated Renewable Portfolio Standard	Included in SB 1368 reductions	2007–2009	CPUC	This rule/regulation will examine RPS long term planning and address the use of tradable renewable energy credits for RPS compliance.	Underway or to be initiated by CAT members in 2007-2009 period
CA Solar Initiative	1 MMT CO_2e by 2020	2007–2009	CPUC	Initiative to deliver 2000 MWs of clean, emissions free energy to the CA grid by 2016.	Underway or to be initiated by CAT members in 2007-2009 period
Carbon Capture and Sequestration	TBD	2007–2009	CPUC	Proposals for power plants with IGCC and/or carbon capture in the next 18 months.	Underway or to be initiated by CAT members in 2007-2009
Source: Data complied by EDAW in 2007					

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

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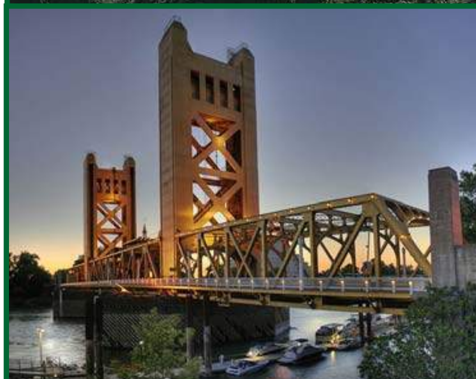
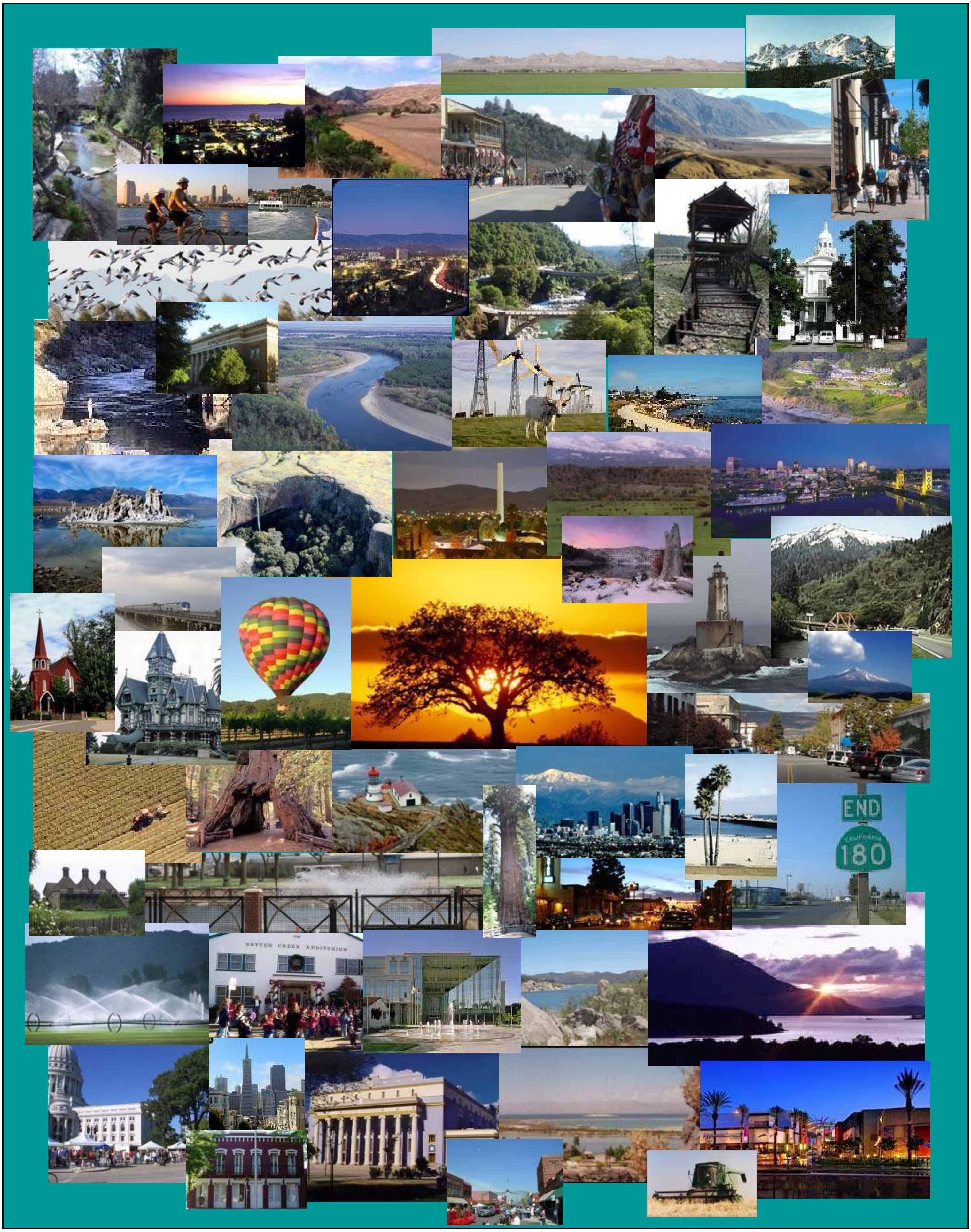


Model Policies for Greenhouse Gases in General Plans

A Resource for Local Government to Incorporate General Plan Policies to Reduce Greenhouse Gas Emissions

June 2009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Disclaimer

The California Air Pollution Control Officers Association (CAPCOA) has prepared this white paper consideration of model policies for addressing greenhouse gas emissions in General Plans to provide a common platform of information and tools to support local governments.

This paper is intended as a resource, not a guidance document. It is not intended, and should not be interpreted, to dictate the manner in which a city or county chooses to address greenhouse gas emissions in the context of its General Plan.

This paper has been prepared at a time of flux in California law and regulation, as well as accepted practice, regarding how climate change should be addressed in government programs. There is pending litigation that may have bearing on these decisions, as well as active legislation at the federal level. And finally, our understanding of the science of climate change continues to evolve, too. In the face of this uncertainty, local governments are working to understand the new expectations, and how best to meet them. This paper is provided as a resource to local policy and decision makers to enable them to make the best decisions they can during this period of uncertainty.

Finally, this white paper reviews requirements, discusses policy options, and highlights methods, tools, and resources available, but it is not intended to provide legal advice and should not be construed as such. Questions of legal interpretation, or requests for legal advice, should be directed to the jurisdiction's counsel.

Acknowledgements

This paper on Model Policies for Addressing Greenhouse Gas Emissions in General Plans benefited from the hard work and creative insights of many people. CAPCOA appreciates the efforts of all who contributed their time and energy to the project. In particular, the Association thanks the following individuals:

Principal Authors

Barbara Lee, NSCAPCD
John Yu, CAPCOA

Project Core Group

Larry Allen, SLOAPCD
Barbara Lee, NSCAPCD
Tim Taylor, SMAQMD
Jill Whynot, SCAQMD
Dave Vintze, BAAQMD
John Yu, CAPCOA

CAPCOA Climate Protection Committee: Model Policies Review Group

Larry Allen, SLOAPCD
Jeane Borkenhagen, SMAQMD
Barbara Lee, NSCAPCD
Greg Tholen BAAQMD
Dave Warner, SJVUAPCD
Jill Whynot, SCAQMD
Molly Wright, SMAQMD
Dave Vintze, BAAQMD
John Yu, CAPCOA
Mel Zeldin, CAPCOA

External Reviewers

Pete Parkinson, County of Sonoma
Nancy McKeever, CEC
Judy Corbett, LGC

Proofing & Layout

Celia Diamond, SCAQMD
Pauline King, CAPCOA
Patricia Whiting, SCAQMD
John Yu, CAPCOA

Contract Support

ICF Jones & Stokes, and Rimpo & Associates

CAPCOA Climate Protection Committee

Larry Allen, SLOAPCD, Chair
Alan Abbs, TCAPCD
Bobbie Bratz, SBAPCD
Jeane Borkenhagen, SMAQMD
Karen Brooks, SLOCAPCD
YuShuo Chang, PCAPCD
Christa Darlington, PCAPCD
Jorge DeGuzman, SMAQMD
Mat Ehrhardt, YSAQMD
Adam Fieseler, SCAQMD
Jean Getchell, MBUAPCD
Larry Greene, SMAQMD
Henry Hilken, BAAQMD
Dave Jones, KCAPCD
Barbara Lee, NSCAPCD
Tom Murphy, SBAPCD
Don Price, VCAPCD
Brad Poiriez, ICAPCD
Violette Roberts, MDAQMD
Jean Roggenkamp, BAAQMD
Greg Tholen, BAAQMD
Tim Taylor, SMAQMD
Mike Villegas, VCAPCD
David Vintze, BAAQMD
Dave Warner, SJVUAPCD
Jill Whynot, SCAQMD
John Yu, CAPCOA
Mel Zeldin, CAPCOA

…and other air district staff members who offered insight and expertise.

Approved For Release by the CAPCOA Board of Directors

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List of Acronyms and Abbreviations

Acronym/ Abbreviation	Meaning
AB 32	Assembly Bill 32 Global Warming Solutions Act of 2006
AFV	Alternative Fuel Vehicle
AG	Attorney General
AMI	Advanced Metering Infrastructure
ARB	Air Resources Board
APCD	Air Pollution Control District
APS	Alternative Planning Strategy
AQMD	Air Quality Management District
BAAQMD	Bay Area Air Quality Management District
BOF	Board of Forestry
Cal/EPA	California Environmental Protection Agency
Cal Fire	California Department of Forestry and Fire Protection
CAISO	California Independent System Operator
CAP	Climate Action Plan
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resource Board
CAS	Climate Adaptation Strategy
CAT	Climate Action Team
CCA	Community Choice Aggregation
CCAP	Climate Change Action Plan
CCAR	California Climate Action Registry
CCC	California Conservation Corps
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CDFA	California Department of Food and Agriculture
CH_4	Methane
CIWMB	California Integrated Waste Management Board
CO_2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
CPUC	California Public Utilities Commission
DOC	Department of Conservation
DFG	Department of Fish and Game
DGS	Department of General Services
DPC	Delta Protection Committee
DTSC	Department of Toxics Substances Control
DWR	Department of Water Resources
EIR	Environmental Impact Report
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPIC	Environmental Protection Indicators for California
EPS	Emissions Performance Standard

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Meaning
ESP	Energy Service Provider
FAR	Floor Area Ratio
GHG	Greenhouse Gas
GWP	Global Warming Potential
HFC	Hydrochlorofluorocarbons
HSR	High Speed Rail
HOV	High Occupancy Vehicle Lanes
ICLEI	International Council for Local Environmental Initiatives (now known as Local Governments for Sustainability)
IOU	Investor Owned Utility
IPCC	International Panel on Climate Change
LAFCO	Local Area Formation Commission
LEED	Leadership in Energy and Environmental Design
LCFS	Low Carbon Fuel Standard
LNG	Liquefied Natural Gas
LUSCAT	Land Use Subgroup of the Climate Action Team
$MMTCO_2e$	Million Metric Tons Carbon Dioxide Equivalent
MPO	Metropolitan Planning Organizations
MWh	Megawatt hour
MVAC	Motor Vehicle Air Conditioning
NAS	National Academy of Sciences
NAST	National Assessment Synthesis Team
N_2O	Nitrous Oxide
NO_X	Oxides of Nitrogen
ODS	Ozone Depleting Substances
OFA	Office of Fleet Administration
OPAR	Caltrans Office of Policy Analysis and Research
OPC	California Ocean Protection Council
OPR	State Office of Planning Research
PIER	Public Interest Energy Research Program
PFC	Perfluorocarbon
PHEV	Plug-In Electric Hybrid Vehicles
PG&E	Pacific Gas & Electric
POU	Publicly Owned Utilities
PM	Particulate Matter
PPB	Parts Per Billion
PPM	Parts Per Million
PPT	Parts Per Trillion
RHNA	Regional Housing Needs Assessment
RPS	Renewable Portfolio Standards
RTAC	Regional Targets Advisory Committee
RTP	Regional Transportation Plan

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Meaning
RTIP	Regional Transportation Improvement Program
RTPA	Regional Transportation Planning Agency
S-3-05	Executive Order S-3-05
SABRC	State Agency Buy Recycled Campaign
SB	Senate Bill
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
SCEA	Sustainable Communities Environmental Assessment
SCS	Sustainable Communities Strategy
SCSA	State and Consumer Services Agency
SDG&E	San Diego Gas & Electric
SEA Change	Strategic Energy Alliance for Change
SJVAPCD	San Joaquin Valley Air Pollution Control District
SF_6	Sulfur Hexafluoride
SLOAPCD	San Luis Obispo Air Pollution Control District
SMAQMD	Sacramento Metropolitan Air Quality Management District
SRI	Solar Reflectance Index
SWAMP	Surface Water Ambient Monitoring Program
SWIM	System for Water Information Management
SWRCB	State Water Resources Control Board
TBD	To Be Determined
TMM	Traffic Mitigation Measures
TPP	Transit Priority Projects
UGB	Urban Growth Boundary
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
WCI	Western Climate Initiative
ZEV	Zero Emissions Vehicle

Executive Summary

Global climate change has been clearly documented and is predicted to have substantial effects on the world we live in, not only in parts of the world that are far away, but here in California. Emissions of greenhouse gases (GHGs) must be curtailed if we hope to minimize the extent and impact of climate change. The majority of GHG emissions come from combustion of fossil fuels for energy and transportation. While renewable energy sources, cleaner fuels, and green technology will help to reduce GHG emissions, we also need significant changes in how we design and construct our "built environment" to meet our climate protection goals.

The General Plans developed and implemented by cities and counties must be at the heart of any effort to change our built environment, and many of these local governments have stepped up to the challenge. In order to support their important efforts, the California Air Pollution Control Officers Association (CAPCOA) has prepared this report of Model Policies for Greenhouse Gases in General Plans. The report is intended to serve as a resource for cities and counties. It discusses General Plan structure and options for including GHG policies in existing General Plan Elements, or by creating a separate GHG Element and/or GHG Reduction Plan. The Model Policies Report contains a menu of model language for inclusion in the General Plan Element(s). The report does not dictate policy decisions, rather, it provides cities and counties with an array of options to help them address GHGs in their General Plans.

The statutory and regulatory landscape affecting GHG emissions and climate planning in California has evolved considerably over the last several years. The Governor's Executive Order 2-3-05, and the Global Warming Solutions Act of 2006 (AB 32) establish the broad policy goals for the state for 2020 and 2050. To meet these goals, the Air Resources Board (ARB) has identified discrete Early Action Measures that will be adopted and enforceable by 2010, and approved a Scoping Plan that lays out the longer term strategy for rulemaking and market mechanisms to reduce GHG emissions. The Scoping Plan specifically includes reductions from local government operations and land use decisions. In addition to this core framework, there are a number of other important statutes and regulations affecting GHGs from motor vehicles, fuels, energy production and use, and land use planning, among others. In particular, SB 375 (Steinberg) was signed by the Governor in 2008, and puts in place the framework for regional targets for GHG reductions, and improved regional planning to meet them. There are also new sources for incentive funding to support clean energy and transportation, and reductions of GHG emissions. And the implementation of some programs that have been in place for a long time, such as the building standards in Title 24 and the California Environmental Quality Act (CEQA), is evolving in response to our heightened concern about climate change.

The role of local governments is increasingly in the spot light as we choose our path to a greener and more sustainable future. There are a number of ways cities and counties can reduce GHG emissions. Reductions need to be made in GHG emissions from local government operations, including energy use, waste and recycling, water delivery and wastewater treatment, transportation, and the built environment. Local governments also have a key role to play in educating local businesses and communities, and supporting their efforts to reduce GHG emissions. Cities and counties can also ensure the impacts of GHG emissions are mitigated when projects are reviewed under CEQA. And, of course, GHG reduction polices can be incorporated into the regional and local planning efforts, including the General Plan.

Integrated regional planning (as supported by Steinberg's SB 375) can provide a framework for cities and counties to contribute to GHG reductions needed for the region to meet the target set by ARB. Cities and counties can also make explicit local commitments to reduce GHG emissions, and adopt Climate Action Plans to make those reductions happen. Policies can be incorporated into existing General Plan Elements. Alternatively a separate element can be created specifically to address GHGs and climate change. In order to be effective, local planning efforts alternatives must be evaluated for consistency with regional plans, including Blueprint Plans, Air Quality Management Plans, and Regional Transportation Plans. The robust and coordinated planning effort envisioned here provides important opportunities to streamline the CEQA review process while ensuring the environment is protected.

As we plan for and implement GHG reduction strategies, it is critical that we review our progress, not only to ensure that we are reaching our goals, but also to ensure that we are not creating unintended and potentially adverse outcomes. Air quality and public health must still be protected, and we must ensure equal protection for all Californians regardless of their income status or ethnic background.

General Plans are, in a broad sense, comprised of goals, objectives, policies, standards, and/or implementation measures, as well as a set of maps and diagrams that describe a vision for the community's future development. The law requires that the General Plan be internally consistent, and there are specific measures of that consistency. Because of this, new policies for GHG need to be considered in the context of the existing elements. These include the mandatory elements, including land use, conservation, circulation, open space, housing, noise, safety, and, in certain circumstances, air quality, as well as non-mandatory elements, such as energy, economic development, capital improvements and public facilities, community design, water, and agriculture. The way the different elements interrelate is an important consideration when incorporating policies for GHGs in the General Plan, and ensuring that those policies are internally consistent throughout the Plan.

The majority of this report is comprised of model policies for GHG reduction that can be incorporated into a jurisdiction's General Plan. Model language is provided in nine major categories: GHG Reduction Planning (overall); Land Use and Urban Design; Transportation; Energy Efficiency; Alternative Energy; Municipal Operations; Waste Reduction and Diversion; Conservation and Open Space; and Education. In addition to the model language, the report provides a worksheet in the form of a table to facilitate the evaluation of the policies for local use, considering specific local factors and criteria. The table also has links to examples of plans that have incorporated the model policy, or a similar policy, to provide a more in-depth understanding of what has been done, under what circumstances, and how.

Finally the report contains technical appendices that provide more detailed information about greenhouse gases, programs that address them, the projected impacts of climate change, climate science, the top ten actions local governments should take, the roles of different agencies on climate and GHG, and examples of plans and policies that have been adopted in California as well as other resources.

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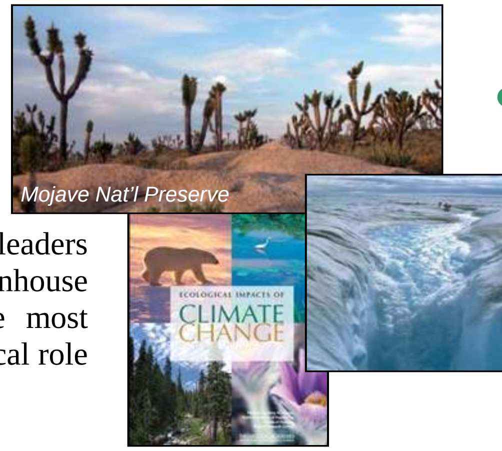
Climate change has already begun to have real and significant impacts on our world and our lives. Some of the changes seem trivial, while others are alarming. As the climate changes more over the next decades, the impacts we see will affect us in increasingly dramatic ways. Recognizing this, the public and government leaders have called for action to reduce emissions of greenhouse gases in the hope that we can stave off the most catastrophic effects. Local government has a critical role to play in this effort.



Mojave Nat'l Preserve

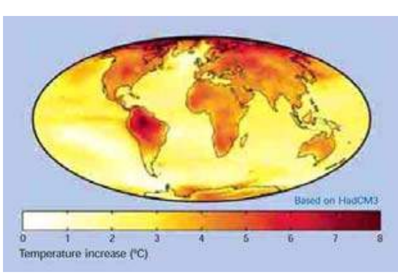
NAS Brochure

Because the vast majority of greenhouse gas emissions come from burning fossil fuels, there is tremendous interest in alternative fuels, renewable energy, green technology, and energy conservation as means to cut emissions. There is great promise in these solutions, however alone they are not enough. Studies show that in order to cut emissions to the levels needed, in time to make a difference, we will have to make significant changes in how we live our daily lives, and specifically in how we organize our communities and infrastructure. The key to this organization, and to changing it, is the General Plan that cities and counties develop and implement.

Addressing climate change in a General Plan is no small task. Historically, local air districts have assisted cities and counties in developing the Air Quality Element of their General Plans. In the last few years, air districts across California have been asked by cities and counties for help integrating greenhouse gas emission reduction strategies into their General Plans as they update them. In response, the air districts have pooled their resources through the California Air Pollution Control Officers Association (CAPCOA) to develop a series of Model Policies for Greenhouse Gases in General Plans, and supporting material. CAPCOA would like to acknowledge the Climate Focus Group at ICF Jones & Stokes, and Rimpo and Associates, for their assistance in collecting and compiling information on policies that have been adopted to address GHG emissions.

General Information on Climate Change

An understanding of climate change, and its current and potential future effects on our communities and resources, is essential to good decision making. A detailed description of the science and implications of climate change is provided in the technical appendices at the end of this document. The following provides a basic summary of the issue.



Source: www.scienceschools.org

Climate change is a shift in the "average weather" that a given region experiences. This is measured by changes in the features that we associate with weather, such as temperature, wind patterns, precipitation, and storms. Global climate change means change in the climate of the Earth as a whole. The Earth's natural climate has always been, and still is, constantly changing. The climate change we are seeing today, however, differs from previous climate change in both its rate and its magnitude.

Human activities are exerting a major influence on some of the key factors that govern climate by changing the composition of the atmosphere and by modifying the land surface. The concentration of carbon dioxide (CO2) in the atmosphere has risen about 30 percent since the late 1800s (National Assessment Synthesis Team [NAST], 2001). This increase has resulted from the burning of coal, oil, and natural gas, and the destruction of forests around the world to provide space for agriculture and other human activities. Concentrations of other greenhouse gases caused by human activities have also increased significantly: for example methane has risen nearly 20% and nitrous oxides over 150% during the same period. Average global surface temperatures have shown a corresponding increase of more than 1° F over the past 100 years, with an average increase of 9° F in the polar regions. The nine warmest years on record have all occurred in the last decade. Figure 1 (right) shows the change in temperature over the last one thousand years. Figure 2 (below) provides thermal maps representing the high and the low in the range of predicted changes in temperature.

Figure 1: Temperature History

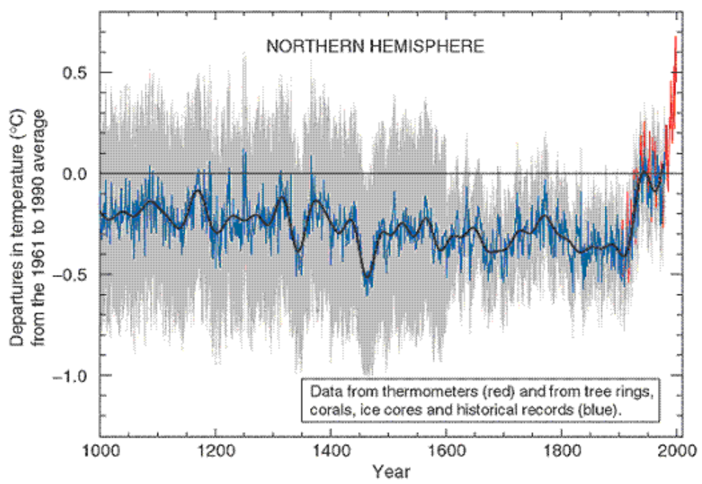
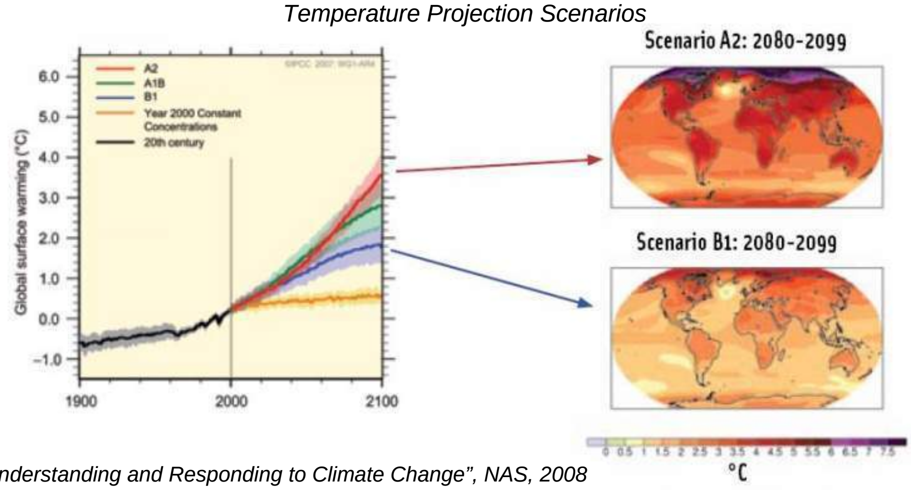


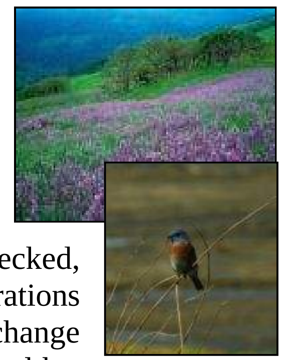
Figure 2:
Temperature Projection Scenarios



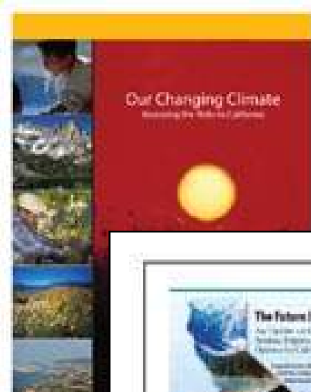
Source: "Understanding and Responding to Climate Change", NAS, 2008

Global projections of population growth and assumptions about energy use indicate that the CO2 concentration will continue to rise, likely reaching between two and three times its late-19th-century level of 280 ppm (parts per million) by 2100, depending on the level and timeliness of preventative actions taken by California and the rest of the world. Such increases in CO2 and other GHGs in the atmosphere and the resulting increase in average global temperatures are predicted to have significant consequences worldwide that will vary in nature and severity depending on location. Impacts predicted for California are summarized below.

Projected Climate Change Impacts in California



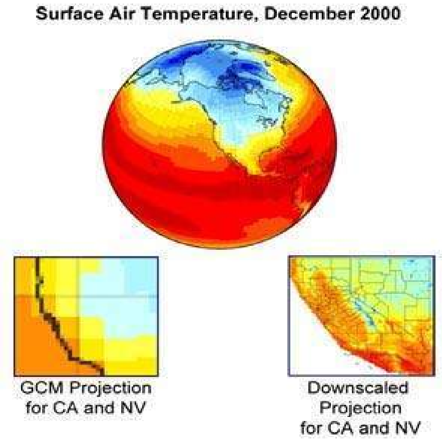
In California and throughout western North America, signs of a changing climate are evident. During the last 50 years, winter and spring temperatures have been warmer, spring snow levels in lower- and mid-elevation mountains have dropped, snowpack has been melting one to four weeks earlier, and flowers are blooming one to two weeks earlier. These regional changes are consistent with global trends. If left unchecked, by the end of the century CO2 concentrations could reach levels at which climate change impacts would severely impact our public health, economy, and environment.



State of the art climate modeling was performed for the California Energy Commission (CEC) to determine potential future impacts of climate change in California under three different scenarios: a low emissions scenario that assumes aggressive action is taken to reduce GHG emissions, a medium emissions scenario assuming a moderate level of GHG reductions, and a high emissions scenario that assumes little action is taken to reduce emissions. The range of potential impacts modeled was summarized in a 2006 CEC document called: *"Our Changing Climate: Assessing the Risks to California."* This document outlines the growing severity of consequences predicted statewide as temperature rises, and also identifies those impacts that may be unavoidable and for which we will need to develop coping and adaptation strategies. The report contains significant existing climate change scientific evidence to support the need for regulating GHG emissions. The CEC prepared a biennial update on the risks to California from climate change, and has summarized key points in the brochure: *"The Future is Now."*

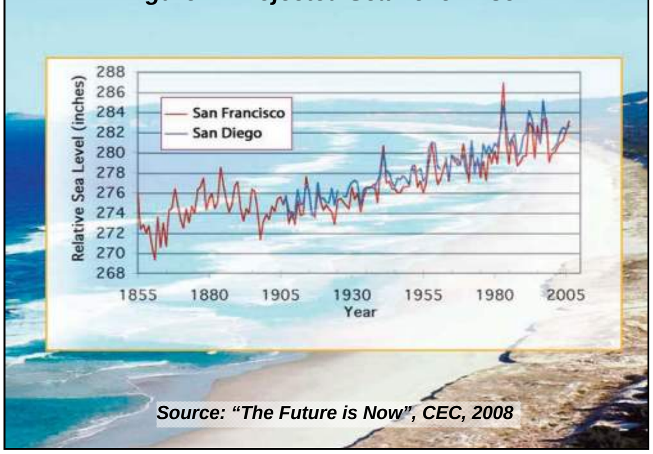
As the atmospheric concentration of GHGs increases, California can anticipate increased average temperatures of 1 to 2 degrees F in the next few decades, and perhaps as much as 10°F by the end of the century. Figure 3 (right) shows results of thermal modeling performed for the CEC, including grid scales for the western region of the U.S., downscaled to California and Nevada. The higher temperatures will increase the formation of smog during summer months with the number of days with unhealthy air more than doubling under the worst-case scenario. In addition, there will be as many as 100 more days each year where temperatures exceed 90°F, and a corresponding rise in illness and death from extreme heat. While total annual precipitation in the state is not expected to change substantially, a much greater percentage will fall as rain instead of snow, with a corresponding decrease in snowpack and the spring runoff that supplies water to the state's agriculture and major urban centers. Reduced water supplies and increased temperatures will directly impact which crops can be grown in California, and this may lead to a greater incidence of disease and pest damage. This damage will also affect the state's forests which will likely sustain a sharp increase in catastrophic wildfires. Finally, as shown in Figure 4, the predicted rise in sea level from 1 to 3 meters by the end of the century will drastically alter California's extensive coast, as well as low-lying inland areas, and land along tributaries, inlets, and bays. A more detailed discussion of predicted impacts is presented in Appendix D.

Figure 3: Thermal Modeling



Source: "Climate Change Impacts Assessment: Second Biennial Science Report to the California Climate Action Team", CEC, 2008

Figure 4: Projected Sea Level Rise



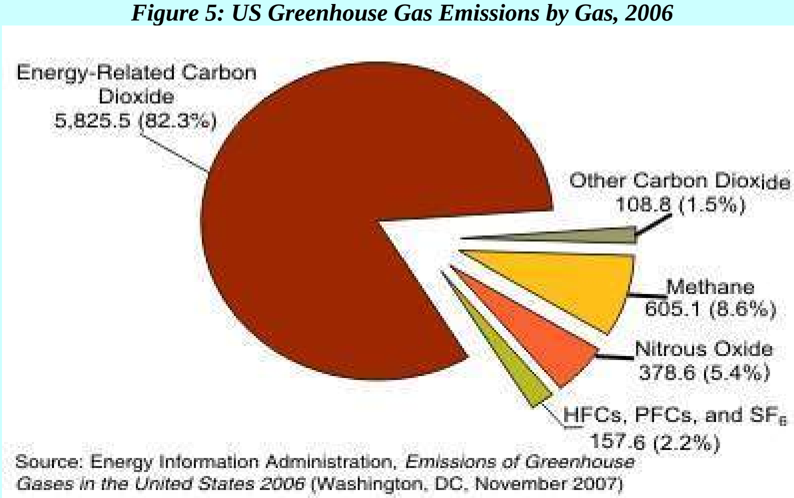
Source: "The Future is Now", CEC, 2008

Greenhouse Gases and Their Sources

Carbon dioxide is the most dominant greenhouse gas; however a number of other gases also contribute significantly to climate change, including methane (CH4), nitrous oxide (N2O), sulfur hexafluoride (SF6), hydrochlorofluorocarbons (HFCs) and perfluorocarbons (PFCs). Each gas has a different heat trapping capacity compared to CO2. For instance, methane is 21 times more effective at trapping heat in the atmosphere compared to the same mass of CO2, while some of the fluorocarbons have thousands of times more heat trapping capacity as CO2. To account for these differences when comparing emissions for the different compounds, the emissions are generally expressed in terms of CO_2 equivalents (CO_2e). Thus, generic references to GHG emissions generally mean CO_2 equivalent emissions.

As shown in Figure 5, CO_2 makes up approximately 84% of total GHG emissions by volume, with nitrous oxide and methane contributing about 6% and 7% respectively. SF_6, HFCs and PFCs, collectively referred to as high global warming potential (GWP) gases, represent the remaining 3% of statewide GHG emissions. High GWP gases are compounds with significantly higher heat-trapping capacity than CO_2.

Figure 5: US Greenhouse Gas Emissions by Gas, 2006

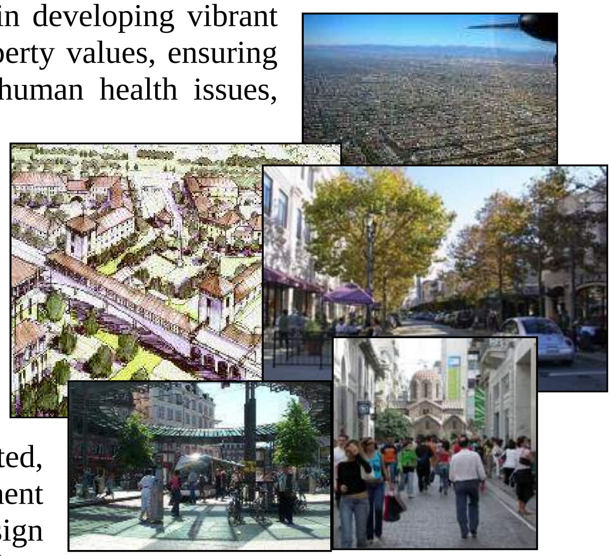


From a land use standpoint, carbon dioxide and methane are the most important GHGs that local government has the potential to significantly influence and will be the primary focus of the recommended policies and reduction strategies identified in this document.

Increasing CO_2 concentrations in the atmosphere primarily result from increased combustion of fossil fuels. Fossil fuel combustion accounts for 98 percent of California CO_2 emissions, generating 360 million metric tons of CO_2 in 2002; this represents approximately 7 percent of total U.S. emissions from this source category. The transportation sector is the largest contributor in California, accounting for 38% of CO_2 emissions, with gasoline combustion the greatest portion of those emissions.

Methane accounted for approximately 6 percent of California's total GHG (CO_2e) emissions in 2002. Methane is produced during anaerobic decomposition of organic matter in biological systems. Decomposition occurring in landfills accounts for the majority of anthropogenic CH_4 emissions in California and in the United States as a whole. Agricultural processes such as enteric fermentation, manure management, and rice cultivation are also significant sources of CH_4 in California.

What Is The Land Use Connection?



Land use planning is a critical element in developing vibrant and livable communities, increasing property values, ensuring economic vitality, addressing potential human health issues, promoting transportation efficiency, ensuring affordable housing, and improving environmental protection. The distribution of different types of land uses, their design, their accessibility, and their intensity can have profound effects on energy use, water use, and vehicle miles of travel.

When properly designed and located, compact, accessible, mixed-use development using energy and water-saving design techniques requires less energy and less vehicle travel than the typical development patterns over the past 60 years. Thus, land use planning is an area of opportunity for guiding development and land use decisions in a manner that considers the heat-trapping emissions of human activity and aims to reduce such emissions. Unfortunately, there is no "one size fits all," cookie cutter approach to effective land use planning. A project that might be beneficial, and reduce VMT and other energy needs, in one situation can actually work in the negative, increasing VMT and energy demands, if sited without proper regard to the circumstances and needs of the site, the community, and the region. For this reason, recommended strategies and approaches should always be considered in context, and evaluated for their appropriateness based on the specific circumstances in which they would be implemented.

What Does This Document Contain?

The California Air Pollution Control Officers Association (CAPCOA) Model Policies for GHGs in General Plans (Model Policies Report) is a resource document intended to help cities and counties address climate change and GHG emissions in their General Plans. The Model Policies Report provides a variety of useful information, including a toolbox of policies, strategies and model language that can be used in General Plans. The Model Policies Report identifies the various issues related to GHG emissions that may cut across several elements of a General Plan; interrelationships of these elements were considered when developing the set of potential development policies for consideration. In addition, the Model Policies Report reviews and analyzes the efficacy of the different goals, objectives, policies & implementation measures available to reduce GHG emissions.

Finally, the Model Policies Report provides model language for GHG policies in General Plan elements, including a list/menu of approaches that are currently being used so that jurisdictions can choose which approaches are most appropriate to them. The Model Policies Report is intended to offer flexible guidance to allow for different approaches to address GHG in General Plans.

This document is focused on issues surrounding the reduction of greenhouse gas emissions. An equally important challenge related to climate change is planning for adaptation to environmental change (such as sea level rise and other climate effects) that is inevitable, regardless of success in reducing greenhouse gas emissions. Local land use planning should also consider how to plan for climate-resilient communities in light of foreseeable environmental change, but that is not the focus of this document.

What Is the Purpose of This Document?

This document provides local jurisdictions with relevant information for considering climate change and GHG reductions in General Plan development and updates. Since the passage of the Global Warming Solutions Act of 2006 (Assembly Bill 32, or AB 32), and Executive Order S-03-05 (EO S-03-05), there has been substantial interest at the State level in finding ways to reduce statewide GHG emissions. The California Air Resources Board (ARB) is given the primary responsibility to develop strategies and regulations to reduce California's overall GHG emissions to 1990 levels by 2020. As required under AB 32, the ARB adopted a Scoping Plan calling for targeted reductions of CO2 from various sectors, including a proposed 2 million metric ton reduction from land use and local government.

The California Attorney General's Office (AG) has taken an active role in the cause of climate change and GHG emissions reductions. The AG has written over 20 extensive project comment letters concerning climate change, some of which were directed toward cities and counties addressing climate change in their General Plans. As an example of his commitment to this role, the AG litigated San Bernardino County based on its failure to analyze in its General Plan Environmental Impact Report (EIR) the increased greenhouse gas emissions that would result from the county's proposed General Plan update. The suit was settled, and although not binding on other communities, the precedent-setting settlement between the AG and San Bernardino County has led many to believe that an EIR for a General Plan must inventory GHG emissions, describe impacts due to the forecasted emissions, and identify feasible mitigation measures to reduce those emissions. Further, mitigations adopted in a General Plan EIR often will require the amendment of General Plan goals, objective, policies, or implementation measures in order to feasibly reduce GHG emissions.

Local governments will face many challenges ahead in reducing GHG emissions. To help provide foundational information, in January 2008, CAPCOA published a white paper entitled, "CEQA & Climate Change"-- a resource document developed to assist public agencies in establishing procedures for reviewing GHG emissions from projects subject to the California Environmental Quality Act (CEQA). This Model Policies Report continues CAPCOA's efforts to provide meaningful information and tools to local jurisdictions in response to the rapidly evolving regulations in regards to GHGs and climate change. When developing the Model Policies Report, CAPCOA took into account the range of requirements a community must address in preparing or updating a General Plan: internal consistency; equal status among elements; consistency between elements; consistency within elements; area plan consistency; and long-term perspective.

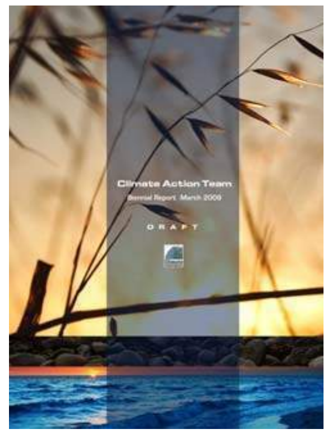
For Whom Is This Document Intended?

This document is intended for use by local city and county policy and decision makers. The State of California requires each city and county to prepare a comprehensive, long-term General Plan. One of the main purposes of a General Plan is for the jurisdiction to articulate its development goals, objectives, principles and policies for all land areas under its control. Decision and policy makers may find this document useful when evaluating how to incorporate policies and goals related to climate change in their General Plan. Planners and General Plan practitioners may also find this document useful as a general reference.

Colusa County

Over the last several years, a number of new programs have been established to reduce emissions of GHGs. While most of these do not operate directly on or through General Plans, they create a strong foundation upon which General Plan elements for GHGs can be built. This section of the report provides a brief summary of the key programs. Appendix B provides additional description of programs specifically implementing AB 32. Additional information on other programs is summarized in Appendix C. The appendices also provide links to respective program websites where more detailed information can be found.

State Reduction Targets for GHGs (Executive Order S-3-05)



On April 1, 2009, California's Climate Action Team released a draft of its second report to the Governor and the Legislature.

The first comprehensive state policy to address climate change was established through an Executive Order of the Governor of California. In 2005, Governor Schwarzenegger issued California Executive Order S-3-05, which established ambitious GHG reduction targets for the state: reduce GHG emissions to 2000 levels by 2010, reduce to 1990 levels by 2020, and reduce emissions 80% below 1990 levels by 2050. These targets reflect the world-wide emission reduction trajectory identified by the International Panel on Climate Change (IPCC) as being necessary to avert catastrophic global climate change. Under the Executive Order, each state agency is directed to identify and pursue actions within their purview that could contribute to the necessary emission reductions. The Secretary of the California Environmental Protection Agency (Cal/EPA) has the role of coordinating the emission reduction efforts, through the Governor's Climate Action Team, which the Secretary chairs.

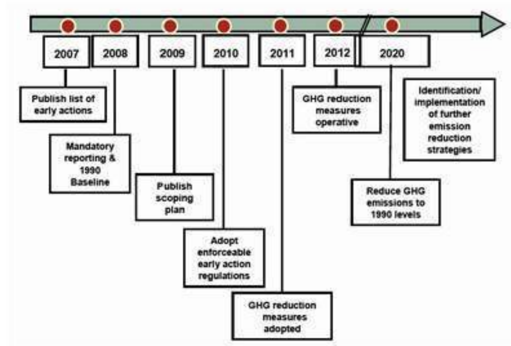
This Executive Order is binding only on state agencies, and has no force of law for local governments; however, S-3-05 was important for two reasons. First, it obligated state agencies to implement GHG emission reduction strategies. Second, the signing of the Order sent a clear signal to the Legislature about the framework and content for legislation to reduce GHG emissions.

Global Warming Solutions Act of 2006 (AB 32)

California AB 32, the "Global Warming Solutions Act of 2006," codifies the State's GHG emissions target by directing the ARB to reduce the State's global warming emissions to 1990 levels by 2020. ARB regulations must begin phasing in by 2012. AB 32 was co-authored by Assembly Member Fran Pavley and Assembly Speaker Favian Núñez; it was signed and passed into law by Governor Arnold Schwarzenegger on September 27, 2006.

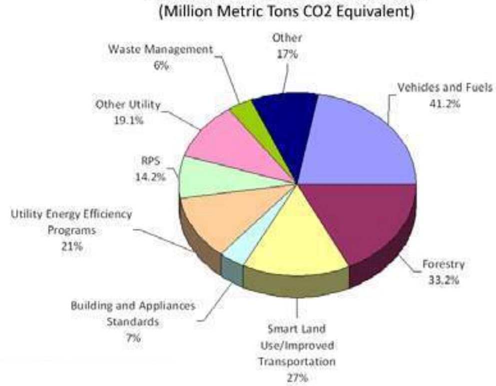
As shown in Figure 6, AB 32 defines a number of milestones to be met in the effort to achieve the 2020 emissions target. It vests the principle authority to implement the program in the ARB, but provides that the Secretary of Cal/EPA will coordinate across state agencies. The cornerstone of the program is the development and adoption by ARB of a Scoping Plan that identifies specific reduction strategies, implementation mechanisms, and timelines. The statute requires that ARB adopt the Scoping Plan by the end of 2008, and that regulations to implement the Plan's strategies must be enforceable by 2012. The statute also requires the ARB to adopt discrete early action measures in 2007, and to study the feasibility and effectiveness of market mechanisms to achieve the needed emission reductions. Finally, it provides that progress towards attainment of criteria air pollutant standards should not be impaired by the climate program, nor should the program create or exacerbate impacts on communities. Figure 7 shows the key GHG emitting sectors of California's economy.

Figure 6: AB 32 Timeline



Source: ARB Staff Report on Early Action Measures

Figure 7:
Sources of Potential Reductions
(Million Metric Tons CO2 Equivalent)



Source: March 2006 Climate Action Team Report

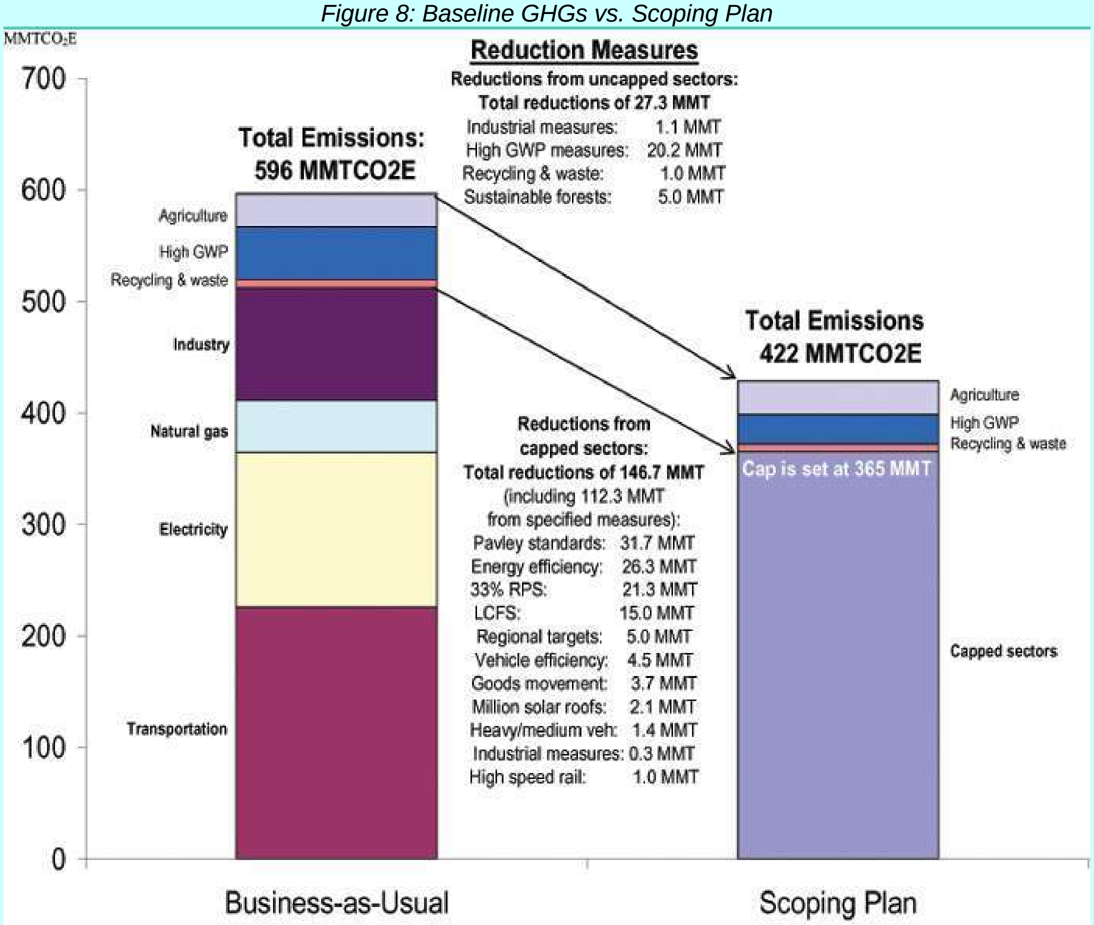
Early Action Measures:

The ARB approved a package of discrete early action measures in June, 2007. The core measures are three proposed rulemakings, including the codification of the Low Carbon Fuel Standard called for in the Governor's Executive Order S-1-07 (see discussion later in this chapter), the capture and recovery of refrigerants with high global warming potential during the servicing of automobile air conditioning systems, and the capture and recovery of methane from landfills, with additional reductions to come from other smaller scope regulations, and as co-benefits from criteria pollution rulemaking efforts. In October, 2007, the ARB added measures to the list, including reductions anticipated from improved energy efficiency at cement manufacturing plants, rulemaking on refrigerants, tire inflation programs, and other programs in trucking and at the ports. Further details on these programs are provided in Appendix B of this report.

Scoping Plan: The Scoping Plan was approved by the ARB Board in November, 2008. The Plan does several things. First, it specifies the target level of GHG emissions that must be achieved by 2020, and estimates the levels that would occur in the absence of measures to reduce emissions – the "business-as-usual" scenario. The difference represents the quantity of emissions that must be reduced by the measures in the plan. Second, the Plan identifies a mix of strategies to achieve the mandated reductions, and estimates the emission reductions that can be expected from each strategy or measure. Finally, the Plan provides general direction for the implementation of key strategies, recognizing that the details of the requirements will be developed through the public rulemaking process.

In December of 2007, the ARB approved the baseline inventory analysis of the GHG emissions in California in 1990; total GHG emissions were 427 MMTCO2(e). ARB estimates that under the business-as-usual scenario, GHG emissions will rise to 596 MMTCO2(e) by 2020. In order to comply with the mandates of AB 32, California must implement strategies sufficient to remove 169 MMTCO2(e). This represents an overall reduction of 30% from business-as-usual, and about 10% from the levels emitted today.

Figure 8: Baseline GHGs vs. Scoping Plan

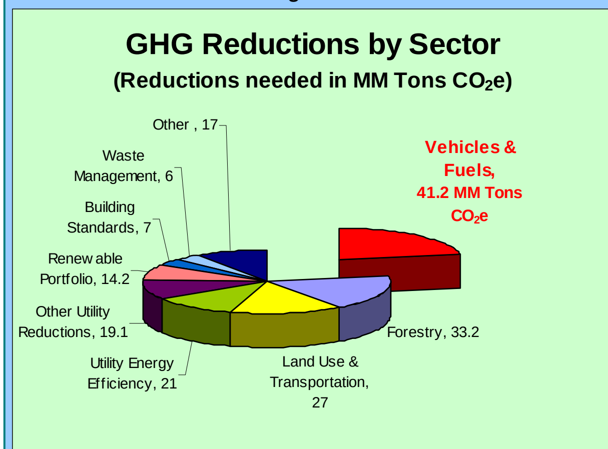


Source: ARB Scoping Plan, Fig. 3, p. 21

On a per capita basis, each Californian will be responsible for nearly 14 tons of CO2(e) in 2020 under a business-as-usual scenario, and that needs to be reduced to about 10 tons for each man, woman, and child. Figure 8 shows the GHG emissions under baseline conditions, and as they are projected to be in 2020, with full implement-tation of the Scoping Plan.

The Scoping Plan identifies measures and strategies in 19 basic categories, and Figure 9 shows the reductions needed from key categories. The greatest contribution comes from the transportation sector, which is responsible for about 60.2 MMTCO2(e) in reductions.

Figure 9



Data from CEC

The reductions (shown parenthetically in MMTCO2(e) for each category) come from implementation of GHG emission standards for vehicles (31.7), the Low Carbon Fuel Standard (15), vehicle efficiency measures (4.8), goods movement improvements (3.7), reductions from medium and heavy duty vehicles (2.5), and implementation of high speed rail (1). The electricity sector is the second largest contributor, with a total of 49.7 MMTCO2(e), coming from energy efficiency measures (26.4), acceleration of the Renewable Energy Portfolio Standard (21.2), and deployment of SB 1 (Murray) the Million Solar Roofs Initiative (2.1). Other sectors include reductions in emissions of GHGs with high global warming potential (16.2), sustainable forestry (5), efficiencies in water movement, treatment, and storage (4.8), improvements in land use (5), direct local government actions to reduce GHGs (15% reduction below present levels; tons TBD), control of methane at landfills (1), and methane capture at large dairies (1). The amount of reductions from the large industrial sector is yet to be determined, and the balance of the needed emission reductions is expected to come from the market-based cap and trade program (34.4).

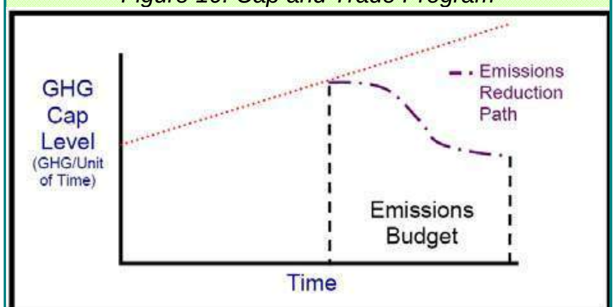
Specifically in regard to reductions from improvements in land use, the Scoping Plan discusses establishing Regional Targets for GHG reduction, and requiring an integrated planning process for transportation, air quality, and General Plans. This approach is further supported by SB 375 (Steinberg), which the Governor signed in September, 2008. The legislation is discussed below, and the concept of Regional Targets and integrated planning is further explored in Section 4 of this report.

Toolkit available at: www.coolcalifornia.org

The Scoping Plan discusses two primary ways in which local governments can achieve direct GHG reductions (that is, reductions that do not result from improved land use planning). Local governments can take actions to reduce energy use at their own facilities, increase their recycling, reduce their waste and water use, reduce the energy used in the handling and treatment of waste and water, and reduce the carbon emissions from their vehicle fleets and from trips to and from their facilities. Similarly, local governments can adopt policies that support reductions in these same areas by businesses and residents within their communities. These kinds of local government actions form the fabric of the Model Policies, and the effective development and integration of thee strategies is the focus of the remaining sections of this report.

There has been considerable interest in the market-based elements of the AB 32 program. Although many of the details remain to be determined through public rulemaking, the Scoping Plan provides certain basic information about market-based efforts. Market-based programs generally fall into three categories: incentives, fees and fee-bates, and cap-and-trade systems. The Scoping Plan envisions a role for all three. Incentives are contemplated for broad, consumer-based programs, such as installation of solar technology, or early adoption of energy efficiency technologies. Fees are envisioned primarily as a mechanism to fund program administration, not as an emission reduction strategy; however, some consideration is given to establishing a fee on upstream carbon (attached to distribution of fuels and electricity) as a backstop measure. The greatest attention is given to a cap-and-trade market mechanism, a system in which a limited number of "allowances" to emit GHG are available, and emitters must either reduce emissions to match the allowances they hold, or they must purchase allowances from another emitter who holds more than needed to cover emissions. The total available allowances would decrease as the 2020 deadline approaches. The Scoping Plan proposes a market that would initially cover a subset of sectors, but would expand to include essentially all sectors over time. The Plan also contemplates a market that is initially linked throughout the western U.S. and Canada, and in which initial allowances are assigned through a combination of targeted allocation and open auction, but which transitions to a market where all allowances are auctioned. It is not yet clear how local governments would be covered under a market system. Figure 10, above, gives a graphical representation of the baseline emissions over time (shown in red) compared to the declining cap (shown in purple). Additional discussion of the cap-and-trade program is provided in Appendix B.

Figure 10: Cap and Trade Program



Source: ARB Meeting Materials- AB 32 Program Design Technical Stakeholders Meeting, April 25, 2008, p. 3

Greenhouse Gas Emission Standards for Vehicles (AB 1493)

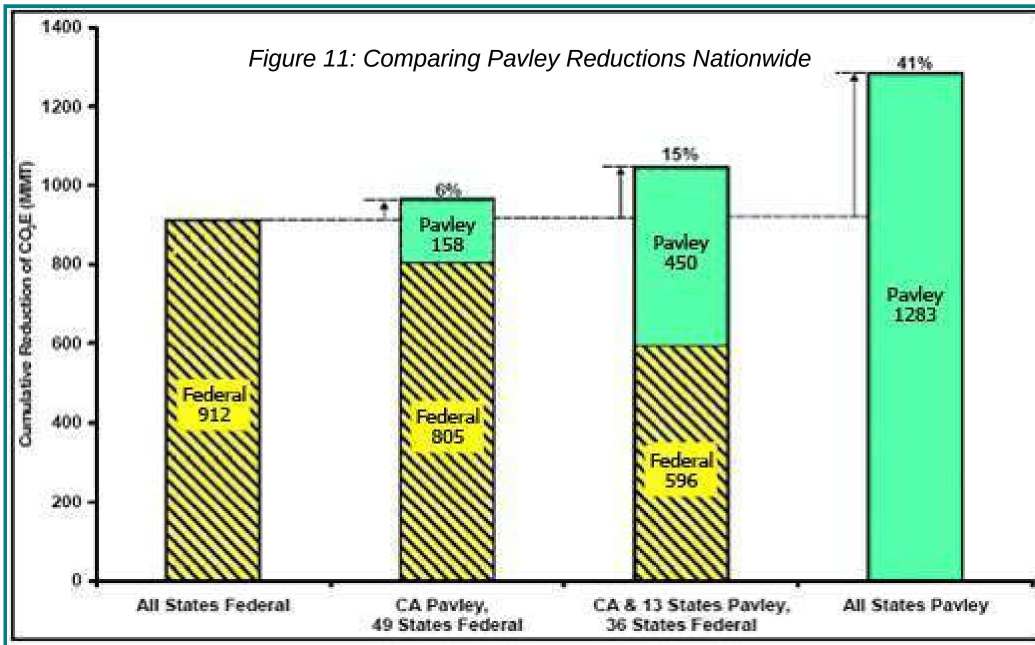
Passed in 2002, before the overarching climate program was established, AB 1493 (Chapter 200, Statutes of 2002) was authored by Assembly Member Fran Pavley. The bill required ARB to develop and adopt the nation's first GHG emission standards for automobiles, and the emission limits it requires are commonly referred to as the Pavley Standards. The ARB approved GHG emission limits for light duty vehicles in 2004. The standards become effective in 2009 and would reduce GHG emissions from California passenger vehicles by about 22 percent by 2012 and about 30 percent by 2016.

Although the federal government generally reserves the authority to establish tailpipe emission standards for motor vehicles, the federal Clean Air Act provides that California may establish such standards; however, any standards adopted by the state must be granted a waiver from the federal preemption by the U.S. EPA before they can be enforced. In December, 2007, EPA denied California's waiver request for the Pavley standards and in early 2008 California's Attorney General filed a petition in federal court to challenge that denial. Seventeen states supported the petition, and the U.S. Congress lodged inquiries into the EPA decision. The Obama administration agreed to review the matter, and in February, 2009, the Administrator of EPA requested comments on the reconsideration of the waiver petition.

In addition to the waiver denial, implementation of the standards has also been challenged in court in a lawsuit filed by automobile manufacturers. The suit alleges that the standards are de facto fuel efficiency standards, which are the exclusive purview of the federal government.

The Pavley standards account for about 19 percent of the emission reductions specified in the Scoping Plan. Although the federal government has adopted new fuel efficiency standards, ARB estimates that between 2009 and 2016, Pavley standards will achieve 56% more reduction in GHG emissions in California (about 19 million metric tons) compared to the federal standards, and by 2020 the difference is 49%. Figure 11 compares the total national emission reductions achieved by different implementation scenarios for the Pavely standards. If the Pavley standards are not ultimately

Figure 11: Comparing Pavley Reductions Nationwide



Source: ARB, May, 2008

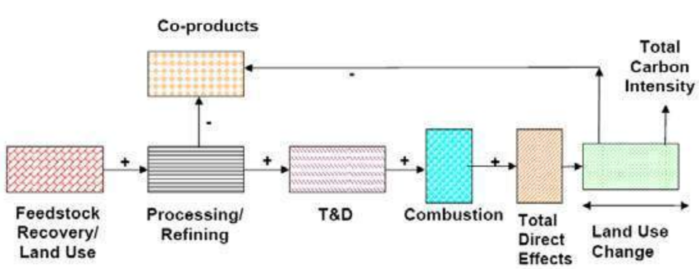
implemented, the lost reductions of GHG will need to be recovered through additional measures, beyond the reductions already identified in the Scoping Plan. ARB suggests the use of a carbon fee on the sale of new vehicles with GHG emissions greater than would have been allowed under the Pavley standards; the fees would be rebated back to the purchasers of vehicles with GHG emissions lower than the Pavley standards. The fees would have to be established at a price point that would inventivize purchasing behavior that results in the same emissions profile as the Pavley standards would have.

Low Carbon Fuel Standard (Executive Order S-1-07)

In his January 2007 State of the State message, Governor Schwarzenegger asserted California's leadership in clean energy and environmental policy by establishing a Low-Carbon Fuel Standard (LCFS) by Executive Order. This first-in-the-world greenhouse gas standard for transportation fuels will spark research in alternatives to oil and reduce GHG emissions. Executive Order S-1-07, the Low Carbon Fuel Standard (LCFS) (issued on January 18, 2007), calls for a reduction of at least 10 percent in the carbon intensity of California's transportation fuels by 2020. The carbon intensity of a fuel is a direct measure of the GHGs emitted during the full life-cycle of the fuel, including directly emitted CO2 as well as other GHG associated with each step in the fuel cycle (a.k.a., "well-to-wheels" for fossil fuels and "seed-to-wheel" or "field-to-wheel" for biofuels). Figure 12 shows the components of a combustion fuel life cycle. The Executive Order instructed the California Environmental Protection Agency to coordinate activities between the University of California, the California Energy Commission and other state agencies to develop and propose a draft compliance schedule to meet the 2020 target. Furthermore, it directed ARB to consider initiating regulatory proceedings to establish and implement the LCFS.

Figure 12:

Block Diagram for the various Components for a Fuel Pathway



source: ARB LCFS Staff Report

In response, ARB identified the LCFS as an early action item with a regulation to be adopted and implemented by 2010. The standard was approved by the Board in April, 2009. It establishes a baseline level of carbon intensity for affected providers, and places a declining cap on that intensity where each year fewer GHGs may be emitted. This is a market-based program that uses carbon intensity credits for fuels sold, where fuels that have lower carbon intensity than required yield "excess" credits that may be used to offset other, higher intensity fuels, or may be banked for use in future years, or sold to other providers who have not been able to reduce the intensity of their fuels to meet the cap.


California Environmental Protection Agency
Air Resources Board

Proposed Regulation to Implement the Low Carbon Fuel Standard

Volume I

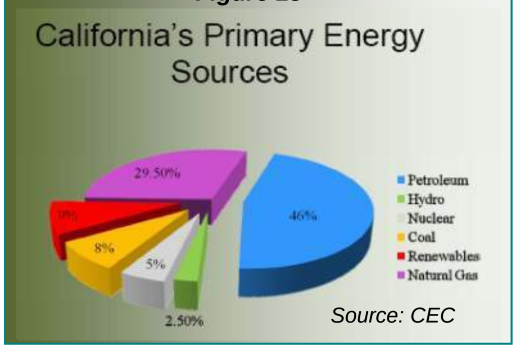
Staff Report: Initial Statement of Reasons

Release Date: March 5, 2009

Renewable Energy Portfolio (SB 1078 and SB 107)

Established in 2002 under SB 1078 (Sher, see: Chapter 516, Statutes of 2002) and accelerated in 2006 under SB 107 (Simitian, see: Chapter 464, Statutes of 2006), California's Renewable Portfolio Standard (RPS) obligates investor-owned utilities (IOUs), energy service providers (ESPs) and community choice aggregators (CCAs) to procure an additional 1% of retail sales per year from eligible renewable sources until 20% is reached, no later than 2010. ARB's Scoping Plan identifies a target RPS of 33% by 2020.

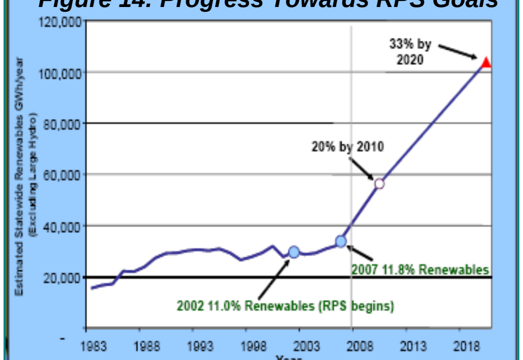
Figure 13



Source: CEC

The California Public Utilities Commission (CPUC) and California Energy Commission (CEC) are jointly responsible for implementing the program. Figure 14a shows the mix of energy sources in California in 2008, and Figure 14b shows progress towards the RPS goals. As of July, 2008, the largest IOUs in California had renewable portfolios as follows: Pacific Gas and Electric (PG&E) - 11.4% ; Southern California Edison (SCE) - 15.7%; San Diego Gas & Electric (SDG&E) - 5.2%.

Figure 14: Progress Towards RPS Goals



Source: CEC

Improved Land Use Planning (SB 375)

In September, 2008, the Governor signed Senate Bill 375 (Steinberg). This bill has five main provisions:

1. It requires ARB to establish regional targets for reductions in greenhouse gas emissions from use of light duty vehicle (passenger cars and small trucks) associated with land use decisions.

2. It requires that metropolitan planning agencies (MPOs) create a Sustainable Communities Strategy (SCS) in their Regional Transportation Plans (RTPs) to meet the reduction targets established by ARB.

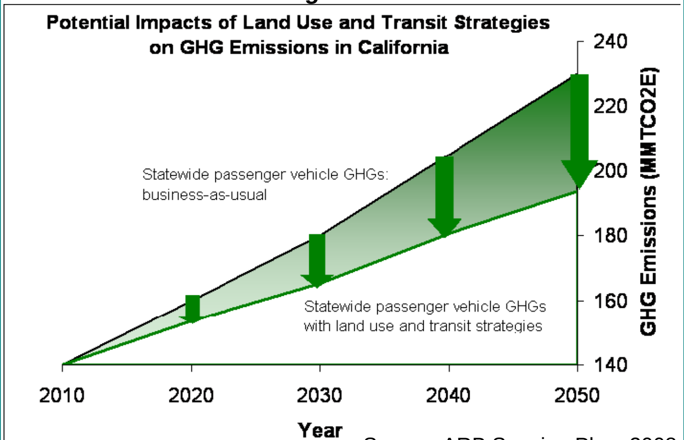
3. It requires that funding decisions for regional transportation projects be internally consistent within the RTP.

4. It aligns the Regional Housing Needs Assessment (RHNA) with the RTP.

5. It provides CEQA relief, in the form of streamlining and exemptions, for projects that are consistent with the SCS.

Targets- ARB is required to approve regional GHG emission reduction targets by September 30, 2010, and to review them, and update them as appropriate, on an eight-year schedule. The targets may be expressed in terms of total tons of emissions to be reduced, reductions per capita, per household, or another metric identified by the air board. ARB has already indicated that the reductions attributed to land use in the Scoping Plan are not, necessarily, the same as the reduction targets that will be assigned to regions under SB 375. ARB believes the Scoping Plan is not an enforceable commitment (unlike the State Implementation Plan for attaining national ambient air quality standards, for example); rather, it is a best estimate, and a general road map. ARB believes the SB 375 process will result in more accurate and specific assessments of the magnitude of reductions that are achievable through sustainable transportation planning. Figure 15 shows the emissions projected from passenger vehicles between 2010 and 2050, and the reductions targeted in the Scoping Plan for that sector.

Figure 15:



Source: ARB Scoping Plan, 2008

To guide the establishment of the regional targets, from which all other provisions flow, SB 375 creates a Regional Targets Advisory Committee (RTAC) with representation from affected stakeholders, including local government, air districts, and MPOs. The committee will make recommendations to ARB on the factors to be considered by ARB in setting the targets, and on the methodologies to be used. The RTAC does not give explicit recommendations about the targets themselves; however, individual MPOs may make recommendations regarding their own specific target. The RTAC recommendations are due to the ARB by September 30, 2009, which leaves the ARB one year to establish the targets after the RTAC makes its recommendations.

Sustainable Communities Strategy- Metropolitan Planning Organizations (or their subdivisions) are required to develop a Sustainable Communities Strategy that will constitute the land use element of the Regional Transportation Plan. The SCS is required to do all of the following:

- Identify the general location of uses, residential densities, and building intensities within the region;

- Identify areas within the region sufficient to house all the population of the region, including all economic segments of the population, over the course of the planning period of the RTP (i.e., 25 years), taking into account net migration into the region, population growth (presumably referring to natural increase), household formation, and employment growth;

- Identify areas within the region sufficient to house an eight-year projection of the regional housing need (i.e., an eight-year RHNA);

- Identify a transportation network to service the transportation needs of the region;

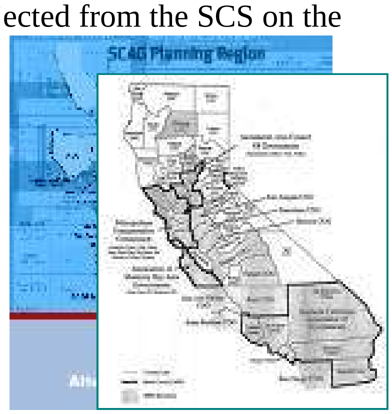
- Gather and consider the best practically available scientific information regarding resource areas and farmland in the region;

- Consider state housing goals;

- Forecast a development pattern for the region, which when integrated with the transportation network and other transportation measures and policies, will achieve, to the extent practicable, the targeted greenhouse-gas emission reduction from automobiles and light trucks, while also permitting the RTP to comply with the Clean Air Act;

- In doing all of the above, consider spheres of influence that have been adopted by Local Area Formation Commissions (LAFCOs).

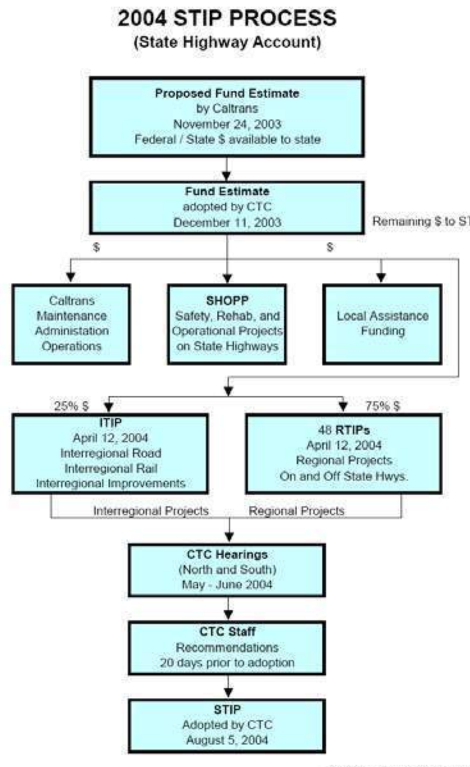
The SCS will also embody the plan to achieve the GHG reductions needed to meet the region's target. It must contain all feasible measures to reduce GHG, but the determination of feasibility is left to the MPOs. The MPOs are required to quantify the emissions reductions that will result from implementation of the SCS, and compare the expected reductions to what is required to meet the targets established by ARB. The bill acknowledges that implementing all feasible strategies under the SCS may not yield sufficient emission reductions to meet the regional target. If that is the case, the MPO is required to develop an Alternative Planning Strategy (APS) that includes additional strategies (including those that were rejected from the SCS on the basis of feasibility) sufficient to reach the target.



Because the SCS is part of the RTP, it is tied to federal transportation planning law and structures. The bill specifies, however, that the SCS is *not* a land use plan, and SB 375 does not confer land use authority on the MPOs. Technically, SB 375 does not require the local General Plan to conform to the SCS. Conformity is strongly encouraged, however, through funding incentives and CEQA streamlining. It is important to note here that the APS is not part of the SCS, and is therefore not part of the RTP. Under SB 375, the APS is not a binding commitment; however, consistency with the APS can provide some streamlining and regulatory relief under CEQA. Finally, both the SCS and the APS are subject to approval by ARB, but ARB's role is limited to a determination of whether the measures included in the SCS and/or the APS will achieve the target ARB established for the region.

Funding- Although SB 375 does not explicitly direct transportation funding to specific types of projects or measures, it does affect the flow of transportation dollars indirectly. The bill requires that the RTP be internally consistent, meaning that transportation funding allocated under the umbrella of the RTP must be allocated consistent with the programmatic elements of the plan, including the SCS. So if the SCS calls for or prioritizes a specific type of transportation project, funding must be allocated to that type of project, rather than a project type that is not included in the RTP or has been awarded low priority. The same construct does not extend to the APS, however, because it is explicitly not part of the RTP. Figure 16 is a diagram of the process by which the RTIP is created in the Bay Area; for further information, see www.mtc.ca.gov.

Figure 16:



Source: MTC

Affordable Housing- The bill makes specific changes to the requirements for the housing element of the General Plan, to align the Regional Housing Needs Assessment (RHNA) with the RTP. Broadly, it does the following:

- In areas where the RTP is on a four-year review cycle, the bill changes the review cycle under RHNA to eight years, such that the RTP and the RHNA will be reviewed together on a regular basis. In areas where the RTP remains on a five-year review cycle, the RHNA cycle remains at five years.

- Requires that the concurrent review of the RTP and the RHNA begin in the first RTP update after 2010, and that two assessments be consistent. Cities and counties are required to amend the Housing Element in their General Plans within the specified time frame, or to be placed on a more frequent four-year RHNA review cycle.

- Establishes a timeline for completing zoning changes to reflect the RHNA, and severely restricts the local authority on project review for affordable housing if the timeline is not met. Specifically, the local authority may only act to disapprove a project, and only if the project would result in a serious health risk.

Streamlining of CEQA- To incentivize projects that are consistent with the SCS or APS, the bill provides certain exemptions from, or streamlining of, requirements under CEQA. Specifically, streamlining is provided for residential projects meeting certain criteria, and for projects that fall under the newly defined category of "transit priority project."
Residential Projects Consistent with SCS/APS: The bill reduces CEQA requirements for a residential development (or a mixed-use development that devotes at least 75% of the square footage to residential uses) if it meets both of the following requirements: 1) the project is consistent with an SCS or APS that ARB has determined will achieve the regional targets, and 2) the project implements the mitigation measures required under an applicable prior environmental document. A project meeting these criteria does not have to describe or discuss in any CEQA document growth-inducing impacts, any project-specific or cumulative vehicle impacts on global warming or the regional transportation network, or a reduced residential density alternative to vehicle impacts.

Transit Priority Projects: The bill defines a new category of project, "Transit Priority Projects," and establishes a categorical exemption from review under CEQA for such projects, provided they meet additional specified criteria. Projects that meet the definition of the category, but not the additional criteria, are afforded other streamlining of CEQA requirements, but are not fully exempt. The definition of "Transit Priority Projects" is based on four factors:

- The project is consistent with the SCS or APS, whichever has been determined by ARB to meet the assigned reduction targets; and
- The project meets specified mixed-use criteria; and
- The project has a minimum net density of at least 20 units per acre; and
- The project is within a half mile of a major transit stop (existing or planned), or a "high quality" transportation corridor.

A categorical exemption is provided for TPPs that conform to all criteria on a specified list, as well as at least one additional criterion from a list of options. The TPP must meet all of the following criteria:

- The project is no larger than 8 acres and not more than 200 units;
- The project can be served by existing utilities and has paid all applicable in-lieu and development fees;
- The project does not have a significant effect on historical or environmental resources (e.g. natural habitat);

- The project has remediated any environmental hazards to applicable standards and is not subject to significant and defined catastrophic risks;

- The project is not located on developed open space;

- The buildings in the project are 15 percent more energy efficient than required by California law and the project is designed to achieve 25 percent less water usage than the average household use in the region;

- The project does not result in the net loss of affordable housing units in the area;

- The project does not include any single-story building larger than 75,000 square feet;

- The project incorporates mitigation measures from previous environmental impact reports;

- The project does not conflict with nearby industrial uses.

To meet the categorical exemption, the TPP must also conform to at least one of the following:

- At least 20 percent of the housing units will be sold to families of moderate income, or not less than 10 percent of the housing will be rented to families of low income, or not less than 5 percent of the housing will be rented to families of very low income and the developer commits to the continued availability of the non-market units (55 years for rental units, 30 years for ownership units); **or**

- The developer pays in-lieu fees equivalent to costs of meeting the first requirement; **or**

- The project provides public open space equal to or greater than five acres per 1,000 residents.

TPPs that do not meet the criteria for a full categorical exemption from CEQA can qualify for streamlining under a Sustainable Communities Environmental Assessment or by implementing approved Traffic Mitigation Measures.

A TPP may be reviewed under a Sustainable Communities Environmental Assessment (SCEA) if the project incorporates all feasible mitigation measures, performance standards, or criteria from an applicable prior environmental impact report. The SCEA is similar to an EIR, but it does not have to address potential growth-inducing impacts, any project-specific cumulative impacts on climate change from the use of light duty vehicles, or any other cumulative effects of the project that have been addressed and mitigated in prior environmental documents. In addition to this streamlining, the bill provides that a legal challenge of the SCEA is to be reviewed under a standard of "substantial evidence" rather than under the "fair argument" standard that is generally applied to EIRs.

The bill also authorizes cities and counties to adopt specific Traffic Mitigation Measures (TMMs) to apply specifically to TPPs. The TMMs include such measures as requirements for the installation of traffic control improvements, street or road improvements, transit passes for future residents, or other measures that will avoid or mitigate the traffic impacts of transit priority projects. Any TPP that implements the approved TMMs is not required to identify or implement any additional measures to mitigate traffic impacts under CEQA.

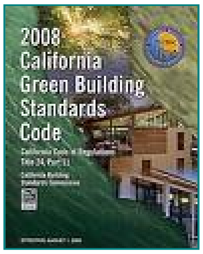
Alternative and Renewable Fuel & Vehicle Technology Program (AB 118)

In October 2007, Governor Schwarzenegger signed AB 118 (Nunez, Statutes of 2007), into law. AB 118 provides approximately $200 million annually through 2015 for three new programs to fund air quality improvement projects and develop and deploy technology and alternative and renewable fuels. The bill creates a dedicated revenue stream for the programs via increases to the smog abatement, vehicle registration, and vessel registration fees. The three new programs are: the Air Quality Improvement Program administered by ARB, the Alternative and Renewable Fuel and Vehicle Technology Program administered by the California Energy Commission, and the Enhanced Fleet Modernization Program administered by the Bureau of Automotive Repair.

The Air Quality Improvement Program will provide about $50 million per year for grants to fund clean vehicle and equipment projects which reduce criteria and toxic air pollutants as well as research on the air quality impacts of alternative fuels and advanced technology vehicles. ARB will be developing guidelines for the Air Quality Improvement Program and the Alternative and Renewable Fuel and Vehicle Technology Program to ensure that both programs complement efforts to meet the federal and state ambient air quality standards and to reduce air toxics.

California Energy Efficiency Standards (Title 24, Chapter 6)

Title 24, Part 6 (California's Energy Efficiency Standards for Residential and Nonresidential Buildings) of the California Code of Regulations was first established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to allow consideration and incorporation of new energy efficiency technologies and methods. These standards are mandatory and thus new building permitted by City and County governments must comply with the standards in effect at the time. These standards also promote cost-effective means to reduce energy use and thus GHG emissions for new development relative to business as usual conditions.

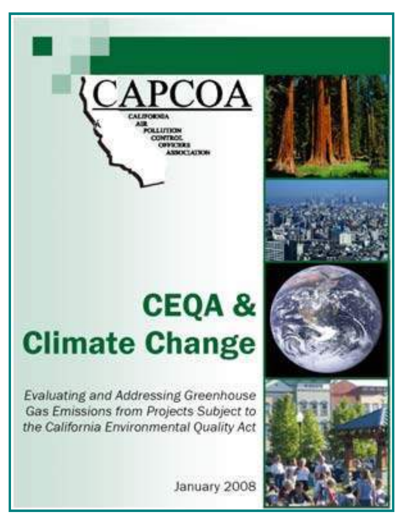


The Energy Commission adopted the 2008 Standards on April 23, 2008, and the Building Standards Commission approved them for publication on September 11, 2008. These new Standards will be in effect as of July 1, 2009. The requirement for when the 2008 Standards must be followed is dependent on when the application for the building permit is submitted. If the application is submitted after 7/1/09, the 2008 Standards must be met.

California Environmental Quality Act

The California Environmental Quality Act (CEQA) (Pub. Res. Code §21000 et seq.) is not specific to GHG regulation and does not create specific new mandates for General Plans; however, its basic goal is to ensure that environmental impacts of proposed projects are evaluated, and significant impacts are mitigated and disclosed to the public. CEQA substantially influences the approval process for General Plans. The evaluation is done through an Environmental Impact Report (EIR) which provides State and local agencies and the general public with detailed information on potentially significant environmental impacts a proposed project is likely to have and ways to mitigate those impacts, and also to evaluate potential alternatives to the project.

Because of the global nature of the climate change problem, most projects will not result in GHG emissions that are individually significant. CEQA also requires consideration of whether impacts are *cumulatively* significant, however. The determination of significance is made by the agency with primary jurisdiction over the project. CEQA allows the agency to establish thresholds for significance, based upon sufficient scientific evidence, but thresholds are not required.



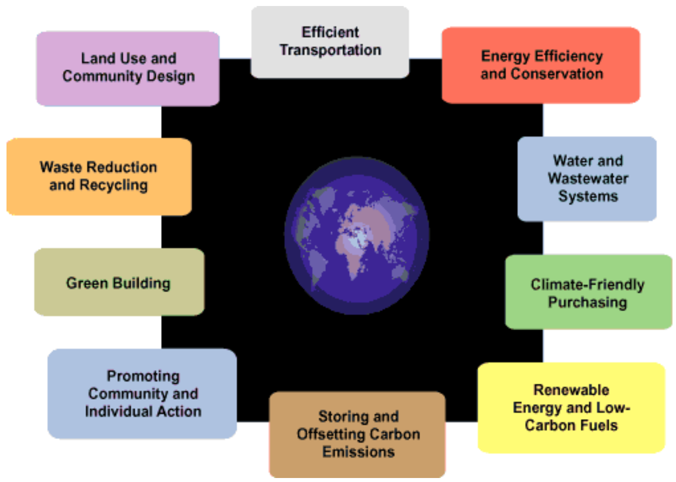
In January of 2008, CAPCOA released a resource document called *CEQA and Climate Change*, that reviewed the various options available to lead agencies to determine significance of a project. The document also evaluated tools and methodologies, and provided a list of mitigation strategies. A more comprehensive discussion of CEQA and its applicability to GHG emissions is provided in that document.

On April 13, 2009, the Governor's Office of Planning and Research sent proposed amendments of the CEQA Guidelines to the Secretary of the Resources Agency for promulgation. The proposed amendments contain recommended changes to fourteen sections of the existing guidelines, including: the determination of significance as well as thresholds; statements of overriding consideration; mitigation; cumulative impacts; and specific streamlining approaches. Overall, the proposal includes the same basic approaches covered in the CAPCOA document. The proposed Guidelines also include an explicit requirement that EIRs analyze GHG emissions resulting from a project when the incremental contribution of those emissions may be cumulatively considerable. A copy of the full proposal, as well as the letter of transmittal, may be found at: www.opr.ca.gov.

An important consideration of CEQA with respect to planning is the growing consensus that a robust effort to address GHG emissions at the General Plan level can substantially streamline subsequent project review under CEQA, provided the project is consistent with the GHG reduction policies in the Plan. This is specifically allowed in the OPR proposal, and is being further developed in the context of SB 375. Although the specifics of what is entailed here have yet to be established, the concept is important to consider in shaping the policies included in the General Plan.

Local government has an enormously important role to play in reaching the goals of AB 32, and more importantly, in the achieving the greater long term goal of preventing catastrophic climate change. There are many strategies a local government can undertake that will reduce GHG emissions, and help minimize the extent of climate change that does occur. Some of the strategies depend on coordinated action with other agencies and levels of government; others can be implemented independently.

This section of the report is mainly focused on the more immediate actions local governments can take, including direct reductions from local government operations; the role of local government in fostering reductions in the business sector and in local communities; and lead agency obligations to address GHG emissions under CEQA. This chapter also touches briefly on the crucial, longer term role of local government: establishing over-arching plans that will achieve reductions through changes to land use and transportation, resource management, and the efficiency of the built environment. The Institute for Local Government provides resources and a forum for sharing ideas on many of these important topics (see www.cacities.org). The role of local government in planning for GHG reductions is explored more fully in Chapter 4.



Source: Institute for Local Government

Reductions in Local Government Operations

There are five core areas of local government operations that are responsible for GHG emissions. These include: energy use, waste and recycling, water delivery and wastewater treatment, transportation, and the build environment.

In addition, there are actions the local government can take to preserve open space and undertake reforestation, for example, that can mitigate or offset the emissions resulting from operations.

A brief discussion of each operational area is included below. These lists are not exhaustive; rather, they provide a sampling, and links are provided in the References section of this report where additional information and examples can be found. Finally, the discussion here is limited to emissions from operations as opposed to those associated with policies governed by the General Plan, a discussion of which follows.

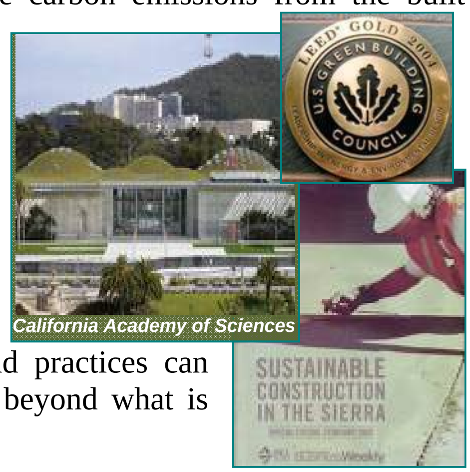
Energy Use: The buildings, equipment, and infrastructure of local government all use energy. In general, newer purchases and installations tend to be more energy efficient, but there are plenty of opportunities to enhance efficiency and cut energy use. Buildings can be made more efficient by upgrading insulation and installing low emissive glass, using high-efficiency lighting with timers and sensors, installing cool roofs, and simply adjusting heating and cooling levels. Alternative energy sources can be developed, such as installation of solar collectors, or landfill gas to energy projects. Local governments can also change the emissions profile of the energy they purchase from their energy providers. Equipment that heats and cools buildings can be upgraded to the most efficient models, as can computers, telecommunications, and office equipment. And infrastructure such as street lighting and traffic signals can be upgraded with state-of-the art technology such as halogen bulbs and solar collectors and storage at power or signal poles. Lifecycle carbon costs of maintaining infrastructure as diverse as roads, bridges, and transit facilities can be evaluated so that the least carbon-intensive materials and procedures are used.

Waste and Recycling: There are GHG emissions associated with the energy involved in waste handling, and due to methane from waste decomposition as well as some GHG with high global warming potential from foam products and refrigerants released during the handling of these materials. Local governments are users of waste and recycling systems for their own operational waste. To reduce emissions from their own operational waste stream, jurisdictions can enhance employee access to recycling, create purchasing guidelines to emphasize recycled materials, less packaging, and to avoid products that release more potent GHGs. In one creative example, the City of San Francisco is replacing bottled water at coolers and in dispensers with filters on drinking fountains. Local governments also may operate or exercise contractual control over waste handling programs, depending on how these services are structured and provided in their jurisdictions. Emissions from this portion of the waste stream can be reduced through methane recovery, recovery of potent GHG from foam and refrigerant systems, and other adjustments to collection systems.

Water Delivery and Wastewater Treatment: Movement, storage, and treatment of water and wastewater use significant amounts of energy. Local governments can reduce their own water use by installing low-flow fixtures, by inspecting, repairing and replacing leaking components, especially irrigation and other water supply at remote sites that often go unnoticed for long periods, and through xeriscaping. Water reclamation and graywater systems can also trim the carbon footprint from water use, and managing time of demand with large water users can significantly alter the energy needs at peak delivery times.

Transportation: Local governments can reduce the GHG emissions of their vehicles by replacing older vehicles with the highest efficiency vehicle that can perform the needed function. They can also reduce the overall size of the fleet by increasing the use of pooled vehicles instead of assigned vehicles, and encouraging carpooling when on government business. As employers, local governments can institute programs to increase employee use of alternate modes of transportation, such as transit, carpooling, biking, and walking to work, and they can offer compressed work schedules, telecommuting, and even satellite offices. If properly designed, many of these strategies can also help decrease GHG from the public accessing the jurisdiction's services, as can offering access to services online.

The Built Environment: Commitments to highly efficient construction in their own new facilities is one way local governments can reduce carbon emissions from the built environment. Many local governments are building or retrofitting their facilities to LEED certification standards. The siting of new facilities is also an opportunity to improve access by employees and the public and reduce transportation related emissions. In addition, when it establishes the building codes for its jurisdiction, local government has the opportunity to significantly alter the energy used in constructing, maintaining, and using the built environment. A careful review of local needs and practices can identify opportunities for energy performance well beyond what is required under California's Title 24 standards.



California Academy of Sciences

Mitigation Projects: Separate from its core operational mission, a local jurisdiction can undertake projects or actions for the purpose of mitigating or offsetting GHG emissions. Examples of these projects include securing the development rights to land that might otherwise be developed (especially where the site does not lend itself to sustainable transportation planning) and undertaking reforestation projects either in open space that has been previously deforested, or through urban forestry efforts. Advanced technology demonstration projects can also ease the transition to new technologies and enhance public acceptance of them, for example purchasing or leasing a plug-in hybrid, fuel cell, or full electric vehicle and demonstrating its use at public events. Some local governments purchase emissions offsets for certain transportation-related emissions, such as

air travel, although any GHG emissions can be offset. When offsets are purchased, the jurisdiction should take extra precaution in verifying the value of the offsets, as some are of dubious origin.

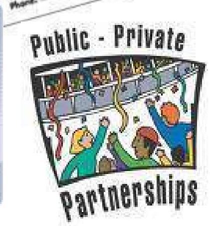
Fostering GHG Reductions in the Business and Community Sectors

In addition to implementing programs to reduce its own carbon emissions, local government has an important role to play in bringing others to the table and helping them to reduce their GHG emissions. Local governments can develop public education and outreach programs, can establish public-private partnerships and programs to publicly recognize achievements, and offer incentives (non-monetary as well as financial) for actions that reduce GHG emissions. Examples of these types of actions are also provided as model policies in Chapter 6, but they can also be implemented without the benefit of an overarching plan.

Education and outreach programs would include events such as conferences, workshops, or fairs, featured speakers, public service announcements, print messages, and online information or interactive sites. Ideally, topics will span a broad range, including the fundamentals of climate change and how our actions contribute to it, down specific actions or projects, such as a "lights out" campaign, a "green tip of the day" or a how-to workshop on gardening with drought-tolerant, native plants. Programs involving schools are also beneficial, and model units on climate and conservation are available; events like poster contests and recycle drives are a good way to get children involved.

Local governments are also in a unique position to work with local businesses on climate protection projects and partnerships. Many of the GHG reduction strategies that rely on improved efficiency in energy, water, fuel use, or waste reduction, can generate significant cost savings for businesses over a fairly short time frame. A local government that has implemented some of these strategies in its own municipal operations is in a good position to demonstrate savings, but even if the government does have data of its own to share, it can encourage business participation in these types of programs.

Small Business Toolkit available at: www.coolcalifornia.org



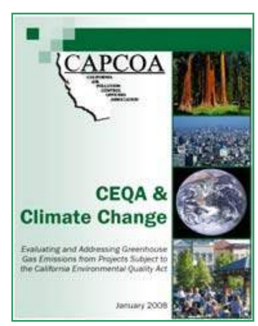
Suggestions include working with the local chamber of commerce, business associations, or business-focused civic groups to establish a forum to share efforts and results, such as newsletters, or a monthly breakfast meeting or luncheon. Local government can also help establish demonstration projects, and can publicly recognize local leaders with awards or in public service messages.

Incentives are another important tool to encourage actions that reduce GHG emissions in the near term. To be effective, the incentive does not have to be monetary. As noted above, public recognition can be a powerful motivator, but local governments have other tools they can use to promote GHG emission reductions. Examples include preferred parking for electric or alternative fuel vehicles, and express permitting of projects on a "green project" list. Financial incentives can be small or large, beginning with free compact fluorescent light bulbs or reduced transit fairs on a designated "don't drive" day, to rebates for high efficiency toilets and electric lawn mowers, to creative financing for energy efficiency improvements or installation of solar panels. In some cases, the government can partner with the private sector for sponsorship of these kinds of efforts, which can help defray some of the costs.

Mitigating Impacts through Project Review

Local governments review proposed projects under CEQA, either as a lead or a responsible agency. Until recently, climate change was not considered an environmental impact under CEQA, and GHG emissions associated with projects were not quantified, disclosed, or mitigated. This has changed, however, and there is now broad recognition that these are potentially significant impacts, either individually or cumulatively, and that they do need to be addressed. Some jurisdictions recognized this early on and began to evaluate climate impacts during their CEQA review process. Following the passage of AB 32 in 2006, greater attention was paid to this issue, and in 2007, California's Attorney General put local governments on notice that these impacts could no longer be overlooked. There was a fair amount of confusion, however, about how to quantify GHG emissions, at what level they would be considered significant, and what steps could be taken to mitigate them.

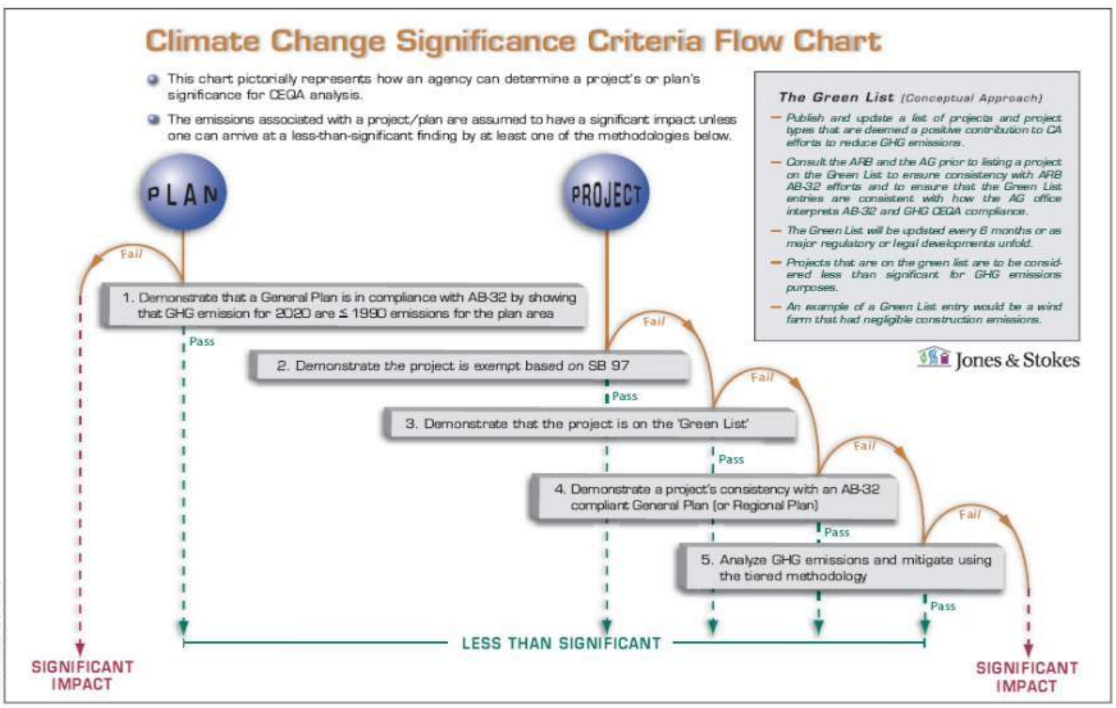
In January of 2008, CAPCOA released a resource document, *CEQA and Climate Change*, that collected and presented information to support local governments as they undertake a review of GHG emissions from projects subject to CEQA. The document considered approaches to determining significance of emissions, evaluated available methodologies and tools for quantifying GHG emissions, and provided a summary of GHG mitigation measures for projects.



Three approaches to determining significance are explored in the CAPCOA document, including the benefits and potential concerns associated with each. Significance can be determined without first establishing a significance threshold; in this case, the determination will be made on a case by case basis, which creates uncertainty and may be vulnerable to challenge. A significance threshold can be set at zero, on the premise that any GHG emissions contribute in a cumulative way to the global problem; this approach is simple in its construct and provides certainty, but the work associated with preparing and reviewing EIRs on all projects is likely to overwhelm the system and lessen the effectiveness of review across the board. A significance threshold can be set at an emission level other than zero; the chief challenge for this approach is to identify and scientifically support an appropriate threshold, and the CAPCOA report evaluates several different options for doing this. Of particular interest are two elements discussed in the non-zero approach. These are: the role of robust treatment of GHG emission reduction policies in the General Plan, and the creation of a "Green List" of projects that will reduce or mitigate GHG emissions, both which could be used to substantially streamline the review process under CEQA. Figure 17 presents these non-zero threshold concepts in a flow diagram.

The CAPCOA report also evaluates a number of technical models and tools currently

Figure 17



Source: CEQA and Climate Change, CAPCOA 2008

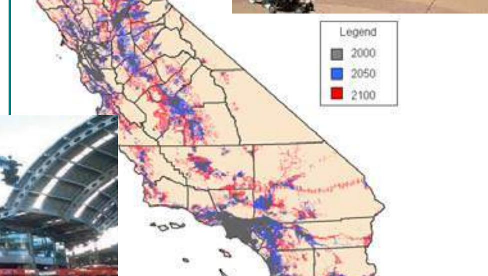
available for quantifying GHG emissions, as well as several that are still under development. The report concludes that there is currently sufficient information to quantify GHG emissions for the purposes of evaluating projects under CEQA, but that improvements in several key areas will greatly improve the sensitivity and usefulness of available methods.

Finally the CAPCOA report compiles and presents information on measures to mitigate GHG emissions. It includes tables that provide information on measure applicability, jurisdiction, feasibility, effectiveness, secondary effects, and cost.

CAPCOA will provide a supplement to its report in 2009, with a summary of new developments in CEQA review of GHG, including policies and thresholds adopted since the original report, advances in methods and tools, and innovative strategies to mitigate impacts. Readers interested in additional information about mitigating emissions of GHGs from projects subject to CEQA are encouraged review CAPCOA's report and the 2009 supplement. Readers should also keep in mind that many of the mitigation strategies that are summarized in the CAPCOA report can be implemented even if there is no project subject to CEQA review, on a voluntary basis.

Finally, as discussed in Chapter 2, on April 13, 2009, the Governor's Office of Planning and Research recommended CEQA Guidelines changes to the Secretary of Natural Resources. The proposed changes include a new section that specifies that previously established standards of mitigation apply to GHG emissions. They also address the use of General Plans to streamline mitigation requirements, and specify that in order to use this approach, the General Plan must be specific enough in its treatment of the project type in an actual measure. The OPR package also proposes revisions to Appendix F that contain specific energy efficiency measures that may reduce GHG emissions.

Reducing Emissions through Planning



Historic & Projected Urbanization
Source: Climate Action Team draft
2009 Report to the Governor & Legislature

Transportation and energy use account for most of the emissions of GHGs. In order to achieve substantial and lasting reductions in these emissions, we need technological advances and we need policy advances. On the technology front, development alternative energy sources and low carbon fuels, more efficient vehicles and products that use less energy, and mechanisms to recover energy lost without beneficial work, or to capture and sequester or destroy emissions, will make a significant cut in the GHGs emitted by living and working in our world as we do now. But that is not enough to avoid the worst impacts of global climate change. We also need innovative policies that change the patterns of our lives to produce fewer GHGs. This means creating communities that are designed to decrease the use of single occupancy vehicle travel, to encourage the use of local products, and to minimize waste. The key to creating these communities is the General Plan.

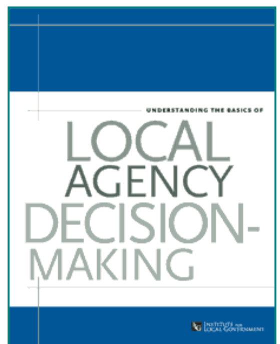
Powerful forces and competing needs have combined to create the land use patterns we see today across California. It is neither quick nor easy to change these patterns, and there are significant obstacles to overcome. Funding is one of the obstacles. In the Scoping Plan, ARB commits to work with other State agencies and with local governments to secure funding to support the planning needed to achieve real changes. Another obstacle is the uncertainty about outcome. Notwithstanding such obstacles, some local governments have moved forward with creative planning that has revitalized the urban core zones in their areas with transit-oriented, mixed-use, high-density development of brownfield sites. The results are vibrant, livable, walkable communities where local residents work, shop, and play, and which attract visitors and bring economic vitality along with quality of life. Examples can be seen in both urban settings such as Sacramento, as well as in suburban areas like Fruitvale in the San Francisco East Bay, and even more rural settings, such as Petaluma and Windsor in Sonoma County. By encouraging more of these models of sustainable design, we can demonstrate that they are not only feasible, but successful. In its Scoping Plan, ARB suggests that one possible use of revenue from the auction of credits in a cap and trade system, or from carbon fees, would be to provide incentives for sustainable land use design. Opportunities to support sustainable planning should be cultivated, to ensure that the most successful approaches are recognized and replicated.

The planning that local governments undertake, namely the General Plan, and any specific Area Plans or Climate Action Plans, can form the basis for thoughtful and effective actions to reduce GHG emissions from local activities. When this planning is undertaken in concert with broader regional planning, such as “Blueprint” planning, regional transportation planning, and air quality planning, the impact of GHG reduction efforts is multiplied many times. Chapter 4 discusses the role of these planning efforts, and how they interrelate to effectively respond to the challenge of climate protection.

Introduction

The commitment to reduce GHG emissions under AB 32, in and of itself, highlights the importance of effective long-term planning by local government to minimize GHG produced by land use and transportation patterns, use of natural resources, and the built environment. When it is considered together with the newly approved changes to regional transportation planning under SB 375, there is an overwhelming call to enhance our planning efforts and remake our communities so that they are sustainable, and sustaining. We have the tools to accomplish this, and now we have a substantial statutory underpinning to support the effort.

There are several key planning approaches a local agency can rely on to address climate protection goals. The intersection of AB 32 and SB 375 will result in regional GHG reduction targets in most metropolitan areas, with accompanying regional planning. This effort will be most effective if local governments support and reflect GHG reduction policies in their own local planning efforts. Local governments can also adopt separate Climate Action Plans that focus on an overarching commitment to greenhouse gas emissions reduction, and set forth the specific policies and mechanisms to achieve that reduction. Jurisdictions can incorporate climate protection goals into their General Plans, either through a stand-alone element or by integrating into existing elements. They can also rely on, draw from, and align with the measures in other regional plans, including "Blueprint" plans, air quality plans, and transportation plans. These options are not mutually exclusive; in fact, they will provide the most robust reductions in greenhouse gases if they are implemented in concert, with careful attention to coordination of goals and optimizing limited resources. An added benefit of a more comprehensive approach is the potential to simplify the administrative process associated with review of projects under CEQA, while ensuring the highest standard of environmental protection.

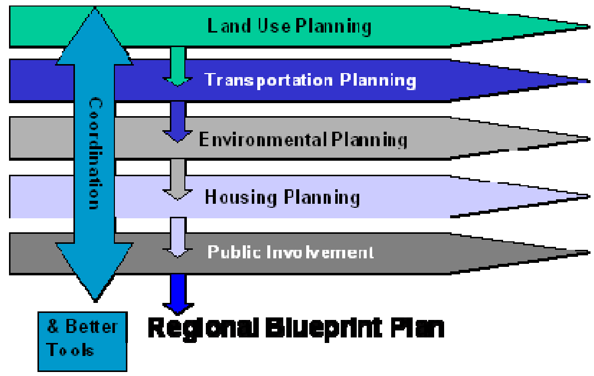


Source: LGC

Finally, as this coordinated planning effort moves forward it is important not to lose sight of the potential for unintended consequences, and to ensure a mechanism to review progress and outcomes, and to ensure those consequences, specifically any that would harm environmental justice goals, are addressed with prompt, mid-course corrections.

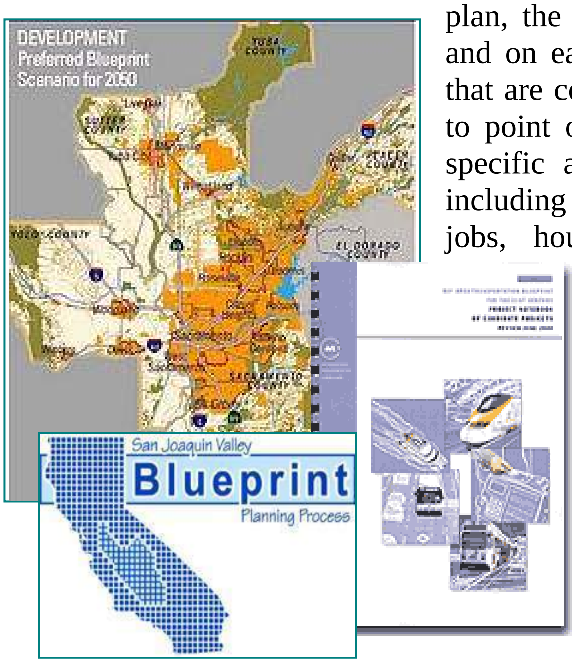
Regional Targets and Planning

Recent studies with models of land use and transportation related emissions show that improved planning and design can reduce GHG from this sector by a significant amount. In the near term, that is by 2020, the emission reductions are relatively modest, on the order of 4% from the business-as-usual scenario. But because the benefits from these types of improvements accrue incrementally over time, as new planning policies are implemented and transportation patterns and habits change in response, the emission reductions in out years are much greater. By 2030, reductions are projected to double, and by 2050, could be as much as 18%.



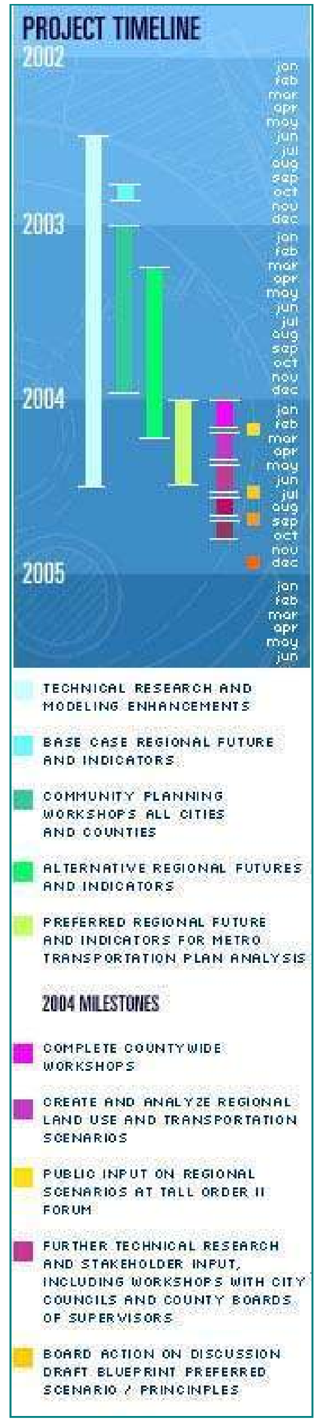
Source: www.fhwa.dot.gov

In order to actually achieve these reductions, air quality, land use, and transportation planning will need to be integrated regionally. These efforts have already begun in several large metropolitan areas, using a "Blueprint" planning model. This model allows the cities and counties within the region to collectively select future growth scenarios for land use and transportation that lead to more sustainable communities and cleaner air, including fewer emissions of GHGs. The plans are developed through a public process and provide for local accountability. Each jurisdiction incorporates the agreed-upon growth scenario into its General Plan. The success of the effort depends on the robustness of the Blueprint plan, the faithful incorporation into each General Plan, and on each jurisdiction making project-level decisions that are consistent with its General Plan. It is important to point out here that the planning needs to be highly specific and consider a number of important factors, including (but certainly not limited to) where current jobs, housing, and transportation infrastructure are placed, and the relationship of those things to the residents the project is intended to serve. While "high density" development is generally considered a product of "good" planning, if it is the wrong project, in the wrong place – that is, if it is implemented without consideration of all of the elements that contribute to the current pattern of land use and transportation – that high density project could actually exacerbate existing problems.



Recognizing the potential for long-term, durable reductions, ARB has proposed to establish regional GHG emission reduction targets. According to the Scoping Plan, ARB envisions a regional planning process that will: (1) Use integrated scenario modeling to align regional transportation plans and local General Plans; (2) Take into consideration other State policy goals; (3) Incorporate performance indicators to monitor progress; (4) Coordinate local and regional planning efforts to achieve maximum emission reductions; and (5) Establish priorities for and direct State resources to help local and regional governments meet the regional GHG targets.

As discussed in Chapter 2 of this report, SB 375 (Steinberg) establishes a statutory framework for this integrated regional planning approach. The Steinberg bill requires that ARB assign regional GHG reduction targets to specified metropolitan areas. Among other things, the bill also provides that ARB must approve the emission reduction quantification that underpins the Sustainable Communities Strategy (SCS) developed by these regions, or their alternate plan that contains additional reduction measures if the primary strategy fails to meet the assigned targets.



Source: www.sacregionblueprint.org

Under SB 375, the ARB is not given the authority or responsibility to determine the land use and transportation policies for any given region, nor is the regional planning body (the MPO) given any specific land use authority under SB 375. Land use decisions are still vested in the local city or county government. Because the SCS is part of the Regional Transportation Plan, however, and because SB 375 requires that funding allocated under the RTP be consistent with the programmatic and policy elements of the RTP, the bill essentially ties transportation funding for the RTP to implementation of the SCS policies.

Another important clarification is that the Alternate Plan is not part of the RTP, and therefore transportation funding is not linked to implementation of this plan. In order to incentivize its implementation, the bill provides exemptions from certain CEQA review requirements for projects consistent with SCS and ACS that achieve the regional target reductions in GHG emissions, as approved by ARB.

Finally, while there is material overlap between the policies that will be embodied in the regional SCS and the GHG reductions from measures in the city or county's General Plan or Climate Action Plan, they are not the same. The SCS is a transportation driven strategy, whereas the General Plan and the Climate Action Plan address other important opportunities for GHG reduction in addition to transportation. In the best case, the measures in the SCS will be reflected in and complemented by the measures in the General Plan and the Climate Action Plan.

Climate Action Plans and Commitments

In the Scoping Plan, ARB recognizes the value of local Climate Action Plans and commitments to reduce GHG emissions. Climate Action Plans provide an overarching policy direction for local governments committed to reducing GHG emissions within their jurisdictions. Many areas have already established these plans; examples and references are included in Appendix G.

An effective Climate Action Plan will have several core elements, including an inventory of emissions, a target for reductions, timeframes, milestones, and tracking and accountability mechanisms, and strategies for achieving the reductions. First, as its foundation, the Plan will rely on a complete inventory of GHG emissions in what will become the Plan's base year. Although AB 32 identifies 1990 as a base year for California, most local jurisdictions do not have the underlying data necessary to establish GHG emissions in 1990. Rather than approximate emissions in that year, local governments are better served by selecting a year for which they have complete and accurate data on energy use, vehicle miles traveled, and other key parameters that affect GHG emissions. In selecting the year, it is helpful to also choose a year that is not heavily influenced by an unusual event or circumstance.

The inventory should include GHG emissions from three aspects of the local jurisdiction. There are emissions that result directly from local government operations, emissions associated with local government policies and decisions, and emissions from the community within the jurisdiction. Working with ICLEI and CCAR, ARB has adopted a reporting protocol for local government operations' GHG emissions. Information on calculating emissions associated with policies and decisions (essentially, land use and transportation emissions, as well as other sectors address in the General Plan) can be found in the CAPCOA report, *CEQA and Climate Change*, in the section on Analytical Methodologies. ARB is currently developing a reporting protocol for local communities, as well as a "Local Government Toolkit" which is available at www.coolcalifornia.org. Examples of Climate Action Plans that have baseline inventories are provided in Appendix G. There are also businesses and organizations that provide consulting services in this area.

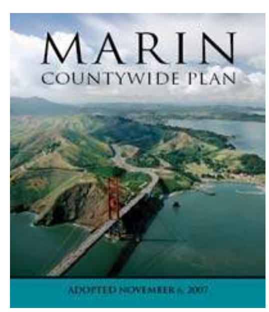
In choosing emission reduction targets, the jurisdiction should consider the statewide GHG reduction targets, any assigned regional targets, and what is feasible for the jurisdiction to achieve. ARB has estimated that reductions of 28% from business-as-usual are needed on a statewide basis to reach the goals of AB 32. But the business-as-usual scenario may be difficult for a local jurisdiction to calculate. If the goals of AB 32 are presented as a reduction from the average statewide GHG emissions between 2002 and 2004, a reduction of almost 10% is needed. If a local government can establish a baseline looking at average annual emissions between 2002 and 2004, a reduction target to reduce the total GHG emissions from the jurisdiction by 10% by 2020 would be consistent with AB 32. While 10% may not sound like a large number, it is important to remember that the current trend is one of significant emissions growth. Regional targets for metropolitan areas will be developed and assigned pursuant to SB 375. Local feasibility will need to be assessed based on the jurisdiction's inventory and in consideration of local input through a public process.

AB 32 provides a fairly straightforward timeframe for achieving reductions in GHG emissions. Areas that adopted Climate Action Plans before the passage of AB 32 may have identified other deadlines for reaching their targets. For those areas, it may be useful to review their reduction targets and deadlines to ensure that the local commitments are consistent with statewide goals to the extent feasible. In addition to overall deadlines, however, intermediate milestones are important, and the Plan should specify mechanisms to measure progress, as well as make midcourse corrections if reductions are not being realized as anticipated. Milestones can be based on actual reductions in GHG, but because some analysis is needed to determine GHG emissions and reductions, there should also be performance milestones that reflect progress implementing plan elements.

Climate Protection in General Plans

Whether or not a local government adopts a Climate Action Plan, its General Plan should address climate change, its potential impacts, and local contributions to the problem. The Governor's Office of Planning and Research (OPR) is preparing guidance on this, which will be forwarded to the California Resources Agency for formal adoption. In addition, the California Attorney General has challenged the EIRs for General Plans that have failed to address climate change. Policies to mitigate climate change should be incorporated into the General Plan either within existing elements, or in a separate Greenhouse Gas Reduction element.

Incorporating Policies into Existing General Plan Elements- Existing General Plans will invariably contain policies (and any associated goals, objectives, policies, standards and implementation measures) that help to reduce GHG emissions. However, they are just as likely to contain policies that work against that goal. There are opportunities to strengthen existing General Plan policies and/or incorporate new policies that reduce emissions. Several options exist for integrating additional policies, including the three discussed below.



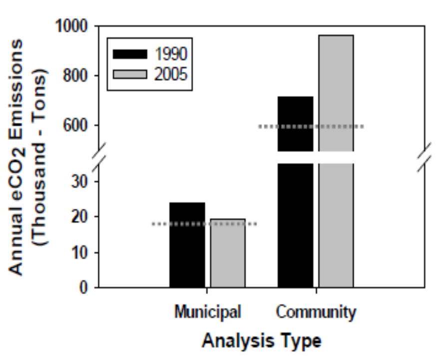
Policies may be incorporated into a jurisdiction's existing General Plan elements through a General Plan amendment. In this scenario, no additional elements would be necessary. Identifying existing policies in each General Plan element that already do or could help reduce GHG emissions would be a critical first step in assessing the type and nature of new policies needed. Categorizing existing helpful policies by their function would greatly aid this assessment; the following are important categories to include: land use, circulation, energy efficiency, alternative energy, municipal operations, waste reduction, conservation, and education. Incorporation of these policies should include a comprehensive review of all elements of the General Plan to ensure that conflicting policies are eliminated as part of the amendment, in the interest of maintaining internal consistency.

Creating a Climate Change Element- A new climate change element could be added as an amendment to an existing General Plan. This should again be accompanied by a comprehensive review of the General Plan to identify and revise or eliminate conflicting policies. The element could include an introduction about climate change, a GHG inventory if feasible, and new and existing policies organized into the following categories: land use, circulation, energy efficiency, alternative energy, municipal operations, waste reduction, conservation, and education. These three main components of a climate change element are discussed further below.

The Introduction*:* The introduction should provide descriptive background information on climate change and its impacts to inform the reader on the issue and the need for incorporating new General Plan policies to reduce GHG emissions. Information needed for the introduction can be found in the first chapter in this report, as well as in Appendix D. Additional information is available from the Air Resources Board (www.arb.ca.gov), the Energy Commission (www.energy.ca.gov) the Climate Action Team (www.climatechange.ca.gov), and the National Academies of Science, Division of Earth and Life Science (www.dels.nas.edu/dels/).

The GHG Inventory*:* As described for Climate Action Plans, above, a greenhouse gas inventory is an important tool for establishing a baseline of existing emissions within the jurisdiction. This will greatly aid the process of determining the type, scope and number of GHG reduction policies to be included, particularly in the context of meeting regional GHG targets; it will also facilitate tracking of policy implementation and effectiveness. GHG inventories for local jurisdictions typically consist of two distinct components: one for the city/county as a whole defined by its geographical borders, and the second for emissions resulting from the city/county's municipal operations.
The municipal inventory would effectively be a subset of the community-scale inventory (the two are not mutually exclusive). Preparing an inventory is not required in order to incorporate General Plan policies that reduce GHG emissions, but it's highly advisable and is a critical component of any Climate Action Plan. The inventory may be included as an appendix to the General Plan. Figure 18 shows municipal and community emissions as calculated for the City of Chula Vista.

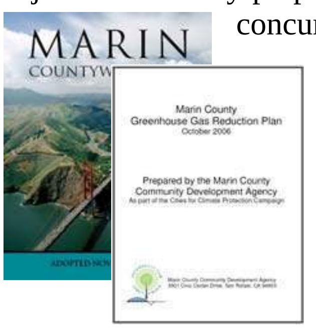
Fig. 18: Example Display of Municipal & Community Emissions



Objectives and Policies*:* As mentioned above, identifying existing General Plan objectives and policies that could or do reduce GHG emissions and categorizing them appropriately is a key step in determining what new policies may be needed to achieve established GHG reduction goals. The following eight category designations are recommended for this purpose: land use, circulation, energy efficiency, alternative energy, municipal operations, waste reduction, conservation, and education. These categories help associate the identified policies with how the reductions are achieved and indicate which General Plan element would contain related policies. Figure 19 shows how reductions in different categories add together to reach the overall target. The new objectives and policies developed for inclusion in this element would also be categorized in the same fashion, with the document structure similar to the other elements in the existing General Plan. Including a matrix or table of all the new and existing/revised policies in the element and the categories under which they fall is a helpful tool in developing implementation mechanisms.

Preparing a Climate Action Plan and Updating the General Plan

A jurisdiction may prepare a Climate Action Plan (CAP) prior to a General Plan update, concurrently with a General Plan update, or following a General Plan update. As described above, the Climate Action Plan would: provide background information on the causes of climate change and projections of its impacts on California and the jurisdiction; present estimates of the jurisdiction's baseline greenhouse gas emissions inventory and reduction target; describe recommended emission reduction actions in the key target sectors; and, identify next steps required over the near term to implement the plan.



Preparation of a CAP prior to updating the General Plan would provide much of the information needed to incorporate appropriate GHG reduction policies into the update. That may not be feasible, however, and is not essential to the preparation of an effective General Plan update with sufficient climate protection measures. However, developing a CAP subsequent to completing the General Plan update may necessitate further revision of the General Plan to provide a general policy basis for the CAP actions.

Coordination with Other Regional Plans

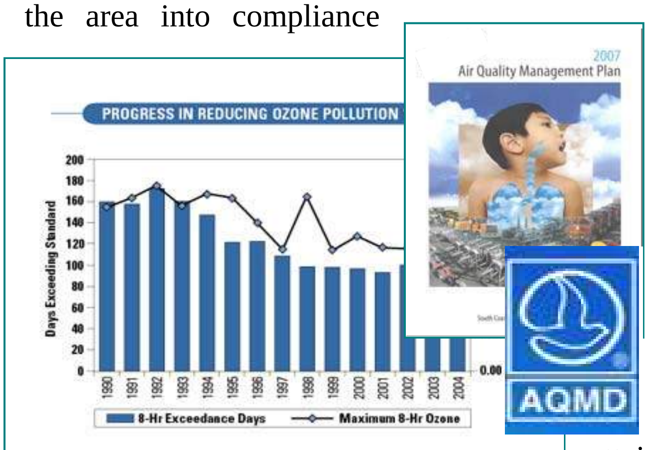
Coordination with regional blueprint plans, regional transportation plans and air district attainment plans, is critical to ensuring the measures within each plan support and do not conflict with the other plans, and that they are working together to reduce GHG emissions. Communication and coordination can improve effectiveness and reduce costs.

Association of Bay Area Governments
Bay Area Air Quality Management District
Bay Conservation and Development Commission
Metropolitan Transportation Commission

Coordination with Blueprint Plans: As discussed above, the AB 32 Draft Scoping Plan encourages local governments to incorporate regional "blueprint plans" into their General Plans. Blueprint plans are envisioned as regional guidance for land use decision-making that would be adopted by the applicable Regional Transportation Planning Agency or Metropolitan Planning Organization. Each regional blueprint would establish recommended land use patterns, transportation systems, and transportation investments to reduce GHG emissions, as well as other air pollutants and congestion within the defined region. The Proposed Scoping Plan does not identify specific mandates for General Plans, but recommends incentives for promoting consistency with one another, such as CEQA streamlining. Cities and counties should take an active part in drafting the blueprint plans through cooperation with the Regional Transportation Planning Agency or Metropolitan Planning Organization so that the plans reflect the cities' and counties' approaches to GHG emissions reductions.

Coordination with Air Quality Management Plans: California has 35 air pollution control districts (APCDs) and air quality management districts (AQMDs), each covering one or more counties. Air districts are governed by locally elected officials (or individuals appointed by locally elected officials) and have regulatory control over stationary sources of air pollutants such as industrial and manufacturing facilities. They are also responsible under CEQA for evaluating and recommending appropriate mitigation for air quality impacts of new development. Air districts also administer a variety of incentive programs to reduce emissions from diesel equipment, including engines, trucks, construction equipment, commercial vessels and other local emission sources.

Air quality attainment plans are prepared by an air pollution control district or air quality management district for a county or region designated as a nonattainment area. The plans identify the control measures and market mechanisms that will be implemented to bring the area into compliance with the national and /or California ambient air quality standards within a specified timeframe. There are often policies, regulations, and programs within an attainment plan that may affect or influence local government activities. Participation by jurisdictions in the public review process required prior to adoption of an attainment plan is important to ensure all the planning efforts work together in achieving mutual goals. The local attainment plan can also be an important resource for jurisdictions embarking on GHG planning efforts. Many of the GHG



reduction strategies also reduce other air pollutants, and may therefore already be addressed in the local attainment plan, which can then be a starting point from which to expand the GHG plan. Even if the attainment plan does not contain some of the measures where there is overlap, coordination is important to determine how the two plans will impact each other, and if there are efficiencies, synergies, or even disbenefits between them. For this reason, it is important to contact your local air district when embarking on your GHG Plan.

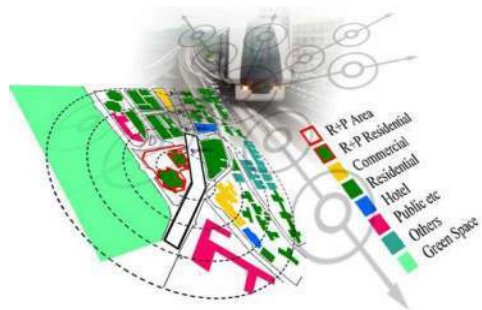
Coordination with Regional Transportation Plans: The Regional Transportation Plan (RTP) is a long-term blueprint of a region's transportation system. These plans are normally the product of recommendations and studies carried out and put forth by a Metropolitan Planning Organization (MPO) or Regional Transportation Planning Agency (RTPA). The Plan identifies and analyzes the mobility needs of the metropolitan region and creates a framework for prioritizing and funding transportation projects to meet those needs during the timeframe of the plan. RTPs are typically updated every four to five years and have a twenty to thirty year planning horizon.

In developing the RTP, the MPO or RTPA must analyze population and growth trends and projections, regional land use and development patterns, existing transportation system efficiency for travel and goods movement, and the projected funding available to accomplish needed improvements. Thus, the MPO or RTPA must coordinate closely with local governments to ensure the RTP reflects the growth and development expectations of local General Plans. The adopted RTP must also be consistent with federal transportation planning requirements, and the projected emissions from transportation projects listed in the Plan must be incorporated into the local or regional air quality attainment plan.

As described in Chapter 2 and at the beginning of this chapter, SB 375 requires RTPs to also contain a Sustainable Communities Strategy and (if needed) an Alternative Planning Strategy designed to meet the regional GHG reduction targets established by ARB. Although the legislation does not require local governments to incorporate the SCS into its own local planning efforts, there are strong incentives to do so.

CEQA Streamlining

The previous discussion of SB 375 outlined specific CEQA streamlining it affords. Even greater streamlining is possible, however, when the local government has adopted a Climate Action Plan, used it as the basis for addressing climate change in its General Plan, and made sure that those efforts reflect, to the extent possible, regional reduction targets and planning for transportation sustainability. When done in a thoughtful and comprehensive way, this integrated planning effort will yield a robust GHG mitigation strategy with a programmatic EIR that, applied consistently to individual projects, can significantly reduce the procedural and administrative burden of review under CEQA, while ensuring full environmental protection.



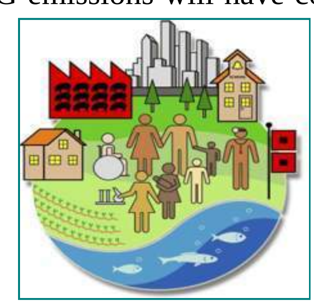
The degree to which CEQA requirements can be streamlined will be directly proportional to the specificity of the applicable plans, and the extent to which they are consistent with each other. For example, the exemptions and streamlining under SB 375 generally rely upon the quantitative demonstration that the SCS/APS meets the regional target, and the existence of approved mitigation measures for transportation projects. In order to demonstrate that the target is met, the transportation models will require more detailed information about demand, use patterns, and other specific factors than is typically used in RTPs today. Some of this detail will have to come from local land use patterns and growth commitments. If the coordination between the local and regional plans is poor, the data will either not be available or will be conflicting, which will render the demonstration unapprovable.

The opportunity for CEQA streamlining also calls for greater specificity in the General Plan. For example, by including a “Green List” of projects in the plan and conducting the environmental review of the projects upfront, the local government can provide downstream relief from further review. This saves resources while preserving environmental protection, and it also enhances the viability of desirable projects.

The application of CEQA to a ubiquitous pollutant with such serious global impacts has raised a number of difficult policy questions, not the least of which concerns the appropriate basis for establishing a threshold of significance. Without engaging in a discussion of the various arguments here, it should be pointed out that the debate can be substantially minimized by undertaking a more thorough and coordinated planning effort upfront and limiting the involvement with CEQA for specific projects.

Unintended Consequences and Assuring Environmental Justice

Many of the measures that will be implemented to reduce GHG emissions will have co-benefits reducing criteria and toxic air pollution, and others are specifically designed to enhance the livability of local communities. But sometimes there are conflicts instead of co-benefits, and sometimes changes to communities can adversely affect some groups within the community, especially those who have lower incomes or are people of color. This kind of unintended consequence should be avoided.



A first step in avoiding environmental justice impacts is to actively seek and incorporate participation from all sectors of the community. This should include outreach efforts in non-traditional as well as traditional media, and may rely on local advocacy groups, and religious and civic organizations. Where languages other than English are used, efforts should be made to provide information and materials in the language(s) most used. The goal of these outreach efforts is true communication, which is two-way. When done successfully, the agency will have explained what it is proposing and what the expected impacts are, and the community members will not only understand those things, but will have the opportunity to have their suggestions and concerns heard and addressed.

In addition to the existing mechanisms for tracking progress towards the goals of a plan or group of plans, it is important to establish a process and a schedule to review the impacts of implementation and especially to look for unintended and potentially adverse outcomes. This review should also include communication with the community. In the unfortunate, and hopefully rare situation where unintended and potentially adverse outcomes are found, steps should be taken to eliminate or mitigate those outcomes right away.

Although addressing climate change is a very important goal, it is not the only goal, and in certain circumstances it is expressly not the goal that governs. Specifically, AB 32 clearly states that climate protection will not come at the expense of air quality and public health protection. In addition, California law guarantees equal environmental protection to all Californians regardless of income status or ethnic background.

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The General Plan is the gateway to transforming our communities into more efficient, low-carbon, sustainable, vital places for us, our families, and our neighbors to live, work, and play. It is within this framework that the web of interactions between policies can be examined and aligned to produce the world we want for our future. The remainder of this report is devoted to exploring the General Plan process and ways to maximize its effectiveness for reducing GHG emissions and lessening the impact of climate change. This chapter discusses legal requirements for General Plans in California and their relation to potential new goals, objectives, policies, and implementation mechanisms to reduce GHG emissions. The General Plan requirements are set out in Section 65300 et seq. of the California Government.

Introduction

Every city and county must adopt "a comprehensive, long term General Plan" (§65300). The General Plan must cover a local jurisdiction's entire planning area and address the broad range of issues associated with a city's or county's development. The General Plan includes diagrams that illustrate the distribution of land uses, location of hazards, and location of the traffic circulation system. A city or county General Plan is expected to reflect local conditions and circumstances, while meeting the minimum requirements set out in state law (§65300.7).

These requirements are discussed in detail in the *General Plan Guidelines* issued by the Governor's Office of Planning and Research, which offers advisory, not mandatory, suggestions for the content of General Plans. In a broad sense, a General Plan is made up of text describing goals, objectives, policies, standards, and/or implementation measures, as well as a set of maps and diagrams. Together, these constituent parts paint a picture of the community's future development. In framing the model policies set forth in Chapter 6 of this report, CAPCOA used the following framework of goals, objectives, policies, standards, and implementation measures:

- Goal - A goal is a general direction for the jurisdiction. It is an ideal future end related to health, safety, or general welfare. "The General Plan shall consist of a statement of development policies and shall include a diagram or diagrams and text setting forth objectives, principles, standards, and plan proposals." (§65302) A goal is a general expression of community values and, therefore, may be abstract in nature and is generally not quantified or time-dependent. *Example: The County shall reduce its greenhouse gas emissions consistent with state and federal planning to reduce the scale and intensity of climate change effects on the County, the state, and the planet.*

- Objective - An objective is a specified end. It should be achievable, measurable and time-specific. An objective may pertain to one particular aspect of a goal or it may be one of several successive steps toward goal achievement. Consequently, there may be more than one objective for each goal. *Example: The County shall reduce its greenhouse gas emissions by 30 percent relative to business as usual emissions projected for year 2020.*

- Policy - A policy is a specific statement that guides decision-making. It indicates a commitment of the local legislative body to a particular course of action. A policy is based on and helps implement a General Plan's objectives. *Example: The County shall require new residential and commercial buildings to be energy-efficient in order to reduce greenhouse gas emissions.*

- Standards - A standard is a rule or measure establishing a level of quality or quantity that must be complied with or satisfied. Standards define the abstract terms of objectives and policies with concrete specifications. *Example: All new residential buildings shall achieve a minimum of 50 points on the Greenpoints rating system and all new commercial buildings shall achieve a minimum standard of LEED certification.*

- Implementation Measures - An implementation measure is an action, procedure, program, or technique that carries out General Plan policy. The General Plan is a policy document and is implemented by other governmental regulations and actions. Many General Plans include at least one corresponding implementation measure for each policy. *Example: The County shall establish a Green Building Ordinance that includes minimum requirements for residential and commercial energy efficiency within 24 months of adoption of the General Plan.*

Consistency

The overriding legal requirement for a General Plan is that it be internally consistent. "In construing the provisions of this article, the Legislature intends that the General Plan and elements and parts thereof comprise an integrated, internally consistent and compatible statement of policies for the adopting agency." (§65300.5). This requirement will come into play as GHG reducing measures are introduced into a General Plan, because so many of the measures cut across elements. So, for example, a land use policy supporting pedestrian-friendly streetscapes in a neighborhood center must be aligned with the transportation measures affecting that same neighborhood center, to ensure that they are compatible. If the transportation measures called for the removal of a planted median strip and the addition of traffic lanes through the neighborhood center, the elements would not be internally consistent.
Consistency is evaluated in five ways:

- All elements are equal - No element can supersede other elements or be the "default" element for resolution of conflicts between General Plan policies.

- Consistency between elements – The requirements of one element may not conflict with the requirements nor hinder the furtherance of goals and objectives of another element.

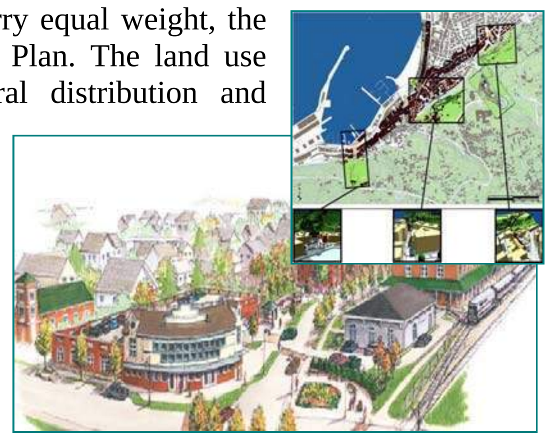
- Consistency within elements – Each element must be internally consistent between its various goals, objectives, and policies.

- Area Plan Consistency – If the General Plan includes Community or Area Plans, those must also be consistent with the overall General Plan.

- Text/Diagram consistency - Diagrams must be consistent with the General Plan's text and vice-versa.

GHG Reduction Opportunities in General Plan Mandatory Elements

Land Use Element



Although all elements of the General Plan carry equal weight, the land use element is the heart of the General Plan. The land use element must address the "proposed general distribution and general location and extent of the uses of the land for housing, business, industry, open space, including agriculture, natural resources, recreation, and enjoyment of scenic beauty, education, public buildings and grounds, solid and liquid waste disposal facilities, and other categories of public and private uses of land" (§65302[a]). The land use element shall include a statement of the standards of population density and building intensity recommended for the various districts and other territory covered by the plan. In addition, the land use element must identify and annually review those areas covered by the plan that are subject to flooding.

The land use element should, consistent with §65302(a), address each of the following issues to the extent that it is relevant:

- Distribution of housing, business, and industry;

- Distribution of open space, including agricultural land;

- Distribution of mineral resources and provisions for their continued availability;

- Distribution of recreation facilities and opportunities;
- Location of educational facilities;
- Location of public buildings and grounds;
- Location of future solid and liquid waste facilities;
- Identify areas subject to flooding;
- Identify existing Timberland Preserve Zone lands; and
- Other categories of public and private uses of land.

The key opportunities in the land use element related to GHG reductions include:

- Foster land use intensity near, along with connectivity to, retail and employment centers and services to reduce vehicle miles travelled and increase the efficiency of delivery of services through adoption and implementation of smart growth principles and policies;
- Improve the local jobs/housing balance to reduce vehicle miles travelled;
- Zone for appropriate mixed use development to encourage walking and bicycling for short trips, rather than vehicles;
- Link residential and commercial development to transit facilities;
- Reduce parking requirements to facilitate higher density development that fosters access by walking, biking and public transit;
- Identify potential sites for renewable energy facilities and transmission lines;
- Promote recycling to reduce waste and energy consumption; and
- Identify appropriate sites for waste recovery facilities to minimize escape of GHGs.

Conservation Element

Generally stated, the conservation element must address "the conservation, development, and utilization of natural resources including water and its hydraulic force, forests, soils, rivers and other waters, harbors, fisheries, wildlife, minerals, and other natural resources" (§65302[d]). This includes, but is not limited to, consideration of water supply to meet future needs, flood protection, the effects of development on water resources, erosion control, pollution prevention, and watershed protection.

The key opportunities in the conservation element related to GHG reductions include:

- Conserve natural lands for carbon sequestration;
- Identify lands suitable for wind power generation;
- Conserve water to promote energy efficiency;
- Promote recycling and waste recovery; and
- Promote urban forestry and reforestation as feasible.

Circulation Element

The circulation element is required “to identify the general location and extent of existing and proposed major thoroughfares, transportation routes, terminals, any military airports and ports, and other local public utilities and facilities, all correlated with the land use element of the plan” (§65302[b]). Typically, the circulation element describes the road system and its minimum development standards, as well as provisions for non-motorized transportation. The local planning agency should coordinate its circulation element provisions with applicable state and regional transportation plans (see §65103[f] and §65080, et seq.). Likewise, the state must coordinate its plans with those of local governments (§65080(a)). The federal government is under a similar obligation (Title 23 USC §134). If the circulation element is to be an effective basis for exactions, it must be based upon traffic studies that are sufficiently detailed to link land uses and related demand to future dedications.

The circulation element's policies can be a means of reducing vehicle miles traveled, a substantial indicator of GHG production from transportation. Key opportunities in the circulation element related to GHG reductions include:

- Identify and prioritize infrastructure improvements needed to support increased use of alternatives to private vehicle travel, including transit, bicycle, and pedestrian modes;
- Coordinate with adjacent municipalities, transit providers, and regional transportation planning agencies to develop mutual policies and funding mechanisms to increase the use of alternative transportation;
- Establish higher priorities for transit funding relative to street and road construction and maintenance;
- Incorporate "Complete Streets" policies that foster equal access by all users, including pedestrians and bicyclists;
- Promote linkages between development locations and transportation facilities;
- Preserve transportation corridors for renewable energy transmission and for new transit lines;
- Identify appropriate locations for intermodal transportation stations; and
- Identify opportunities, in cooperation with transit providers, to provide financing for transit operations and maintenance.

Open Space Element

The open space element is to identify open space for: (1) the preservation of natural resources; (2) the managed production of resources, including but not limited to, forest lands, rangeland, agricultural lands, areas required for recharge of groundwater basins, bays, estuaries, marshes, rivers and streams, and areas containing major mineral deposits; (3) outdoor recreation, including but not limited to, areas of outstanding scenic, historic and cultural value, areas particularly suited for park and recreation purposes, including access to lakeshores, beaches, and rivers and streams; and areas that link major recreation and open-space reservations; (4) for public health and safety; (5) open space in support of the mission of military installations, that comprises areas adjacent to military installations, military training routes, and underlying restricted airspace that can provide additional buffer zones to military activities and complement the resource values of the military lands; and (6) for

the protection of places, features, and objects of cultural value to Native American tribes (§65560).

The key opportunities in the open space element related to GHG reductions include:

- Identify existing and potential future urban growth boundaries to limit sprawling development patterns and foster a more compact urban form;
- Conserve natural lands for carbon sequestration; and
- Promote trail systems to facilitate bicycle and pedestrian trips in lieu of vehicle travel.

Housing Element

A General Plan is required to include a housing element "that facilitate[s] the improvement and development of housing to make adequate provision for the housing needs of all economic segments of the community" (§65580[d]). The housing element must provide opportunities for the private and public sectors to develop sufficient housing meet the jurisdiction's allocated share of the region's housing needs. Unlike the other elements of the General Plan, the housing element requirements are quite detailed and must be followed carefully. In addition, the housing element is subject to review by the state's Housing and Community Development Department for consistency with state law. The housing element must be updated every five years.

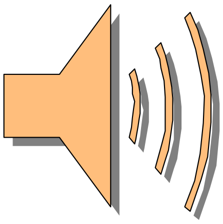
The key opportunities and constraints in the housing element related to GHG reductions include:

- Identify sites for higher density housing closer to employment centers, retail and services, and transit facilities;
- Identify sites for affordable housing for workers close to employment centers;
- Establish or support programs to assist in the energy-efficient retrofitting of older affordable housing units; and
- Balance additional upfront costs for energy efficiency and affordable housing economic considerations by providing or supporting programs to finance energy-efficient housing.

Noise Element

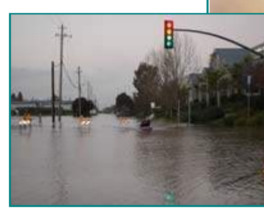
The noise element must identify and appraise noise problems in the community for the purpose of avoiding conflicts with noise-sensitive land uses (§65302[f]).

The noise element does not contain any measures that directly reduce GHG emissions. However, some of the potential GHG reduction strategies in other elements such as increased residential density, mixed use, expanded transit services, and wind energy could adversely affect the noise environment, which would be an issue for the noise element to address. The noise element's development standards may need to be strengthened to ensure that higher densities and mixed uses avoid excessive noise exposure for residents. At the same time, some GHG reduction strategies, for example, those that increase energy efficiency by adding insulation, may have a positive impact on the noise environment.



Safety Element

The safety element is to provide for the protection of the community from any unreasonable risks associated with the effects of seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche (wave), and dam failure; slope instability leading to mudslides and landslides; subsidence, liquefaction, and other seismic hazards, and other geologic hazards known to the legislative body; flooding; and wildland and urban fires (§65302[g]).



With inevitable climate change impacts already occurring and predicted to occur in the future, adaptation to changes in safety hazards, such as potential increase in wildland fire potential or coastal or delta flooding resulting from sea level rise, would be topics of discussion in future safety elements. Adaptation planning for climate change impacts is an important and growing issue area that should be incorporated into local and regional planning processes. As this paper only focuses on GHG reductions, issues related to adaptation are not discussed further.

Air Quality Element (Mandatory Only in the San Joaquin Valley)

Many cities and counties throughout the State have adopted air quality elements. They establish policies for reducing emissions from stationary, mobile, and area sources of air pollution. In most cases, the local air district either provides model elements, or assists the city or county in development of the element. The cities and counties within the jurisdiction of the San Joaquin Valley Air Pollution Control District are required to adopt an air quality element. Under statute, the element is to integrate land use plans, transportation plans, and air quality plans, as well as provide for multimodal transportation options that will reduce vehicle trips (§65302.1). Cities and counties should contact their local air district when developing an air quality element.

The key opportunities and constraints in an air quality element related to GHG reductions include:

- Integrate land use plans and transportation plans;
- Provide multimodal transportation options;
- Co-benefits of criteria pollutant reduction strategies that also reduce GHG emissions and vice versa; and
- Disbenefits of potential GHG emissions reductions strategies on criteria and other pollutants.

GHG Reduction Opportunities in Non-Mandatory Elements

State planning law authorizes cities and counties to adopt additional elements that “address any other subjects which, in the judgment of the legislative body, relate to the physical development of the county or city” (§65303). There are no statutory requirements for the subjects or content of any of these optional elements. Following are some of the common optional elements. Keep in mind that each city and county has its own definition of what the element should contain.

Energy

A number of cities and counties have adopted energy elements as part of their General Plans. There are no energy element guidelines or standard set of required contents. In some jurisdictions, these elements establish policies for energy extraction. In others, they are concerned with the conservation of energy.

The key opportunities in an energy element related to GHG reductions include:

- Energy-efficiency requirements for residential, commercial, and industrial construction under local jurisdiction that exceed current standards;
- Facilitate residential and commercial renewable energy facilities (solar array installations, individual wind energy generators, etc.);
- Promote cogeneration facilities for combined heating and electricity;
- Facilitate renewable energy facilities and transmission line siting;
- Establish energy-efficiency standards for public facilities;

- Establish policies to reduce municipal and community petroleum consumption through changes in the vehicle fleet; enhancement and promotion of public transit, carpooling and other transportation modes to reduce employee and student commute trips;

- Establish policies to reduce GHG production by city and county operations, such as improved energy efficiency of public buildings, recycling at public buildings.

Economic Development

Economic development elements generally establish policies intended to encourage economic development within the community. These may include establishing incentives for development, identifying areas of greatest development potential, and creating the basis for other economic development activities to be undertaken by the jurisdiction.

The key opportunities in an economic element related to GHG reductions include:

- Incentives for investment in and deployment of renewable energy technologies;

- Incentives for development of local green technology businesses and locally produced green products;

- Incentives for investment in residential and commercial energy efficiency improvements;

- Incentives for employers to provide workforce housing, thereby reducing the length of trips to work;

- Policies to enhance sales tax revenues that promote incorporation of larger retail uses within downtown areas and mixed use developments to facilitate access by alternative transportation, in favor of larger retail or mixed use developments on the urban fringe;

- Establish financing districts (in charter cities) to encourage installation of solar panels and other energy-efficient improvements (e.g., City of Berkeley Solar Financing District, 11/07);

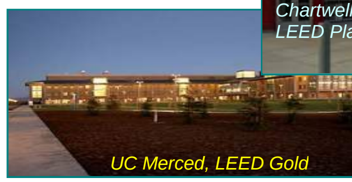
- Encourage implementation of AB 811 (Levine, see Chapter 159, Statutes of 2008), Renewable Energy Resource Credit (7/08), for low interest loans for energy improvements; and

- Use AB 811 to finance the installation of distributed generation renewable energy sources or energy efficiency improvements to lots or parcels which are developed and where the costs and time delays involved in creating an assessment district pursuant to other provisions of law would be prohibitively large relative to the cost of the public improvements to be financed.

Capital Improvements/Public Facilities

Capital improvements are often discussed in the circulation element of the General Plan. However, some cities and counties have adopted separate capital improvements or public facilities elements that discuss expected demand resulting from growth under the General Plan and identify necessary facilities to serve that growth. In some cases, the element will estimate costs and recommend implementation methods for raising the needed funding.


Chartwell School, Seaside, LEED Platinum


UC Merced, LEED Gold

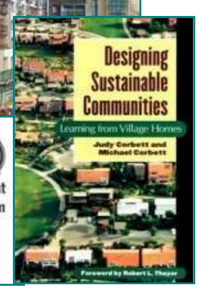
The key opportunities in a capital improvements/public facilities element related to GHG reductions include:

- Establish energy-efficiency standards for public facilities;
- Promote solar installation opportunities for public facilities;
- Other building design energy and water efficiency standards for public facilities;
- Establish purchasing and procurement policies that support the use of green products and services; and
- Identify needs and funding sources for alternative transportation modes such as bicycle facilities and improved transit infrastructure.

Community Design

Community design elements typically provide a set of policies that promote better urban design. These often include provisions for aesthetic treatments, architectural design guidelines, and preferred street design.

The key opportunities in a community design element related to GHG reductions include:



- Incorporate urban design principles that promote higher residential densities in attractive forms with easily accessible parks and recreation opportunities nearby;

- Use urban design standards to facilitate clustered, higher-density, mixed use communities with greater potential for transit ridership, alternatives to vehicle travel, and shorter trips;

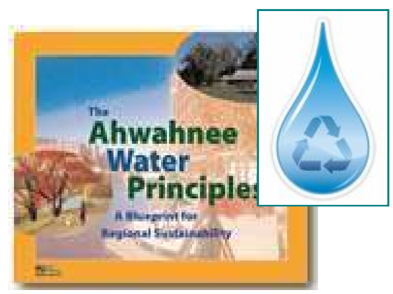
- Establish policies and design principles to incorporate inviting public spaces in high density, mixed use communities;

- Incorporate "Complete Streets" policies that foster equal access by all users, including pedestrians and bicyclists; and

- Promote water-efficient and energy-efficient housing and commercial areas.

Water

A water element typically identifies projected water demand based on the General Plan growth. It describes water supplies within the city or county (most water elements have been adopted by counties) and policies for matching future demand.



Available from: Local Government Commission

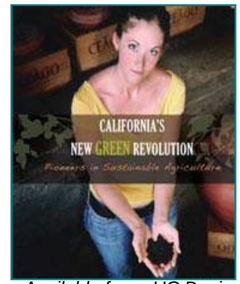
The key opportunities in a water element related to GHG reductions include:

- Incorporate water conservation measures for municipal operations and throughout the community to reduce GHG emissions from pumping and water delivery; and

- Adopt policies and standards to facilitate water recycling for use on landscaping, agricultural operations, and other applications where potable water is not required, to reduce pumping-related GHG emissions.

- Because energy used in moving water through the system is a major component of the GHG inventory, include measures that reduce peak demand for water, and therefore allow for smaller pumps that use less energy overall.

Agriculture



Available from: UC Davis Small Farm Center

Agricultural elements typically identify the highest quality farmland within the city or county (most agricultural elements have been adopted by counties) and establish policies that protect that land from premature conversion to other uses. The goals of an agricultural element are usually aimed at preserving the long-term viability of the agricultural economy of the city or county.

The key opportunities in an agricultural element related to GHG reductions include:

- Establishment of minimum parcel sizes for agricultural lands outside of Agricultural Preserves and restrictions on non-agriculture related development and uses on agricultural parcels to enhance the viability of local agriculture and prevent additional sprawl development that increases dependence on and emissions from private vehicles;

- Development of policies and incentives (e.g., carbon credit programs) to promote voluntary preservation of farmland for carbon sink purposes;

- Adoption of policies and programs that facilitate local farmers markets and farmer co-ops that allow residents to purchase local farm goods and reduce emissions from transportation of agricultural products; and

- Support for agricultural industries that reduce the need to move agricultural products long distances for processing or packaging.

- To the extent the agricultural element addresses water use, it should be noted that efficiencies here, or use of alternatives, can provide substantial GHG reductions.

Element Interrelationships

This section discusses the interrelationships between the mandated General Plan elements by identifying the cross-cutting issues for GHG emissions and opportunities for reductions, categorized by each required element. As previously described, a General Plan must be internally consistent across all adopted elements; thus, cross-cutting issues must be evaluated closely to ensure the goals, objectives, policies and implementation measures in one element do not conflict with, or hinder the implementation of, the requirements of other elements. Cross-cutting issues are first identified in a matrix format; those issues are then matched with the critical relationships that must be established across the elements in a General Plan to identify appropriate linkages and enhance internal consistency. Some examples of consistency considerations include the following:

- Density and Transit-Oriented Development – If increased density and transit-oriented development are strategies used to reduce vehicle miles travelled (and their associated GHG emissions), then the General Plan must provide the land use designations to allow such density to occur, identify the locations where those strategies are to be applied, and identify the land and other infrastructure necessary to facilitate transit connections. This requires consistency between the land use, circulation, housing, and possibly other elements of the General Plan. Further, site constraints such as toxics contamination, noise, or air quality emissions hot spots need to be considered before designating sites for high density and transit-oriented development in order to maintain consistency with the noise and safety elements.

- Specific Plans, Community Plans, and Area Plans: These types of land use plans are used to implement the General Plan. Where the General Plan provides for the preparation of any of these more specific land use plans to implement its strategies, those plans must be consistent with the policies of the General Plan. In particular, development intensity, population density, and location within the community, and roads and transportation facilities will be important facets of plan consistency.

- Energy-Efficiency Requirements – If new policies are added to increase the energy-efficiency requirements beyond that established in current Title 24 standards, these requirements could raise the cost of housing, which could affect the jurisdiction's ability to meet its mandatory requirements for the provision of affordable housing under the housing element. Those policies must not impede the jurisdiction's ability to meet its assigned share of the regional housing need. This requires coordination between the land use, housing, and energy (if one exists) elements.

- Renewable Energy – If new policies require further reliance on renewable energy for municipal and community electricity, then the General Plan must also address the availability of land for new facilities and transmission lines and their compatibility with existing and future adjacent uses. This requires coordination between the land use, circulation, and energy (if one exists) elements and possibly the open space and agriculture elements for transmission lines.

Table 1 (on the next page) summarizes the key element interrelationships relevant to broad GHG reduction strategies. This is also not a comprehensive list of GHG reduction approaches, but is intended to highlight the key linkages between General Plan elements for the strategies with greatest potential for GHG reductions that are under the control or influence of local land use authorities.

Table 1. Element Interrelationships for Greenhouse Gas Emission Reduction Strategies

Reduction Strategy	Key Element Interrelationships
Promotion of jobs/housing balance	Local governments can promote economic development to provide employment for the future workforce of the county and housing appropriate to that workforce to reduce out-of-area and out-of County commute miles and associated vehicle emissions. Mandatory Elements: LAND USE, HOUSING Optional Elements: ECONOMIC DEVELOPMENT
Increased housing density/mixed use/TOD/infill development	Local governments can designate areas of increased density in proximity to employment centers, services, transit linkages, and alternatives to single-occupancy vehicle travel. Mandatory Elements: LAND USE, CIRCULATION, HOUSING, OPEN SPACE Optional Elements: COMMUNITY DESIGN, ECONOMIC DEVELOPMENT
Increased transit	Local government can facilitate increased transit use through efficient links between employment centers, services, and clustered residential areas and to different modes of travel in cooperation with adjacent cities/counties, transportation providers, and regional transportation agencies. Local governments must also address safety and noise issues for new facilities. Mandatory Elements: CIRCULATION, LAND USE, NOISE, SAFETY. AIR QUALITY Optional Elements: AIR QUALITY
Alternative vehicles and alternatives to vehicle travel other than transit	Local government can facilitate bicycle and pedestrian linkages between residential areas, schools, services, centers of employment and recreation. Local government can also utilize alternatively-fueled vehicles for municipal operations and require recharging stations for electric vehicles at new private development Mandatory Elements: CIRCULATION, LAND USE, OPEN SPACE Optional Element: PUBLIC FACILITIES, AIR QUALITY
Energy-Efficiency (public)	Local governments can undertake cost-effective energy-efficient investments, while saving energy costs over the long run. Mandatory Element: LAND USE Optional Elements: ENERGY, PUBLIC FACILITIES, COMMUNITY DESIGN
Energy-Efficiency (private)	Local governments can promote or require energy-efficiency in new residential, commercial, and industrial development that will reduce GHG emissions related to electricity and natural gas consumption. This can include support for programs to retrofit existing residences and businesses. Mandatory Elements: HOUSING, LAND USE Optional Elements: ENERGY, COMMUNITY DESIGN

Reduction Strategy	Key Element Interrelationships
Renewable Energy (utility)	Local governments can identify sites for new renewable energy facilities and transmission lines. Mandatory Elements: LAND USE, CIRCULATION, CONSERVATION Optional Element: ENERGY, AGRICULTURE
Renewable Energy (residential/commercial)	Local governments must balance between the GHG reductions from residential/commercial solar and wind installations and concerns about safety, noise, and aesthetics. Policies should encourage these uses while establishing safety, noise, and aesthetics standards, consistent with state law. Mandatory Elements: LAND USE, NOISE, SAFETY Optional Element: ENERGY
Waste Reduction, Recycling, Reuse, and Recovery	Local governments can promote waste reduction, increased recycling, waste diversion, waste to energy and waste recovery through direct action. Mandatory Elements: LAND USE, CONSERVATION, SAFETY Optional Elements: ENERGY, PUBLIC FACILITIES, AIR QUALITY
Water Conservation and Recycling	Local governments can promote water conservation and recycling through landscaping and irrigation requirements and limitations, fixture and appliance requirements, and expanded use of reclaimed water. Plan policies would set the stage for water conservation and recycling ordinances. Mandatory Elements: LAND USE, CONSERVATION, SAFETY Optional Elements: ENERGY, PUBLIC FACILITIES, AIR QUALITY

Introduction

This chapter provides a presentation of an overarching climate change goal (to reduce municipal greenhouse gas emissions in a manner that is consistent with AB 32) and related objectives, policies, and implementation measures for incorporation into a General Plan - whether as part of an Air Quality element, as a separate Climate Change element, or interspersed throughout other existing elements as appropriate within a General Plan. The model policies provided in this section are grouped by General Plan element, and are provided in a format that should be readily included in a city or county's General Plan. The city or county has full discretion on where to place the policies, whether to change their format or content, and, indeed, whether to incorporate them at all. This report and policies in it are not intended in any way to dictate what a city or county chooses to include in its plan; that choice remains the purview of the locally elected officials who approve the city or county's General Plan.

However, if and when a city or county chooses to incorporate GHG reduction strategies into its General Plan, or into another guiding document, such as a Climate Action Plan, the following policies represent the best practices and current knowledge in land use planning. The climate change policies presented here were compiled through an extensive review of General Plans and Climate Action Plans from cities and counties throughout the State that are already moving forward to address climate change and GHG emissions. CAPCOA, with the help of its contractors, surveyed current practices in the field and aggregated them into model policies to ease the burden on staff at already strapped city and county land use agencies. Those staff remain the experts on their local land use circumstances and needs, however, and their knowledge and judgment, with the oversight of their policy boards, will shape when and how GHG reduction strategies are applied within their jurisdictions. This is not an exhaustive list -- local governments are encouraged to address climate change and GHG emissions through additional or reworked policies and implementation measures according to their unique needs.

The Model Policies

The menu of objectives, policies, and implementation measures is grouped around nine General Plan elements, including one new element, "Greenhouse Gas Reduction Planning." A city or county can place the policies it selects into the most relevant existing General Plan element, if the city or county is integrating GHG reduction strategies throughout its General Plan. On the other hand, the city or county may choose to group all GHG reduction policies under one element, in which case the Greenhouse Gas Reduction Planning element could be broadened to accommodate that. The nine greenhouse gas reduction categories for which model policies are provided are as follows:

1) Greenhouse Gas Reduction Planning (overall);
2) Land Use and Urban Design;
3) Transportation;

4) Energy Efficiency;
5) Alternative Energy;
6) Municipal Operations;
7) Waste Reduction and Diversion;
8) Conservation and Open Space; and
9) Education.

These categories do not correspond exactly to standard California General Plan elements. Some of the policies in this chapter correspond to multiple standard elements, and some do not correspond to any of the required California General Plan elements. These policies could be included in a separate Climate Change element. Please see the table at the end of this chapter for suggestions on which standard elements some of the policies may correspond to. A broad policy goal is identified for GHG reductions in each of these nine categories; more specific objectives are identified within each category; and the model policies are grouped by objective, and are numbered accordingly.

Focus of Policies for Different Communities

There are over 500 cities and counties in California. These jurisdictions range in size from the City of Los Angeles, with over 4 million residents, to the City of Dorris, with less than 900 residents. The eastern portion of the state north of San Bernardino County, and the northern tier of counties from Modoc to Mendocino are generally rural, with only small cities. Although climate change is a global concern and activities throughout the state are contributors, the capability to incorporate and implement climate-related General Plan policies and the applicability of those policies varies among cities and counties.

Policies suitable in urban and suburban areas in the Bay Area, San Joaquin Valley, SCAG region, and San Diego may be infeasible in rural areas that have different land use and resource bases . For that reason, the policies discussed above cannot be considered “one size fits all” solutions. Therefore, providing suggestions about the suitability of policies by general region of the state makes sense.

Air Quality Co-benefits from Greenhouse Gas Reduction Measures

When considering the implementation of a climate change measure, it is vital to consider and discuss the environmental co-benefits associated with GHG reduction measures. If one does not clearly show the co-benefits, then a third party could assume that the only function of a GHG reduction measure is to reduce GHG emissions.

It is well known within the environmental planning community that almost all efforts to reduce GHG emissions result in significant reductions in conventional air pollutant emissions. For instance, most efforts to reduce automobile use through smart growth design principles or improvements in public transit should result in reductions in both

GHG emissions and conventional pollutants associated with smog (such as NOx, PM, VOCs, and ozone). Additionally, efforts to conserve electricity will reduce both GHG emissions and conventional pollutant emissions from power plants.

There are limited scenarios where GHG reductions may cause local air quality impacts. For example, efforts to increase certain types of distributed power generation through the non-optimal combustion of landfill gas may produce localized NOx emissions that contribute to regional smog. Likewise, increasing densities near transit hubs and transportation corridors could increase exposure to unhealthy diesel emissions in certain areas. Fortunately, the potential for adverse air quality impacts from GHG reduction programs and plans is small; in the overwhelming majority of cases, measures implemented to reduce GHG emissions will also contribute to improved air quality.

Since a majority of Californians live in areas where air quality does not meet state and federal health standards for at least one pollutant, GHG reduction measures make sense from a direct and *local* public benefit perspective since they would likely contribute to improved local air quality. Clearly identifying the co-benefits of implementing such measures will potentially engender the support of a broader range of the community.

The communities surrounding the major California ports are a good example. Given the public health concern regarding diesel particulate matter emissions from ships and heavy duty vehicle use near ports, it is highly likely that local residents would prefer and support GHG programs that reduce exposure to pre-existing and well-known local air quality problems to a greater extent than GHG reduction programs that do not have local air quality improvement benefits. Addressing both GHG emissions and local health concerns simultaneously should be encouraged and may determine the selection of optimal multi-target reduction measures.

In general, public support and acceptance of GHG reduction efforts will be enhanced by the clear presentation of the co-benefits associated with these actions. This presents a significant opportunity to local decisionmakers to help improve public health and welfare in their local communities while simultaneously addressing the critical issue of climate change.

Worksheet for Evaluating Policies

Table 2 provides a worksheet for evaluating the expected impact of these policies, as well as factors that affect their implementation. The impacts will vary depending on a number of factors specific to each city and county. As stated previously, the effectiveness of many of these policies depends on how they are applied. For example, a number of the model land use policies are designed to support high-density development near the city center. Done properly, this strategy will result in a workforce that lives near the jobs it fills, and that relies on transit, biking, and walking to commute to work and school, and to reach a broad range of nearby services. If, for example, the housing is not in the proper price range for the workers who fill the local jobs, or if those jobs cannot be easily and safely reached using transit or other modes of transportation, the effect of the strategy

will be much less, and may even be negative. In the worst case, the housing could be purchased by people who work in remote areas and commute to their workplaces in single-occupancy vehicles, and this new housing could displace other housing that was in better balance with the local jobs, causing those workers to commute into the urban core.
In the worksheet, each policy is referenced by number and name. For more detail on the policy, please refer to the text of the corresponding model policy, following in this chapter. The worksheet addresses the following factors:

- Implementation Examples: To the extent that CAPCOA has information, this information is already entered in the worksheet, to show the reader/practitioner examples of places this policy has been adopted or implemented in practice.

- Appropriate General Plan Element: This information is also already entered into the worksheet, to suggest (but not dictate) the most appropriate element or elements where the referenced model policy could be incorporated.

- Relative Effectiveness Reducing GHGs: We suggest ranking measures based on your estimate of their relative effectiveness, considering the local environment and constraints. This does not have to be quantitative; a rating of 1 to 3, or 1 to 5, could be used, or Low-Medium-High, for example. For more information on estimating effectiveness, consult the CAPCOA document on CEQA and Climate Change, the California Climate Action Registry, ICLEI[1], or the ARB Local Government Toolkit.

- Relative Difficulty to Implement: This is intended to be a measure of how prepared a jurisdiction is to implement a measure (do you have the necessary authority, knowledge, infrastructure, and resources, for example) as well as the expected political acceptability and the acceptance by the community.

- Relative Time for Reductions to Occur: This is not intended to be a precise measure, rather a qualitative one. We suggest "near term," "mid term," and "long term" for example, or another system for sorting and ranking measures based on when the return is expected to occur.

- Relative Cost: Measures could be rated qualitatively, for example as low, medium, or high costs, or between $ and $$$$$, with more dollar signs indicating a higher relative cost. Alternatively, a rough cost range could be used.

As cities and counties review these model policies and select the ones that are most appropriate for their jurisdictions, they should make clear and careful decisions about criteria that will properly target the policies to best achieve their intended result.

The model policies are provided in a form that begins, "The City/County will…" To reiterate, this is not meant to dictate what any city or county will do; rather, if a city or

[1] ICLEI is Local Governments for Sustainability

county wishes to incorporate a model policy, the policy has been written to allow the city or county to simply insert its name into the policy in place of "The City/County." As already stated, if other language or another format is preferred, the city or county has full discretion to make any such changes.

As previously noted, the California Air Resources Board has developed an online toolkit of measures for local governments to reduce global warming pollution, available at www.coolcalifornia.org. This toolkit contains emissions inventory utilities, case studies of local governments who have effectively reduced their global warming pollution, financial assistance available for conservation efforts, and other valuable information.

Greenhouse Gas Reduction Planning Policies

Goal: Reduce GHG emissions from all activities within the City/County boundaries to support the State's efforts under AB-32 and to mitigate the impact of climate change on the City/County, State, and world.

Objective GHG-1: By 2020, the City/County will reduce greenhouse gas emissions from within its boundaries to a level 30% less than the level that would otherwise occur if all activities continued under a "business as usual" scenario.

GHG-1.1 Emission Inventories: The City/County will establish GHG emissions inventories including emissions from all sectors within the City/County, using methods approved by, or consistent with guidance from, the ARB; the City/County will update inventories every 3 years to incorporate improved methods, better data, and more accurate tools and methods, and to assess progress.

1.1.1 The City/County will establish a baseline inventory of GHG emissions including municipal emissions, and emissions from all business sectors and the community.

1.1.2 The City/county will define a "business as usual" scenario of municipal, economic, and community activities, and prepare a projected inventory for 2020 based on that scenario.

GHG-1.2 Climate Action Plans: The City/County will establish plans to reduce or encourage reductions in GHG emissions from all sectors within the City/County.

1.2.1 The City/County will establish a Municipal Climate Action Plan which will include measures to reduce GHG emissions from municipal activities by at least 30% by 2020 compared to the "business as usual" municipal emissions (including any reductions required by ARB under AB 32).

1.2.2 The City/County will, in collaboration with the business community, establish a Business Climate Action Plan, which will include measures to reduce GHG emissions from business activities, and which will seek to reduce emissions by at least 30% by 2020 compared to "business as usual" business emissions.

1.2.3 The City/County will, in collaboration with the stakeholders from the community at large, establish a Community Climate Action Plan, which will include measures reduce GHG emissions from community activities, and which will seek to reduce emissions by at least 30% by 2020 compared to “business as usual” community emissions.

1.2.4 Or: The City / County will, in collaboration with the stakeholders from the community at large, establish a CCAP, which will include measures to reduce GHG from community, municipal and business activities by at least 30% by 2020, compared to “business as usual”.

GHG-1.1*A* **Emission Inventories:** *(Alternative form)* The City/County will establish GHG emissions inventories including emissions from all sectors within the City/County, using methods approved by, or consistent with guidance from, the ARB; the City/County will update inventories every 4 years to incorporate improved methods, better data, and more accurate tools and methods, and to assess progress.

1.1.1 The City/County will establish a baseline inventory of GHG emissions including municipal emissions, and emissions from all business sectors and the community.

GHG-1.2*A* **Climate Action Plans:** *(Alternative form)* The City/County will establish plans to reduce or encourage reductions in GHG emissions from all sectors within the City/County.

1.2.1 The City/County will establish a Municipal Climate Action Plan which will include measures to reduce GHG emissions from municipal activities by at least 15% by 2020 compared to the baseline municipal emissions inventory (including any reductions required by ARB under AB 32).

1.2.2 The City/County will, in collaboration with the business community, establish a Business Climate Action Plan, which will include measures to incentivize and support reductions in GHG emissions from business activities, and which will seek to reduce emissions by at least 15% by 2020 compared to the baseline business emissions inventory (including any reductions required by ARB under AB-32).

1.2.3 The City/County will, in collaboration with the stakeholders from the community at large, establish a Community Climate Action Plan, which will include measures to incentivize and support reductions in GHG emissions from community activities, and which will seek to reduce emissions by at least 15% by 2020 compared to the baseline community emissions inventory (including any reductions any reductions required by ARB under AB-32).

Objective GHG-2 The City/County will ensure that its local Climate Action, Land Use, Housing, and Transportation Plans are aligned with, support, and enhance any regional plans that have been developed consistent with state guidance to achieve reductions in GHG emissions.

GHG-2.1 Sustainable Communities Strategy/Regional Blueprint Planning: The City/County will participate in the Sustainable Communities Strategy/Regional Blueprint Planning effort and will ensure that local plans are consistent with the Regional Plan.

Land Use and Urban Design Policies

Goal: Promote land use strategies that decrease reliance on automobile use, increase the use of alternative modes of transportation, maximize efficiency of urban services provision and reduce emissions of GHGs.

Objective LU-1: The City/County will adopt and implement a development pattern that utilizes existing infrastructure; reduces the need for new roads, utilities and other public works in new growth areas; and enhances non-automobile transportation.

LU-1.1 Urban Growth Boundary: The City will establish an urban growth boundary (UBG) with related ordinances or programs to limit suburban sprawl; the City/County will restrict urban development beyond the UGB and streamline entitlement processes within the UGB for consistent projects.

1.1.1 Urban development should occur only where urban public facilities and services exist or can be reasonably made available.

1.1.2 The improvement and expansion of one urban public facility or service should not stimulate development that significantly precedes the City's, or other affected jurisdiction's, ability to provide all other necessary urban public facilities and services at adequate levels.

LU-1.2 Reserve Limits: The City/County will redirect new growth into existing city/urban reserve areas.

LU-1.3 Infill: The City/County will encourage high-density, mixed-use, infill development and creative reuse of brownfield, under-utilized and/or defunct properties within the urban core.

LU-1.4 Urban Service Lines: The City/County will maintain a one dwelling unit per 10 acre minimum lot size or lower density in areas outside designated urban service lines.

1.4.1 Adopt an urban-rural transition zone along the urban service line to ensure that land uses within the City / County are compatible with adjacent open space and agricultural uses.

LU-1.5 Density: The City/County will increase densities in urban core areas to support public transit.

1.5.1 Remove barriers to the development of accessory dwelling units in existing residential neighborhoods inside urban service lines.

LU-1.6 Road Width: The City/County will reduce required road width standards wherever feasible to calm traffic and encourage alternative modes of transportation.

LU-1.7 Parking Spaces: The City/County will reduce parking space requirements, unbundle parking from rents and charge for parking in new developments.

LU-1.8 Bicycle Facilities: The City/County will add bicycle facilities to city streets and public spaces.

LU-1.9 Levels of Service: The City/County will discourage the extension of urban levels of service for new development beyond existing urban service lines, and, if necessary, use zoning to assure that development occurs only if public services are adequate.

Objective LU-2: Promote infill, mixed-use, and higher density development, and provide incentives to support the creation of affordable housing in mixed use zones.

LU-2.1 Mixed-Use Development: The City/County will plan for and create incentives for mixed-use development.

2.1.1 The City/County will identify sites suitable for mixed-use development within an existing urban service line and will establish appropriate site-specific standards to accommodate the mixed uses. Site-specific standards could include:

2.1.1.1 Increasing allowable building height or allowing height limit bonuses;

2.1.1.2 Allowing flexibility in applying development standards (such as FAR[2] and lot coverage) based on the location, type, and size of the units, and the design of the development;

2.1.1.3 Allowing the residential component to be additive rather than within the established FAR for that zone, and eliminating maximum density requirements for residential uses in mixed use zones;

2.1.1.4 Allowing reduced and shared parking based on the use mix, and establishing parking maximums where sites are located within 0.25 miles of a public transit stop;

2.1.1.5 Allowing for tandem parking, shared parking and off-site parking leases;

[2] FAR is Floor Area Ratio

2.1.1.6 Requiring all property owners in mixed-use areas to unbundle parking from commercial and residential leases;

2.1.1.7 Creating parking benefit districts, which invest meter revenues in pedestrian infrastructure and other public amenities;

2.1.1.8 Establishing performance pricing of street parking, so that it is expensive enough to promote frequent turnover and keep 15 percent of spaces empty at all times.

2.1.2 The City/County will seek funding to prepare specific plans and related environmental documents to facilitate mixed-use development at selected sites, and to allow these areas to serve as receiver sites for transfer of development rights away from environmentally sensitive lands and rural areas outside established urban growth boundaries.

2.1.3 The City/County will enable prototype mixed-use structures for use in neighborhood center zones that can be adapted to new uses over time with minimal internal remodeling.

2.1.4 The City/County will identify and facilitate the inclusion of complementary land uses not already present in local zoning districts, such as supermarkets, parks and recreational fields, schools in neighborhoods, and residential uses in business districts, to reduce the vehicle miles traveled and promote bicycling and walking to these uses.

EMPHASIS OF DEVELOPMENT

USE	COMMERCIAL	OFFICE	RESIDENTIAL
Retail	50-70%	10-30%	10-30%
Office	0-20%	50-70%	0-30%
Residential	20-40%	0-30%	50-80%
Public	10-30%	10-30%	10-30%

2.1.5 The City/County will work with employers developing larger projects to ensure local housing opportunities for their employees, and engage employers to find ways to provide housing assistance as part of their employee benefits packages; major projects in mixed-use areas should include work-force housing where feasible.

2.1.6 The City/County will revise zoning ordinance(s) to allow local-serving businesses, such as childcare centers, restaurants, banks, family medical offices, drug stores, and other similar services near employment centers to minimize midday vehicle use.

2.1.7 The City / County will develop form-based community design standards to be applied to development projects and land use plans, using a comprehensive community outreach, for areas designated mixed-use

2.1.8 Mix affordable housing units with market rate units as opposed to building segregated affordable housing developments.

Objective LU-3: Promote greater linkage between land uses and transit, as well as other modes of transportation.

LU-3.1 **Transit-Supportive Density:** The City/County will implement a Housing Overlay Zone for transit centers and corridors. This shall include average minimum residential densities of 25 units per acre within one quarter mile of transit centers; average minimum densities of 15 units per acre within one quarter mile of transit corridors; and minimum FAR of 0.5:1 for non-residential uses within a quarter mile of transit centers or corridors.

LU-3.2 **Transit-Oriented Development:** The City/County will identify transit centers appropriate for mixed-use development, and will promote transit-oriented, mixed use development within these targeted areas, including:

3.2.1 Amending the Development Code to encourage mixed-use development within one-half mile of intermodal hubs and future rail stations; to offer flexible standards for affordable housing; and to establish minimum residential densities and non-residential FAR;

3.2.2 Rezoning commercial properties to residential and/or mixed-use where appropriate;

3.2.3 Providing expanded zoning for multi-family housing;

3.2.4 Providing maximum parking standards and flexible building height limitations;

3.2.5 Providing density bonus programs;

3.2.6 Establishing guidelines for private and public spaces;

3.2.7 Providing incentives for redevelopment of underutilized areas, such as surface parking lots;

3.2.8 Establishing a minimum pedestrian and bicycle connectivity standard;

3.2.9 Creating parking benefit districts, which invest meter revenues in pedestrian infrastructure and other public amenities;

3.2.10 Establishing performance pricing of street parking, so that it is expensive enough to promote frequent turnover and keep 15 percent of spaces empty at all times;

3.2.11 Discouraging auto-oriented development.

LU-3.3 Transit-oriented Brownfield Development: The City/County will promote the development of brownfield sites and other underused or defunct properties near existing public transportation.

LU-3.4 Public Transit Development Focus: The City/County will ensure new development is designed to make public transit a viable choice for residents, including:

3.4.1 Locating medium-high density development near activity centers that can be served efficiently by public transit and alternative transportation modes;

3.4.2 Locating medium-high density development near streets served by public transit whenever feasible;

3.4.3 Linking neighborhoods to bus stops by continuous sidewalks or pedestrian paths.

LU-3.5 City-centered Corridors: The City/County will establish city-centered corridors, directing development to existing transportation corridors.

LU-3.6 Transit-oriented Development Design Standards: The City / County will develop form-based community design standards to be applied to development projects and land use plans, using a comprehensive community outreach program, for areas designated mixed-use *(suggestion: check language with FBCI*[3]*)*

LU-3.7 Affordable Housing: Affordable housing will be located in transit-oriented development whenever feasible.

Objective LU-4: Promote development and preservation of neighborhood characteristics that encourage walking and bicycle riding in lieu of automobile-based travel.

LU-4.1 Pedestrian-oriented Character: The City/County will create and preserve distinct, identifiable neighborhoods whose characteristics support pedestrian travel, especially within, but not limited to, mixed-use and transit-oriented development areas, including:

[3] FBCI is the Form-Based Codes Institute

4.1.1 Designing or maintaining neighborhoods where the neighborhood center can be reached in approximately five minutes of walking;

4.1.2 Increasing housing densities from the perimeter to the center of the neighborhood;

4.1.3 Directing retail, commercial, and office space to the center of the neighborhood;

4.1.4 Encouraging pedestrian-only streets and/or plazas within developments, and destinations that may be reached conveniently by public transportation, walking, or bicycling;

4.1.5 Allowing flexible parking strategies in neighborhood activity centers to foster a pedestrian-oriented streetscape;

4.1.6 Providing continuous sidewalks with shade trees and landscape strips to separate pedestrians from traffic;

4.1.7 Encouraging neighborhood parks and recreational centers near concentrations of residential areas (preferably within one quarter mile) and include pedestrian walkways and bicycle paths that encourage non-motorized travel.

LU-4.2 Pedestrian Access: The City/County will ensure pedestrian access to activities and services, especially within, but not limited to, mixed-use and transit-oriented development areas, including:

4.2.1 Ensuring new development that provides pedestrian connections in as many locations as possible to adjacent development, arterial streets, thoroughfares;

4.2.2 Ensuring a balanced mix of housing, workplaces, shopping, recreational opportunities, and institutional uses, including mixed-use structures;

4.2.3 Locating schools in neighborhoods, within safe and easy walking distances of residences served;

4.2.4 For new development, primary entrances shall be pedestrian entrances, with automobile entrances and parking located to the rear;

4.2.5 Support development where automobile access to buildings does not impede pedestrian access, by consolidating driveways between buildings or developing alley access;

4.2.6 Street parking provided shall be utilized as a buffer between sidewalk pedestrian traffic and the automobile portion of the roadway;

4.2.7 Establish pedestrian and bicycle connectivity standards for new development, with block sizes between 1 and 2 acres;

4.2.8 For existing areas that do not meet established connectivity standards, prioritize the physical development of pedestrian connectors;

4.2.9 Prioritizing grade-separated bicycle / pedestrian crossings where appropriate to enhance connectivity or overcome barriers such as freeways, railways and waterways.

Objective LU-5: Review fee structures and other opportunities to provide financial and administrative incentives to support desired land uses, development patterns, and alternative modes of transportation.

LU-5.1 Developer Fees: The City/County will promote desired land uses by scaling developer fees based on desired criteria, for example:

5.1.1 Increasing or reducing fees proportionally with distance from the city center or preferred transit sites;

5.1.2 Increasing or reducing fees based on the degree to which mixed uses are incorporated into the project;

5.1.3 Reducing fees for creative re-use of brownfield sites;

5.1.4 Increasing fees for the use of greenfield sites.

LU-5.2 Administrative Fees and Streamlining: The City/County will provide fast-track permitting and reductions in processing fees for desired projects. The City/County will research and implement a program of incentives for development projects that are fully consistent with the Sustainable Communities Strategy / Regional Plan.

LU-5.3 Incentives and Loans: The City/County will provide incentive funding and/or infrastructure loans to support desired projects.

LU-5.4 Infrastructure Preference: The City/County will give preference for infrastructure improvements that support or enhance desired land uses and projects.

Objective LU-6: The City/County will mitigate climate change by decreasing heat gain from pavement and other hard surfaces associated with infrastructure.

LU-6.1 Hardscape Heat Gain: The City/County will reduce heat gain from pavement and other hardscaping, including:

6.1.1 Reduce street rights-of-way and pavement widths to pre-World War II widths (typically 22 to 34 feet for local streets, and 30 to 35 feet for collector streets, curb to curb), unless landscape medians or parkway strips are allowed in the center of roadways;

6.1.2 Reinstate the use of parkway strips to allow shading of streets by trees;

6.1.3 Include shade trees on south- and west-facing sides of structures;

6.1.4 Include low-water landscaping in place of hardscaping around transportation infrastructure and in parking areas;

6.1.5 Install cool roofs, green roofs, and use cool paving for pathways, parking, and other roadway surfaces;

6.1.6 Establish standards that provide for pervious pavement options;

6.1.7 Remove obstacles to xeriscaping, edible landscaping and low-water landscaping.

Transportation Policies

Goal: Reduce GHG emissions by reducing vehicle miles traveled and by increasing or encouraging the use of alternative fuels and transportation technologies.

Objective TR-1: The City/County will reduce VMT-related emissions by encouraging the use of public transit through adoption of new development standards that will require improvements to the transit system and infrastructure, increase safety and accessibility, and provide other incentives.

TR-1.1 Transportation Planning: The City/County will ensure that new developments incorporate both local and regional transit measures into the project design that promote the use of alternative modes of transportation.

TR-1.1.1 Project Selection: The City / County shall give priority to transportation projects that will contribute to a reduction in vehicle miles traveled per capita, while maintaining economic vitality and sustainability.

TR-1.1.2 Equal Pedestrian Access: The City / County shall include sidewalks, separated sidewalks whenever possible, on both sides of all new street improvement projects, except where there are severe topographic or natural resource constraints.

TR-1.1.3 Public Involvement: Carry out a comprehensive public involvement and input process that provides information about transportation issues, projects, and processes to community members and other stakeholders, especially to those traditionally underserved by transportation services.

TR-1.2 System Interconnectivity: The City/County will create an interconnected transportation system that allows a shift in travel from private passenger vehicles to alternative modes, including public transit, ride sharing, car-sharing, bicycling and walking.

1.2.1 Ensure transportation centers are multi-modal to allow transportation modes to intersect;

1.2.2 Provide adequate and affordable public transportation choices, including expanded bus routes and service, as well as other transit choices such as shuttles, light rail, and rail;

1.2.3 To the extent feasible, extend service and hours of operation to underserved arterials and population centers or destinations such as colleges;

1.2.3A Focus transit resources on high-volume corridors and high-boarding destinations such as colleges, employment centers and regional destinations;

1.2.4 Coordinate schedules and routes across service lines with neighboring transit authorities;

1.2.5 Support programs to provide “station cars” for short trips to and from transit nodes (e.g., neighborhood electric vehicles);

1.2.6 Study the feasibility of providing free transit to areas with residential densities of 15 dwelling units per acre or more, including options such as removing service from less dense, underutilized areas to do so;

1.2.7 Employ transit-preferential measures, such as signal priority and bypass lanes. Where compatible with adjacent land use designations, right-of-way acquisition or parking removal may occur to accommodate transit-preferential measures or improve access to transit. The use of access management should be considered where needed to reduce conflicts between transit vehicles and other vehicles;

1.2.8 Provide safe and convenient access for pedestrians and bicyclists to, across, and along major transit priority streets;

1.2.9 Use park-and-ride facilities to access transit stations only at ends of regional transitways or where adequate feeder bus service is not feasible.

TR-1.3 Transit System Infrastructure: The City/County will upgrade and maintain transit system infrastructure to enhance public use, including:

1.3.1 Ensure transit stops and bus lanes are safe, convenient, clean and efficient;

1.3.2 Ensure transit stops have clearly marked street-level designation, and are accessible;

1.3.3 Ensure transit stops are safe, sheltered, benches are clean, and lighting is adequate;

1.3.4 Place transit stations along transit corridors within mixed-use or transit-oriented development areas at intervals of three to four blocks, or no less than one-half mile.

TR-1.4 Customer Service: The City/County will enhance customer service and system ease-of-use, including:

1.4.1 Develop a Regional Pass system to reduce the number of different passes and tickets required of system users;

1.4.2 Implement "Smart Bus" technology, using GPS and electronic displays at transit stops to provide customers with "real-time" arrival and departure time information (and to allow the system operator to respond more quickly and effectively to disruptions in service);

1.4.3 Investigate the feasibility of an on-line trip planning program.

TR-1.5 Transit Funding: The City/County will prioritize transportation funding to support a shift from private passenger vehicles to transit and other modes of transportation, including:

1.5.1 Give funding preference to improvements in public transit over other new infrastructure for private automobile traffic;

1.5.2 Before funding transportation improvements that increase roadway capacity and VMT, evaluate the feasibility and effectiveness of funding projects that support alternative modes of transportation and reduce VMT, including transit, and bicycle and pedestrian access.

TR-1.6 Transit and Multimodal Impact Fees: The City/County will assess transit and multimodal impact fees on new developments to fund public transportation infrastructure, bicycle infrastructure, pedestrian infrastructure and other multimodal accommodations.

Objective TR-2: The City/County will implement traffic and roadway management strategies to improve mobility and efficiency, and reduce associated emissions.

TR-2.1 System Monitoring: The City/County will monitor traffic and congestion to determine when and where the city needs new transportation facilities in order to increase access and efficiency.

TR-2.2 Arterial Traffic Management: The City/County will modify arterial roadways to allow more efficient bus operation, including bus lanes and signal priority/ preemption where necessary.

TR-2.3 Signal Synchronization: The City/County will expand signal timing programs where emissions reduction benefits can be demonstrated, including maintenance of the synchronization system, and will coordinate with adjoining jurisdictions as needed to optimize transit operation while maintaining a free flow of traffic.

TR-2.4 HOV Lanes: The City/County will encourage the construction of high-occupancy vehicle (HOV) lanes or similar mechanisms whenever necessary to relieve congestion and reduce emissions.

TR-2.5 Delivery Schedules: The City/County will establish ordinances or land use permit conditions limiting the hours when deliveries can be made to off-peak hours in high traffic areas.

Objective TR-3: The City/County will reduce VMT related-emissions by implementing and supporting trip reduction programs.

TR-3.1 Ride-Share Programs: The City/County will promote ride sharing programs, including:

3.1.1 Designate a certain percentage of parking spaces for ride-sharing vehicles;

3.1.2 Designate adequate passenger loading, unloading, and waiting areas for ride-sharing vehicles;

3.1.3 Provide a web site or message board for coordinating shared rides;

3.1.4 Encourage private, for-profit community car-sharing, including parking spaces for car share vehicles at convenient locations accessible by public transit;

3.1.5 Hire or designate a rideshare coordinator to develop and implement ridesharing programs.

TR-3.2 Employer-based Trip Reduction: The City/County will support voluntary, employer-based trip reduction programs, including:

3.2.1 Provide assistance to regional and local ridesharing organizations;

3.2.2 Advocate for legislation to maintain and expand incentives for employer ridesharing programs;

3.2.3 Require the development of Transportation Management Associations for large employers and commercial/ industrial complexes;

3.2.4 Provide public recognition of effective programs through awards, top ten lists, and other mechanisms.

TR-3.3 Ride Home Programs: The City/County will implement a city/county wide "guaranteed ride home" program for those who commute by public transit, ride-sharing, or other modes of transportation, and encourage employers to subscribe to or support the program.

TR-3.4 Local Area Shuttles: The City/County will encourage and utilize shuttles to serve neighborhoods, employment centers and major destinations.

3.4.1 The City/County will create a free or low-cost local area shuttle system that includes a fixed route to popular tourist destinations or shopping and business centers;

3.4.2 The City/County will work with existing shuttle service providers to coordinate their services.

TR-3.5 Low- and No-Travel Employment Opportunities: The City/County will facilitate employment opportunities that minimize the need for private vehicle trips, including:

3.5.1 Amend zoning ordinances and the Development Code to include live/work sites and satellite work centers in appropriate locations;

3.5.2 Encourage telecommuting options with new and existing employers, through project review and incentives, as appropriate.

TR-3.6 Congestion Pricing: Advocate for a regional, market-based system to price or charge for auto trips during peak hours

Objective TR-4: The City/County will support bicycle use as a mode of transportation by enhancing infrastructure to accommodate bicycles and riders, and providing incentives.

TR-4.1 Development Standards for Bicycles: The City/County will establish standards for new development and redevelopment projects to support bicycle use, including:

4.1.1 Amending the Development Code to include standards for safe pedestrian and bicyclist accommodations, including:

4.1.1.1 “Complete Streets” policies that foster equal access by all users in the roadway design;

4.1.1.2 Bicycle and pedestrian access internally and in connection to other areas through easements;

4.1.1.3 Safe access to public transportation and other non-motorized uses through construction of dedicated paths;

4.1.1.4 Safe road crossings at major intersections, especially for school children and seniors;

4.1.1.5 Adequate, convenient and secure bike parking at public and private facilities and destinations in all urban areas;

4.1.1.6 Street standards will include provisions for bicycle parking within the public right of way;

4.1.2 Require new development and redevelopment projects to include bicycle facilities, as appropriate with the new land use, including:

4.1.2.1 Construction of weatherproof bicycle facilities where feasible, and at a minimum, bicycle racks or covered, secure parking near the building entrances;

4.1.2.2 Provision and maintenance of changing rooms, lockers, and showers at large employers or employment centers.

4.1.3 Prohibit projects that impede bicycle and pedestrian access, such as large parking areas that cannot be safely crossed by non-motorized vehicles, and developments that block through access on existing or potential bicycle and pedestrian routes;

4.1.4 Encourage the development of bicycle stations at intermodal hubs, with attended or "valet" bicycle parking, and other amenities such as bicycle rental and repair, and changing areas with lockers and showers;

4.1.5 Conduct a connectivity analysis of the existing bikeway network to identify gaps, and prioritize bikeway development where gaps exist.

TR-4.2 **Bicycle and Pedestrian Trails:** The City/County will establish a network of multi-use trails to facilitate safe and direct off-street bicycle and pedestrian travel, and will provide bike racks along these trails at secure, lighted locations.

TR-4.3 **Bicycle Safety Program:** The City/County will develop and implement a bicycle safety educational program to teach drivers and riders the laws, riding protocols, routes, safety tips, and emergency maneuvers.

TR-4.4 **Bicycle and Pedestrian Project Funding:** The City/County will pursue and provide enhanced funding for bicycle and pedestrian facilities and access projects, including, as appropriate:

4.4.1 Apply for regional, State, and federal grants for bicycle and pedestrian infrastructure projects;

4.4.2 Establish development exactions and impact fees to fund bicycle and pedestrian facilities;

4.4.3 Use existing revenues, such as state gas tax subventions, sales tax funds, and general fund monies for projects to enhance bicycle use and walking for transportation.

TR-4.5 Bicycle Parking: Adopt bicycle parking standards that ensure bicycle parking sufficient to accommodate 5 to 10% of projected use at all public and commercial facilities, and at a rate of at least one per residential unit in multiple-family developments *(suggestion: check language with League of American Bicyclists).*

Objective TR-5: The City/County will establish parking policies and requirements that capture the true cost of private vehicle use and support alternative modes of transportation.

TR-5.1 Parking Policy: The City/County will adopt a comprehensive parking policy to discourage private vehicle use and encourage the use of alternative transportation, including:

5.1.1 Reduce the available parking spaces for private vehicles while increasing parking spaces for shared vehicles, bicycles, and other alternative modes of transportation;

5.1.2 Eliminate or reduce minimum parking requirements for new buildings;

5.1.3 "Unbundle" parking (require that parking is paid for separately and is not included in the base rent for residential and commercial space);

5.1.4 Use parking pricing to discourage private vehicle use, especially at peak times;

5.1.5 Create parking benefit districts, which invest meter revenues in pedestrian infrastructure and other public amenities;

5.1.6 Establish performance pricing of street parking, so that it is expensive enough to promote frequent turnover and keep 15 percent of spaces empty at all times;

5.1.7 Encourage shared parking programs in mixed-use and transit-oriented development areas.

TR-5.2 Event Parking Policies: The City/County will establish policies and programs to reduce onsite parking demand and promote ride-sharing and public transit at large events, including:

5.2.1 Promote the use of peripheral parking by increasing on-site parking rates and offering reduced rates for peripheral parking;

5.2.2 Encourage special event center operators to advertise and offer discounted transit passes with event tickets;

5.2.3 Encourage special event center operators to advertise and offer discount parking incentives to carpooling patrons, with four or more persons per vehicle for on-site parking;

5.2.4 Promote the use of bicycles by providing space for the operation of valet bicycle parking service.

TR-5.3 Parking "Cash-out" Program: The City/County will require new office developments with more than 50 employees to offer a Parking "Cash-out" Program to discourage private vehicle use.

TR-5.4 Electric/Alternative Fuel Vehicle Parking: The City/County will require new commercial and retail developments to provide prioritized parking for electric vehicles and vehicles using alternative fuels.

Objective TR-6: The City/County will support and promote the use of low- and zero-emission vehicles, and alternative fuels, and other measures to directly reduce emissions from motor vehicles.

TR-6.1 Low and Zero Emission Vehicles: The City/County will support and promote the use of low- and zero-emission vehicles, including:

6.1.1 Develop the necessary infrastructure to encourage the use of zero-emission vehicles and clean alternative fuels, such as development of electric vehicle charging facilities and conveniently located alternative fueling stations;

6.1.2 Encourage new construction to include vehicle access to properly wired outdoor receptacles to accommodate ZEV and/or plug in electric hybrids (PHEV);

6.1.3 Encourage transportation fleet standards to achieve the lowest emissions possible, using a mix of alternate fuels, PZEV or better fleet mixes;

6.1.4 Establish incentives, as appropriate, to taxicab owners to use alternative fuel or gas-electric hybrid vehicles.

TR-6.2 **Vehicle Idling:** The City/County will enforce State idling laws for commercial vehicles, including delivery and construction vehicles.

Energy Efficiency Policies

Goal: Reduce emissions from the generation of electricity by reducing electricity use through increased efficiency.

Objective EE-1 The City/County will establish green building requirements and standards for new development and redevelopment projects, and will work to provide incentives for green building practices and remove barriers that impede their use.

EE-1.1 Green Building Ordinance: The City/County will adopt a Green Building Ordinance that requires new development and redevelopment projects for both residential and commercial buildings to incorporate sufficient green building methods and techniques to qualify for the equivalent of a current LEED Certified rating, GreenPoints, or equivalent rating system.

EE-1.2 Green Building Flexibility: The City/County will allow increased height limits and/or flexibility in other standards for projects that incorporate energy efficient green building practices.

EE-1.3 Green Building Barriers: The City/County will identify and remove regulatory or procedural barriers to implementing green building practices within its jurisdiction, such as updating codes, guidelines, and zoning, and will ensure that all plan review and building inspection staff are trained in green building materials, practices, and techniques.

EE-1.4 Green Building Incentives: The City/County will support the use of green building practices by:

1.4.1 Providing information, marketing, training, and technical assistance about green building practices;

1.4.2 Establishing guidelines for green building practices in residential and commercial development;

1.4.3 Providing financial incentives, including reduction in development fees, administrative fees, and expedited permit processing for projects that use green building practices.

Objective EE-2 The City/County will establish policies and standards to increase energy efficiency at new developments.

EE-2.1 Improved Building Standards: The City/County will adopt energy efficiency performance standards for buildings that achieve a greater reduction in energy and water use than otherwise required by state law, including:

2.1.1 Standards for the installation of “cool roofs”;

2.1.2 Performance standards for heat transfer across the building envelope that result in increased insulation and the use of low-emissive windows;

2.1.3 Requirements to install high-efficiency plumbing fixtures and tankless water heaters;

2.1.4 Performance standards that specify high-efficiency space heating and cooling systems;

2.1.5 Requirements for improved overall efficiency of lighting systems;

2.1.6 Requirements for the use of Energy Star® appliances and fixtures in discretionary new development;

2.1.7 New lots shall be arranged and oriented to maximize effective use of passive solar energy.

EE-2.2 Affordable Housing Energy Efficiency: Affordable housing development shall incorporate energy efficient design and features to the maximum extent feasible.

2.2.1 The City/County will target local funds, including redevelopment and community development block grant resources, to assist affordable housing developers in meeting the energy efficiency requirements.

EE-2.3 Outdoor Lighting: The City/County will establish outdoor lighting standards in the Zoning Ordinance, including:

2.3.1 Requirements that all outdoor lighting fixtures be energy efficient, such as:

2.3.1.1 Full cut-off light fixtures at parking lots and on buildings;

2.3.1.2 Photocells or astronomical time switches on all permanently installed exterior lighting;

2.3.1.3 Directional and shielded LED lights for exterior lighting *(for example, see: www.nightwise.org)*, and install exterior and security lights with motion detectors.

2.3.2 Requirements that light levels in all new development, parking lots, and street lighting not exceed state standards;

2.3.3 Requirements that lighting at the urban-rural boundary be designed to provide one-half the light standard for urban areas;

2.3.4 Prohibition against continuous all-night outdoor lighting in sports stadiums, construction sites, and rural areas unless required for security reasons.

EE-2.4 Residential Wood Burning: The City/County will establish or enhance local ordinances that prohibit solid fuel wood-burning devices in mixed-use high-density development and restrict the installation of wood-burning appliances in new or redeveloped single family residential properties to those that burn pellets, natural gas, or propane, or at a minimum, EPA certified wood-burning units.

Objective EE-3: The City/County will establish policies and standards to reduce exterior heat gain and heat island effects.

EE-3.1 Exterior Heat Gain: The City/County will establish standards for new development and for large redevelopment or rehabilitation (for example, additions of more than 25,000 square feet commercial or 100,000 square feet industrial), to reduce exterior heat gain for 50% of non-roof impervious site landscape (roads, sidewalks, courtyards, parking lots, and driveways), including:

3.1.1 Achieving 50% paved surface shading with vegetation within 5 years, in consultation with city/county arborist;

3.1.2 Use of paving materials with a Solar Reflective Index (SRI) of at least 29, or open grid paving systems;

3.1.3 Covered parking (underground, beneath decking or roofs, or beneath a building), where any roof-covered parking uses roofing material with SRI of at least 29.

EE-3.2 Heat Island Mitigation: The City/County will adopt a Heat Island Mitigation Plan that requires cool roofs, cool pavements, and strategically placed shade trees, and will actively inspect and enforce state requirements for cool roofs on non-residential re-roofing projects.

Objective EE-4: The City/County will pursue policies and programs to improve energy efficiency of existing buildings.

EE-4.1 Energy Audits: The City/County will require the performance of energy audits for residential and commercial buildings prior to completion of sale, and that audit results and information about opportunities for energy efficiency improvements be presented to the buyer.

EE-4.2 Energy Efficiency Funding: The City/County will pursue incentives, grants, and creative financing for projects that improve energy efficiency, including, for example, the option for property owners to pay for such improvements through long-term assessments on their property tax bills.

EE-4.3 Community Energy Program: The City/County will implement an outreach and incentive program to promote energy efficiency and conservation in the community, including:

4.3.1 Launch an "energy efficiency challenge" campaign for community residents;

4.3.2 Implement a low-income weatherization assistance program;

4.3.3 Implement conservation campaigns specifically targeted to residents, and separately to businesses;

4.3.4 Promote the purchase of Energy Star® appliances, including, where feasible, incentive grants and vouchers;

4.3.5 Promote participation in the local "Green Business" program;

4.3.6 Distribute free CFL bulbs or other efficiency fixtures to community members;

4.3.7 Offer exchange programs for high-energy-use items, such as halogen torchiere lamps;

4.3.8 Adopt an ordinance requiring energy upgrades at time of property sale.

Alternative Energy Policies

Goal: The City/County will seek to reduce emissions associated with electrical generation by promoting and supporting the generation and use of alternative energy.

Objective AE-1: The City/County will establish policies and programs that facilitate the siting of new renewable energy generation.

AE-1.1 Site Designation: The City/County will identify possible sites for production of renewable energy (such as solar, wind, small hydro, and biogas), as compatible with surrounding uses, and will protect and promote that use, including:

1.1.1 Designate suitable sites to prioritize their development for renewable energy generation;

1.1.2 Evaluate potential land use, environmental, economic, and other constraints on that use, and mitigate such constraints, as feasible;

1.1.3 Adopt measures to protect the renewable energy use of the sites and their resources, such as utility easements, rights-of-way, and land set-asides.

AE-1.2 Removing Barriers: The City/County will identify and remove or otherwise address barriers to renewable energy production, including:

1.2.1 Review and revise building and development codes, design guidelines, and zoning ordinances to remove such barriers;

1.2.2 Work with related agencies, such as fire, water, health and others that may have policies or requirements that adversely impact the development or use of renewable energy technologies;

1.2.3 Develop protocols for safe storage of renewable and alternative energy products with the potential to leak, ignite or explode, such as biodiesel, hydrogen, and/or compressed air.

AE-1.3 Zoning Flexibility: The City/County will allow renewable energy projects in areas zoned for open space, where consistent with the Open Space element, and other uses and values.

Objective AE-2 The City/County will promote and require renewable energy generation, and co-generation projects where feasible and appropriate.

AE-2.1 On-site Renewable Energy Generation: The City/County will require that new office/retail/commercial or industrial development, or major rehabilitation (e.g., additions of 25,000 square feet commercial, or 100,000 square feet industrial) incorporate renewable energy generation either on- or off-site to provide 15% or more of the project's energy needs.

AE-2.2 Co-generation Projects: The City/County will promote and encourage co-generation projects for commercial and industrial facilities, provided they meet all applicable air quality standards and provide a net reduction in GHG emissions associated with energy production.

AE-2.3 Green Utilities: The City/County will promote and support green utilities, and will evaluate the creation of a locally or regionally owned green utility, perhaps in coordination with other regional strategies.

Objective AE-3: The City/County will promote, support, and require, as appropriate, the development of solar energy.

AE-3.1 Solar-ready Buildings: The City/County will require that, where feasible, all new buildings be constructed to allow for easy, cost-effective installation of solar energy systems in the future, using such "solar-ready" features as:

3.1.1 Designing the building to include optimal roof orientation (between 20 to 55 degrees from the horizontal), with sufficient south-sloped roof surface;

3.1.2 Clear access without obstructions (chimneys, heating and plumbing vents, etc.) on the south sloped roof;

3.1.3 Designing the roof framing to support the addition of solar panels;

3.1.4 Installation of electrical conduit to accept solar electric system wiring;

3.1.5 Installation of plumbing to support a solar hot water system and provision of space for a solar hot water storage tank.

AE-3.2 Solar Homes Partnership: The City/County will require that residential projects of 6 units or more participate in the California Energy Commission's New Solar Homes Partnership, which provides rebates to developers who offer solar power in at least 50% of new units, or a program with similar provisions.

AE-3.3 Passive Solar Design: The City/County will require that any building constructed in whole or in part with City/County funds incorporate passive solar design features, such as daylighting and passive solar heating, where feasible.

AE-3.4 Protection of Solar Elements: The City/County will protect active and passive solar design elements and systems from shading by neighboring structures and trees, as consistent with existing tree shading requirements.

Objective AE-4: The City/County will pursue and provide economic incentives and creative financing for renewable energy projects, as well as other support for community members or developers seeking funding for such projects.

AE-4.1 Renewable Energy Incentives: The City/County will provide, where possible, grants, rebates, and incentives for renewable energy projects, including reduced fees and expedited permit processing.

AE-4.2 Creative Financing: The City/County will provide, where feasible, creative financing for renewable energy projects, including subsidized or other low-interest loans, and the option to pay for system installation through long-term assessments on individual property tax bills.

AE-4.3 Partnerships: The City/County will pursue partnerships with other governmental entities and with private companies and utilities to establish incentive programs for renewable energy.

AE-4.4 Information and Support: The City/County will establish and maintain a clearinghouse of information on available funding alternatives for renewable energy projects, rates of return, and other information to support developers and community members interested in pursuing renewable energy projects.

Objective AE-5: The City/County will implement measures to support the purchase and use of renewable and alternative energy.

AE-5.1 Green Electricity Purchasing: The City/County will establish targets for the purchase of renewable energy, in excess of the state Renewable Portfolio Standards, using such mechanisms as green tags or renewable energy certificates.

AE-5.2 Community Choice Aggregation: The City/County will evaluate the feasibility and effectiveness of using Community Choice Aggregation as a model for providing renewable energy to meet the community's electricity needs, including potential partnerships with other jurisdictions.

Municipal Operations Policies

Goal: Reduce GHG emissions from municipal facilities and operations, and by purchasing goods and services that embody or create fewer GHG emissions.

Objective MO-1: The City/County will enhance the energy efficiency of its facilities.

MO-1.1 Energy Efficiency Plan: The City/County will prepare and implement a comprehensive plan to improve energy efficiency of municipal facilities, including:

1.1.1 Conduct energy audits for all municipal facilities;

1.1.2 Retrofit facilities for energy efficiency where feasible and when remodeling or replacing components, including increased insulation, installing green or reflective roofs and low-emissive window glass;

1.1.3 Implement an energy tracking and management system;

1.1.4 Install energy-efficient exit signs, street signs, and traffic lighting;

1.1.5 Install energy-efficient lighting retrofits and occupancy sensors, and institute a "lights out at night" policy;

1.1.6 Retrofit heating and cooling systems to optimize efficiency (e.g., replace chillers, boilers, fans, pumps, belts, etc.);

1.1.7 Install Energy Star® appliances and energy-efficient vending machines;

1.1.8 Improve efficiency of water pumping and use at municipal facilities, including a schedule to replace or retrofit system components with high-efficiency units (i.e., ultra-low-flow toilets, fixtures, etc.);

1.1.9 Provide chilled, filtered water at water fountains and taps in lieu of bottled water;

1.1.10 Install a central irrigation control system and time its operation for off-peak use;

1.1.11 Adopt an accelerated replacement schedule for energy inefficient systems and components.

MO-1.2 Efficiency Requirement for New Facilities: The City/County will require that any newly constructed, purchased, or leased municipal space meet minimum standards as appropriate, such as:

1.2.1 Requirements for new commercial buildings to meet LEED criteria established by the U.S. Green Building Council;

1.2.2 Requirements for new residential buildings to meet criteria of the Energy Star® New Homes Program established by U.S. EPA;

1.2.3 Incorporation of passive solar design features in new buildings, including daylighting and passive solar heating;

1.2.4 Retrofitting of existing buildings to meet standards under Title 24 of the California Building Energy Code, or to achieve a higher performance standard as established by the City/County;

1.2.5 Retrofitting of existing buildings to decrease heat gain from non-roof impervious surfaces with cool paving, landscaping, and other techniques.

MO-1.3 Training & Support: The City/County will ensure that staff receives appropriate training and support to implement objectives and policies to reduce GHG emissions, including:

1.3.1 Provide energy efficiency training to design, engineering, building operations, and maintenance staff;

1.3.2 Provide information on energy use and management, including data from the tracking and management system, to managers and others making decisions that influence energy use;

1.3.3 Provide energy design review services to departments undertaking new construction or renovation projects, to facilitate compliance with LEED standards.

Objective MO-2: The City/County will improve efficiency at municipal systems and reduce GHG emissions from vehicle and equipment engines.

MO-2.1 Wastewater System Efficiency: The City/County will maximize efficiency of wastewater treatment and pumping equipment.

MO-2.2 Drinking Water System Efficiency: The City/County will maximize efficiency at drinking water treatment, pumping, and distribution facilities, including development of off-peak demand schedules for heavy commercial and industrial users.

MO-2.3 Fleet Replacement: The City/County will establish a replacement policy and schedule to replace fleet vehicles and equipment with the most fuel-efficient vehicles practical, including gasoline hybrid and alternative fuel or electric models.

MO-2.4 Small Tools and Equipment: Install outdoor electrical outlets on buildings to support the use of electric lawn and garden equipment, and other tools that would otherwise be run with small gas engines or portable generators.

Objective MO-3: The City/County will implement measures to reduce employee vehicle trips and to mitigate emissions impacts from municipal travel.

MO-3.1 Trip Reduction Program: The City/County will implement a program to reduce vehicle trips by employees, including:

3.1.1 Providing incentives and infrastructure for vanpooling and carpooling, such as pool vehicles, preferred parking, and a website or bulletin board to facilitate ride-sharing;

3.1.2 Providing subsidized passes for mass transit;

3.1.3 Offering compressed work hours, off-peak work hours, and telecommuting, where appropriate;

3.1.4 Offer a guaranteed ride home for employees who use alternative modes of transportation to commute.

MO-3.2 Bicycle Transportation Support: The City/County will promote and support the use of bicycles as transportation, including:

3.2.1 Providing bicycle stations with secure, covered parking, changing areas with storage lockers and showers, as well as a central facility where minor repairs can be made;

3.2.2 Providing bicycles, including electric bikes, for employees to use for short trips during business hours;

3.2.3 Implementing a police-on-bicycles program;

3.2.4 Providing a bicycle safety program, and information about safe routes to work.

MO-3.3 Municipal Parking Management: The City/County will implement a Parking Management Program to discourage private vehicle use, including:

3.3.1 Encouraging carpools and vanpools with preferential parking and a reduced parking fee;

3.3.2 Institute a parking cash-out program;

3.3.3 Renegotiate employee contracts, where possible, to eliminate parking subsidies;

3.3.4 Install on-street parking meters with fee structures designed to discourage private vehicle use;

3.3.5 Establish a parking fee for all single-occupant vehicles.

MO-3.4 Travel Mitigation: The City/County will mitigate business-related travel, especially air travel, through the annual purchase of verified carbon offsets.

MO-3.5 Transit Access to Municipal Facilities: Municipal employment and service facilities shall be located on major transit corridors, unless their use is plainly incompatible with other uses located along major transit corridors.

Objective MO-4: The City/County will enhance renewable energy generation, and implement programs for load management and demand response.

MO-4.1 Load Management and Demand Response: The City/County will design and implement peak load management and demand response programs for water pollution control, supply and treatment, and distribution, including interface with existing automated systems for building energy management and SCADA systems.

MO-4.2 Renewable Energy Installation: The City/County will install renewable energy systems at its facilities where feasible, including:

4.2.1 Solar collection systems on municipal roofs;

4.2.2 Solar water heating for municipal pools;

4.2.3 Waste-to-energy systems at waste handling operations.

Objective MO-5: The City/County will manage its stock of vegetation to reduce GHG emissions.

MO-5.1 Urban Tree Management: The City/County will conduct a comprehensive inventory and analysis of the urban forest, and coordinate tree maintenance responsibilities with all responsible departments, consistent with best management practices.

MO 5.2 Landscaping: The City/County will evaluate existing landscaping and options to convert reflective and impervious surfaces to landscaping, and will install or replace vegetation with drought-tolerant, low-maintenance native species or edible landscaping that can also provide shade and reduce heat-island effects.

Objective MO-6: The City/County will use its purchasing power to promote reductions in GHG emissions by the suppliers of its goods and services.

MO-6.1 Purchasing Practices: The City/County will adopt purchasing practices and standards to support reductions in GHG emissions, including preferences for energy-efficient office equipment, and the use of recycled materials and manufacturers that have implemented green management practices.

MO-6.2 Contracting Practices: The City/County will establish bidding standards and contracting practices that encourage GHG emissions reductions, including preferences or points for the use of low or zero emission vehicles and equipment, recycled materials, and provider implementation of other green management practices.

Waste Reduction and Diversion Policies

Goal: Reduce GHG emissions waste through improved management of waste handling and reductions in waste generation.

Objective WRD-1: The City/County will improve emissions control at waste handling facilities.

WRD-1.1 Methane Recovery: The City/County will establish methane recovery at all wastewater and solid waste treatment facilities.

WRD-1.2 Waste to Energy: The City/County will implement waste-to-energy projects where characteristics meet criteria for effective energy generation.

WRD-1.3 Best Management Practices: The City/County will utilize best management practices at all waste handling facilities.

Objective WRD-2: The City/County will implement enhanced programs to divert solid waste from landfill operations.

WRD-2.1 Diversion Targets: The City/County will achieve a solid waste diversion of 75% of the waste stream by 2020.

WRD-2.2 Diversion Services: The City/County will expand jurisdiction-wide waste diversion services to include, for example, single stream curbside recycling, and curbside recycling of food and greenwaste.

WRD-2.3 Construction and Demolition Waste: The City/County will adopt a Construction and Demolition Waste Recovery Ordinance, requiring building projects to recycle or reuse a minimum percentage of unused or leftover building materials, including:

2.3.1 Require all new development and major rehabilitation projects (additions of 25,000 square feet commercial or 100,000 square feet industrial) to recycle or salvage XX% of non-hazardous construction and demolition debris (excluding excavated soil and land-clearing debris);

2.3.2 Require preparation of a construction waste management plan identifying materials to be diverted from disposal, and how material will be stored and handled;

2.3.3 Establish clear and consistent guidelines for calculation methods, recordkeeping, and reporting to document compliance with the plan;

2.3.4 Establish clear and consistent guidelines for how and when used construction materials can be used in new or remodel construction.

WRD-2.4 Reuse Center: The City/County will establish a reuse/recycling center where furniture, appliances, building materials, and other useful, non-hazardous items may be dropped off or purchased for a nominal fee.

WRD-2.5 Program Promotion: The City/County will promote and expand recycling programs, purchasing policies, and employee education to reduce the amount of waste produced.

Objective WRD-3: The City/County will enhance regional coordination on waste management.

WRD-3.1 Regional Coordination: The City/County will coordinate with other agencies in its region to develop and implement effective waste management strategies and waste-to-energy technologies.

Conservation and Open Space Policies

Goal: Conserve natural resources such as water and open space to minimize energy used and GHG emissions and to preserve and promote the ability of such resources to remove carbon from the atmosphere.

Objective COS-1: The City/County will adopt and implement a comprehensive strategy to increase water conservation and the use of recycled water.

COS-1.1 **Water Consumption Reduction Target:** The City/County will reduce per capita water consumption by X% by 2020.

COS-1.2 **Water Conservation Plan:** The City/County will establish a water conservation plan that may include such policies and actions as:

1.2.1 Tiered rate structures for water use;

1.2.2 Restrictions on time of use for landscape watering, and other demand management strategies;

1.2.3 Performance standards for irrigation equipment and water fixtures;

1.2.4 Requirements that increased demand from new construction be offset with reductions so that there is no net increase in water use.

COS-1.3 **Recycled Water Use:** The City/County will establish programs and policies to increase the use of recycled water, including:

1.3.1 Create an inventory of non-potable water uses within the jurisdiction that could be served with recycled water;

1.3.2 Produce and promote the use of recycled water for agricultural, industrial, and irrigation purposes, including grey water systems for residential irrigation;

1.3.3 Produce and promote the use of treated, recycled water for potable uses where GHG emissions from producing such water are lower than from other potable sources.

COS-1.4 **Water Conservation Outreach:** The City/County will implement a public education and outreach campaign to promote water conservation, and will highlight specific water-wasting activities to discourage, such as the watering of non-vegetated surfaces and using water to clean sidewalks and driveways.

Objective COS-2: The City/County will ensure that building standards and permit approval processes promote and support water conservation.

COS-2.1 Water-Efficient Design: The City/County will establish building design guidelines and criteria to promote water-efficient building design, including minimizing the amount of non-roof impervious surfaces around the building(s).

COS-2.2 Water-Efficient Infrastructure and Technology: The City/County will establish menus and check-lists for developers and contractors to ensure water-efficient infrastructure and technology are used in new construction, including low-flow toilets and shower heads, moisture-sensing irrigation, and other such advances.

COS-2.3 Gray Water System Standards: The City/County will establish criteria and standards to permit the safe and effective use of gray water (on-site water recycling), and will review and appropriately revise, without compromising health and safety, other building code requirements that might prevent the use of such systems.

Objective COS-3: The City/County will establish programs and policies to ensure landscaping and forests are installed and managed to optimize their climate benefits.

COS-3.1 Water-Efficient Landscapes: The City/County will install water-efficient landscapes and irrigation, including:

3.1.1 Planting drought-tolerant and native species, and covering exposed dirt with moisture-retaining mulch;

3.1.2 Installing water-efficient irrigation systems and devices, including advanced technology such as moisture-sensing irrigation controls;

3.1.3 Installing edible landscapes that provide local food.

COS-3.2 Shade Tree Planting: The City/County will promote the planting of shade trees and will establish shade tree guidelines and specifications, including:

3.2.1 Recommendations for tree planting based on the land use (residential, commercial, parking lots, etc.);

3.2.2 Recommendations for tree types based on species size, branching patterns, whether deciduous or evergreen, whether roots are invasive, etc.;

3.2.3 Recommendations for placement, including distance from structures, density of planting, and orientation relative to structures and the sun.

COS-3.3 Urban Forestry Management: The City/County will develop an Urban Forestry Program to consolidate policies and ordinances regarding tree planting, maintenance, and removal, including:

3.3.1 Establish a tree-planting target and schedule to support the goals of the California Climate Action Team to plant 5 million trees in urban areas by 2020;

3.3.2 Establish guidelines for tree planting, including criteria for selecting deciduous or evergreen trees low-VOC-producing trees, and emphasizing the use of drought-tolerant native trees and vegetation.

Objective COS-4: The City/County will establish policies and programs to develop and preserve conservation areas, including forested areas, agricultural lands, wildlife habitat and corridors, wetlands, watersheds, and groundwater recharge areas, that remove and sequester carbon from the atmosphere.

COS-4.1 Conservation Area Development: The City/County will establish programs and funding mechanisms to create protected conservation areas, including:

4.1.1 Imposing mitigation fees for development on lands that would otherwise be conservation areas, and use the funds generated to protect other areas from development;

4.1.2 Proposing for voter approval a small tax increment (e.g., a quarter cent sales tax, perhaps for a finite time period that could be renewed) to fund the purchase of development rights in conservation areas, or purchase of the land outright.

COS-4.2 Conservation Area Preservation: The City/County will establish policies to preserve existing conservation areas, and to discourage development in those areas.

Education and Outreach Policies

Goal: Increase public awareness of climate change and climate protection challenges, and support community reductions of GHG emissions through coordinated, creative public education and outreach, and recognition of achievements.

Objective EO-1: The City/County will establish a coordinated, creative public outreach campaign, including publicizing the importance of reducing GHG emissions and steps community members can take to reduce their individual impacts.

EO-1.1 **Outreach Methods:** The City/County will use a variety of media and methods to promote climate awareness and GHG reduction, including:

1.1.1 TV and radio spots with local celebrities and community leaders;

1.1.2 Advertising "Green Tips" in the local paper;

1.1.3 Collaborating with utilities, business associations, civic groups, and non-profits to place tips and articles in billing materials or newsletters;

1.1.4 Designing and maintaining an interactive Climate Protection website and collaborating with other organizations to link to the website.

EO-1.2 **Outreach Topics:** The City/County will coordinate with other agencies and outreach efforts to align messages on topics such as:

1.2.1 Energy efficiency and conservation, and green energy;

1.2.2 Trip reduction, public transit, carpooling, vanpooling, and alternative modes of transportation;

1.2.3 Green building and energy-efficient design;

1.2.4 Waste reduction, recycling, and composting;

1.2.5 Water conservation and water-efficient design and products;

1.2.6 The benefits of buying local, and information about locally grown, prepared, and manufactured goods and local services.

Objective EO-2: The City/County will work with local businesses and energy providers on specific, targeted outreach campaigns and incentive programs.

EO-2.1 **Energy Efficiency Campaigns:** The City/County will collaborate with local energy suppliers and distributors to establish energy conservation programs, Energy Star® appliance change-out programs, rebates, vouchers, and other incentives to install energy-efficient technology and products and to cooperate on advertising.

EO-2.2 **Pedestrian and Bicycle Promotion:** The City/County will work with local community groups and downtown business associations to organize and publicize walking tours and bicycle events, and to encourage pedestrian and bicycle modes of transportation.

Objective EO-3: The City/County will organize events and workshops to promote GHG-reducing activities.

EO-3.1 **Waste Reduction:** The City/County will organize workshops on waste reduction activities for the home or business, such as backyard composting, or office paper recycling, and will schedule recycling dropoff events and neighborhood chipping/mulching days.

EO-3.2 **Water Conservation:** The City/County will organize workshops on water conservation activities, such as selecting and planting drought-tolerant, native plants in landscaping, and installing advanced irrigation systems.

EO-3.3 **Energy Efficiency:** The City/County will organize workshops on steps to increase energy efficiency in the home or business, such as weatherizing the home or building envelope, installing smart lighting systems, and how to conduct a self-audit for energy use and efficiency.

EO-3.4 **Climate Protection Summit/Fair:** The City/County will organize an annual Climate Protection Summit or Fair, to educate the public on current climate science, projected local impacts, and local efforts and opportunities to reduce GHG emissions, including exhibits of the latest technology and products for conservation and efficiency.

EO-3.5 **Schools Programs:** The City/County will develop and implement a program to present information to school children about climate change and ways to reduce GHG emissions, and will support school-based programs for GHG reduction, such as school based trip reduction and the importance of recycling.

Objective EO-4: The City/County will sponsor competitions and awards to encourage GHG reductions and recognize success.

EO-4.1 **Climate Champions Awards:** The City/County will establish a Climate Champions Awards program to acknowledge outstanding private and public efforts to reduce GHG emissions.

EO-4.2 **GHG Reduction / Climate Protection Competitions:** The City/County will sponsor competitions and contests with prizes for promoting climate protection and reducing GHG emissions, including such contests as:

4.2.1 Poster contests at schools, with winning entrants receiving scholarship grants and recognition at the Climate Protection Summit/Fair, and posters used in outreach campaigns or compiled in calendars;

4.2.2 Waste diversion contests between schools, businesses, civic organizations, and Scout troops or other groups, with prizes for the greatest percent waste diverted and recognition at the Climate Protection Summit/Fair, and similar contests for planting trees, reducing vehicle trips, or other desired behaviors;

4.2.3 Walkathons, relays, or other similar fundraising challenges, with funds raised to support community climate protection programs and activities.

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Table 2: Worksheet for Model Policies Evaluation

Greenhouse Gas Reduction Planning Policies							
Goal: Reduce GHG emissions from all activities within the City/County boundaries to support the State's efforts under AB32 and to mitigate the impact of climate change on the City/County, State, and world.							
Objective: GHG-1 By 2020, the City/County will reduce greenhouse gas emissions from within its boundaries to a level 30% less than the level that would otherwise occur if all activities continued under a "business as usual" scenario, or to a level 15% less than the levels in 2009.							
Model Policy #	Policy Name/ Subject Area	Implementation Examples (click on link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
GHG-1.1	Emissions Inventories	Cal Poly Pomona GHG inventory	Conservation				
GHG-1.1.1	Baseline Inventory	San Carlos	Conservation				
GHG-1.1.2	Business As Usual Scenario	San Carlos	Conservation				
GHG-1.2	Climate Action Plan (CAP)		Conservation				
GHG-1.2.1	Municipal CAP	San Carlos City of Los Angeles City of Santa Monica – Sustainable City Progress City of Calabasas Issue Paper on GHG Reduction Strategies City of Santa Monica Sustainable Strategies Green County San Bernardino City of Huntington Beach	Conservation				
GHG-1.2.2	Business CAP	The Walt Disney Corporation	Conservation				
GHG-1.2.3	Community CAP	San Carlos	Conservation				
GHG-1.1A	Emissions Inventory Alternative		Conservation				
GHG-1.1	Baseline Inventory – alt		Conservation				
GHG-1.2A	Climate Action Plan (CAP) Alternative		Conservation				
GHG-1.2.1A	Municipal CAP - alt		Conservation				
GHG-1.2.2A	Business CAP - alt		Conservation				
GHG-1.2.3A	Community CAP - alt		Conservation				
Objective: GHG-2 The City/County will ensure that its local Climate Action, Land Use, Housing, and Transportation Plans are aligned with, support, and enhance any regional plans that have been developed consistent with state guidance to achieve reductions in GHG emissions.							
GHG-2.1	Sustainable Communities/ Regional Blueprint	Institute for Local Government Strategies	Land Use/ Circulation				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Land Use and Urban Design Policies							
Goal: Promote land use strategies that decrease reliance on automobile use, increase the use of alternative modes of transportation, and reduce emissions of GHGs.							
Objective: LU-1 The City/County will adopt and implement a development pattern that enhances non-automobile transportation.							
Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
LU-1.1	Urban Growth Boundary	County of Santa Clara Urban Growth Boundary Portland Metropolitan Area Petaluma 2025 General Plan Land Use GOAL 1-G-3: Maintain a well-defined boundary at the edge of urban development. Page 1-15 Land Use GOAL 1-G-4: Urban Growth Boundary Maintain a parcel-specific Urban Growth Boundary. Page 1-17	Land Use / Open Space				
LU-1.1.1	Location of Urban Development		Land Use / Open Space				
LU-1.1.2	Timing of Urban Development		Land Use / Open Space				
LU-1.2	Reserve Limits	Agricultural Land Reserve	Land Use				
LU-1.3	Infill	Smart Infill Greenbelt Alliance State of California Interim Hearing: Best Practices Successful Infill Development Marin Countywide Plan Goal CD-6 Page 3-30, Community Development, Built Environment Element	Land Use				
LU-1.4	Urban Service Lines	Santa Cruz County Urban Services Line	Land Use				
LU-1.4.1	Urban-Rural Transition Zone		Land Use				
LU-1.5	Density	City of Pasadena 2004 General Plan	Land Use				
LU-1.5.1	Barriers to Accessory Units		Land Use				
LU-1.6	Road Width		Circulation				
LU-1.7	Parking Spaces	Victoria Transport Policy Institute Parking Management Los Angeles Department of Transportation Parking and Smart Growth Study MTC Parking Best Practices see page 29 through fin MTC Parking Toolbox see page 29-33 Parking Policy Transit Oriented Development: Lessons for Cities Transit Agencies & Developers	Land Use				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
LU-1.8	Bicycle Facilities	San Francisco Municipal Transportation Authority Bicycle Parking San Francisco Bicycle Coalition Bike Parking at Work Alameda Bicycle	Circulation				
LU-1.9	Levels of Service	San Francisco Department of Public Health 1 / 2 San Francisco County Transportation Authority 1 / 2	Land Use				
Objective: LU-2 Promote infill, mixed use, and higher density development, and provide incentives to support the creation of affordable housing in mixed use zones.							
LU-2.1	Mixed-Use Development	Marin Countywide Plan Goal CD-8, Policy CD 8.7 Page 3-39, Community Development, Built Environment Element Goal DES-2, DES-3, Community Development, Built Environment Element Page 3-84	Land Use				
LU-2.1.1	Site-Specific Standards		Land Use				
LU-2.1.1.1	Allowable Building Height		Land Use				
LU-2.1.1.2	Flexible Development Standards		Land Use				
LU-2.1.1.3	Additive Residential Component/ Eliminate Density		Land Use				
LU-2.1.1.4	Reduced and Shared Parking		Land Use				
LU-2.1.1.5	Tandem and Offsite Parking		Land Use				
LU-2.1.1.6	Unbundle Parking from Leases		Land Use				
LU-2.1.1.7	Parking Benefit Districts		Land Use				
LU-2.1.1.8	Performance Pricing of Parking		Land Use				
LU-2.1.2	Supportive Pre-planning		Land Use				
LU-2.1.3	Prototype Adaptive Use Buildings		Land Use				
LU-2.1.4	Facilitate Complementary Uses		Land Use				
LU-2.1.5	Employer-Assisted Housing		Housing				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
LU-2.1.6	Services Near Employment Centers		Land Use				
LU-2.1.7	Form-based Standards		Land Use				
LU-2.1.8	Non-segregated Affordable Housing		Land Use				
Objective LU-3 Promote greater linkage between land uses and transit, as well as other modes of transportation.							
LU-3.1	Housing Overlay Zone	Marin Countywide Plan Goal CD-2, Policy CD-2.3; Page 3-15, Community Development, Built Environment Element	Land Use				
LU-3.2	Transit-oriented Mixed-use	US Federal Highway Administration: Fruitvale Transit Village Project Marin Countywide Plan Goal DES-2 Page 3-60, Community Design, Built Environment Element Smart Communities Network Transit Strategies	Land Use				
LU-3.2.1	Amend Code to Promote Transit-oriented Mixed-use		Land Use				
LU-3.2.2	Rezone to Allow Mixed Use		Land Use				
LU-3.2.3	Expand Zoning for Multi-Family Housing		Land Use				
LU-3.2.4	Flexible Parking & Bldg. Height		Land Use				
LU-3.2.5	Density Bonus Programs	County of San Diego Density Bonus Program	Land Use				
LU-3.2.6	Guidelines for Private/Public Spaces		Land Use				
LU-3.2.7	Incentives for Redevelopment	City of Knoxville Downtown Incentives	Land Use				
LU-3.2.8	Pedestrian/ Bicycle Connectivity		Land Use				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
LU-3.2.9	Parking Benefit Districts		Land Use				
LU-3.2.10	Performance Pricing for Parking		Land Use				
LU-3.2.11	Discourage Auto-oriented Development		Land Use				
LU-3.3	Transit-oriented Brownfield Development	Marin Countywide Plan Goal CD-6, Page 3-31, Community Development, Built Environment Element Multi Housing News Case Study Windsor, Ontario Brownfield's Strategy	Land Use				
LU-3.4	Public Transit Development Focus	Marin Countywide Plan Goal DES-2 Page 3-60, Community Design, Built Environment Element Victoria Transport Policy Institute 21 TOD Projects in California - Caltrans MTC - 10 Transit Oriented Development Profiles	Land Use				
LU-3.4.1	Density Near Activity Centers	City of Sacramento Smart Growth Strategy	Land Use				
LU-3.4.2	Density Near Transit Routes		Land Use				
LU-3.4.3	Links to Transit Stops		Land Use				
LU-3.5	City-centered Corridors	Map of Marin County	Land Use				
LU-3.6	Transit-oriented Development Design Standards		Land Use				
LU-3.7	Affordable Housing		Land Use				
Objective: LU-4 Promote development and preservation of neighborhood characteristics that encourage walking and bicycle riding in lieu of automobile-based travel.							
LU-4.1	Pedestrian-oriented Character	City of Los Angeles	Land Use				
LU-4.1.1	Design Short Walk to Center		Land Use				
LU-4.1.2	Increase Density Towards Center		Land Use				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
LU-4.1.3	Direct Business Space to Center		Land Use				
LU-4.1.4	Pedestrian Only Streets/Plazas	Urban Design International Santa Monica's Third Street Promenade Abstract	Circulation				
LU-4.1.5	Flexible Parking for Streetscape		Circulation				
LU-4.1.6	Continuous Separated Sidewalks		Circulation				
LU-4.1.7	Bike/Walk Paths to Parks		Circulation				
LU-4.2	Pedestrian Access	City of Los Angeles Marin Countywide Plan Goal TR-2 Page 3-159, Transportation, Built Environment Element	Circulation				
LU-4.2.1	Connectivity of Development		Land Use				
LU-4.2.2	Balanced Mix of Development	Petaluma 2025 General Plan Goal 1-G-1, page 1-14; Maintain a balanced land use program that meets the long-term residential, employment, retail, institutional, education, recreation, and open space needs of the community.	Land Use				
LU-4.2.3	Locate Schools w/ Safe Routes	Transportation Authority of Marin Safe Routes to Schools Transform Safe Routes to School	Land Use				
LU-4.2.4	Entrances to New Development		Land Use				
LU-4.2.5	Location of Driveways		Land Use				
LU-4.2.6	Street Parking as Buffer		Land Use				
LU-4.2.7	Pedestrian/ Bicycle Connectivity		Land Use				
LU-4.2.8	Develop Pedestrian Connectors		Land Use				
LU-4.2.9	Grade-separated Crossings		Land Use				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
Objective LU-5 Review fee structures and other opportunities to provide financial and administrative incentives to support desired land uses, development patterns, and alternative modes of transportation.							
LU-5.1	Developer Fees	ABAG memo to JPC PolicyLink Infill bonuses and Incentives Brownfields Smart Growth Incentives & Loans for Businesses – New Jersey	Land Use				
LU-5.1.1	Proportional to Distance from Center		Land Use				
LU-5.1.2	Incentivize Mixed Use		Land Use				
LU-5.1.3	Reduce fees for Brownfield Redevelopment		Land Use				
LU-5.1.4	Fees for Greenfield Development		Land Use				
LU-5.2	Admin. Fees & Streamlining		Land Use				
LU-5.3	Incentives & Loans		Land Use				
LU-5.4	Infrastructure Preference		Land Use				
Objective LU-6 The City/County will mitigate climate change by decreasing heat gain from pavement and other hard surfaces associated with infrastructure.							
LU-6.1	Hardscape Heat Gain	Cool Houston Plan	Land Use				
LU-6.1.1	Reduce Pavement Widths		Circulation				
LU-6.1.2	Include Parkway Strips		Circulation				
LU-6.1.3	Shade Trees on South and West		Land Use				
LU-6.1.4	Replace Hardscape with Low-Water Landscape		Land Use				
LU-6.1.5	Cool Roofs & Paving	Cool Houston Plan Cool Roof Rating Council	Land Use				
LU-6.1.6	Pervious Pavement Standards		Land Use				
LU-6.1.7	Xeriscaping		Land Use				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Transportation Policies							
Goal: Reduce GHG emissions by reducing vehicle miles traveled and by increasing or encouraging the use of alternative fuels and transportation technologies.							
Objective: TR-1 The City/County will reduce VMT-related emissions by encouraging the use of public transit through adoption of new development standards that will require improvements to the transit system and infrastructure, increase safety and accessibility, and provide other incentives.							
Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
TR-1.1	Transportation Planning	San Francisco Municipal Transportation Authority	Circulation				
TR-1.1.1	Project Selection						
TR-1.1.2	Equal Pedestrian Access		Circulation				
TR-1.1.3	Public Involvement		Circulation				
TR-1.2	System Interconnectivity	San Francisco Municipal Transportation Authority	Circulation				
TR-1.2.1	Multi-modal Transportation Ctrs.	RTD Fastracks	Circulation				
TR-1.2.2	Provide Transportation Options	City of Santa Monica Sustainable Transportation	Circulation				
TR-1.2.3	Extend Transit Service & Hours	King County Night Service	Circulation				
TR-1.2.3A	Focus Transit Resources		Circulation				
TR-1.2.4	Coordinate Across Service Lines	RTD Fastracks	Circulation				
TR-1.2.5	Support "Transit Cars"	King County Free Transit Area	Circulation				
TR-1.2.6	Free Transit Feasibility		Circulation				
TR-1.2.7	Transit Preference Measures		Circulation				
TR-1.2.8	Safe Access Along Major Streets		Circulation				
TR-1.2.9	Park-and-ride Locations		Circulation				
TR-1.3	System Infrastructure	RTD Fastracks	Circulation				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
TR-1.3.1	Efficient, Convenient Bus Stops		Circulation				
TR-1.3.2	Bus Stop Signage & Access		Circulation				
TR-1.3.3	Safe, Clean, Lighted Bus Stops		Circulation				
TR-1.3.4	Transit Station Locations		Circulation				
TR-1.4	Customer Service		Circulation				
TR-1.4.1	Develop Regional Pass System	Bay Area Translink	Circulation				
TR-1.4.2	Implement Smart Bus Technology	AC Transit	Circulation				
TR-1.4.3	Online Trip Planning		Circulation				
TR-1.5	Transit Funding		Circulation				
TR-1.5.1	Funding Preference for Transit		Circulation				
TR-1.5.2	Evaluate Feasible Alternatives		Circulation				
TR-1.6	Transportation Impact Fees	San Francisco County Transportation Authority Transportation Impact Fee	Circulation				
Objective: TR-2 The City/County will implement traffic and roadway management strategies to improve mobility and efficiency, and reduce associated emissions.							
TR-2.1	System Monitoring		Circulation				
TR-2.2	Arterial Traffic Mgt.		Circulation				
TR-2.3	Signal Synchronization		Circulation				
TR-2.4	HOV Lanes	MTC Riverside County Transportation Commission SANBAG HOV	Circulation				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
TR-2.5	Delivery Schedules		Circulation				
Objective: TR-3 The City/County will reduce VMT-related emissions by implementing and supporting trip reduction programs.							
TR-3.1	Ride-Share Programs	King County Ride Share Program UC Irvine Transportation Services	Circulation				
TR-3.1.1	Designated Ride-share Parking		Circulation				
TR-3.1.2	Provide Loading, Unloading, & Waiting Areas		Circulation				
TR-3.1.3	Ride Coordination Support	San Francisco Car and Van Pool	Circulation				
TR-3.1.4	Support Car-sharing Services	San Francisco Car Sharing	Circulation				
TR-3.1.5	Ride-share Coordinator	South Coast AQMD Rule 2202	Circulation				
TR-3.2	Employer-based Trip Reduction	San Francisco Transit Benefit Ordinance	Circulation				
TR-3.2.1	Support Ride-share Organizations	South Coast AQMD Rule 2202	Circulation				
TR-3.2.2	Support Ride-share Legislation		Circulation				
TR-3.2.3	Support Transp. Mgt. Assns.		Circulation				
TR-3.2.4	Recognize Effective Programs		Circulation				
TR-3.3	Ride Home Programs	San Francisco Emergency Ride Home Metro Transit Rider Programs	Circulation				
TR-3.4	Local Area Shuttles	City of Burlingame Public Transportation Caltrain Shuttle Services	Circulation				
TR-3.4.1	Reduced-cost Shuttle Service		Circulation				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
TR-3.4.2	Shuttle Service Coordination		Circulation				
TR-3.5	Low- and No-Travel Employment Opportunities		Circulation				
TR-3.5.1	Zoning & Codes for Live-Work		Land Use				
TR-3.5.2	Support Telecommuting	San Francisco Telecommuting Policy	Circulation				
TR-3.6	Congestion Pricing		Circulation				
Objective TR-4 The City/County will support bicycle use as a mode of transportation by enhancing infrastructure to accommodate bicycles and riders, and providing incentives.							
TR-4.1	Development Standards for Bicycles	San Francisco Municipal Transportation Authority Bicycle Plan	Circulation				
TR-4.1.1	Amend Code to Accommodate Bikes & Pedestrians	San Francisco Municipal Transportation Authority Livable Streets Caltrans Pedestrian & Bicycle Facilities in CA	Circulation				
TR-4.1.1.1	"Complete Streets" Policies	San Francisco Municipal Transportation Authority Livable Streets	Circulation				
TR-4.1.1.2	Include Access thru Easements		Circulation				
TR-4.1.1.3	Dedicated Bike/Pedestrian Paths	New York City Transportation City of Berkeley Transportation	Circulation				
TR-4.1.1.4	Safe Road Crossings	City of Berkeley Transportation	Circulation				
TR-4.1.1.5	Bicycle Parking	King County Bike Facilities City of Albuquerque Biking & Walking	Circulation				
TR-4.1.1.6	Street Standards for Bike Parking		Circulation				
TR-4.1.2	Bike Facilities in New Development	King County Bike Facilities	Circulation				
TR-4.1.2.1	Weather Protected Bike Parking		Circulation				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
TR-4.1.2.2	Changing Rooms, Showers, etc.		Circulation				
TR-4.1.3	Prohibit Projects that Impede Bicycle/ Pedestrian Transit		Circulation				
TR-4.1.4	Bicycle Support Services	San Francisco Municipal Transportation Authority Bicycle Plan	Circulation				
TR-4.1.5	Connectivity Analysis		Circulation				
TR-4.2	Bicycle and Pedestrian Trails	City of Berkeley Transportation City of Albuquerque Biking & Walking	Circulation				
TR-4.3	Bicycle Safety Program	City of Berkeley Transportation California DMV Bike Rules and Safety	Circulation				
TR-4.4	Bicycle and Pedestrian Project Funding		Circulation				
TR-4.5	Bicycle Parking		Circulation				
TR-4.4.1	Apply for Infrastructure Grants	City of Olympia Neighborhood Sustainability Grants	Circulation				
TR-4.4.2	Devel. Exactions & Impact Fees		Circulation				
TR-4.4.3	Redeploy Existing Revenues		Circulation				
Objective TR-5 The City/County will establish parking policies and requirements that capture the true cost of private vehicle use and support alternative modes of transportation.							
TR-5.1	Parking Policy	Redwood City Downtown Parking Management Plan MTC Parking Best Practices	Land Use				
TR-5.1.1	More Parking for Shared Vehicles		Land Use				
TR-5.1.2	Eliminate/ Reduce Parking Minimums	City of Alameda Memo Parking Management Strategy	Land Use				
TR-5.1.3	Require Unbundled Parking	City of Santa Monica Transportation Management	Land Use				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
TR-5.1.4	Increase Parking Rates	Redwood City	Land Use				
TR-5.1.5	Limit Parking Times		Circulation				
TR-5.1.6	Performance Pricing of Parking		Circulation				
TR-5.1.7	Shared Parking		Circulation				
TR-5.2	Event Parking Policies	San Francisco Municipal Transportation Agency Events Parking City of Berkeley Special Events Parking	Circulation				
TR-5.2.1	Promote Peripheral Parking		Circulation				
TR-5.2.2	Transit Discounts to Events		Circulation				
TR-5.2.3	Carpool Parking at Events		Circulation				
TR-5.2.4	Valet Bike Parking at Events	Secure Valet Bike Parking	Circulation				
TR-5.3	Parking Cash-out Program	City of Santa Monica Transportation Management	Circulation				
TR-5.4	Elec./Alt. Fuel Vehicle Policies	City of Albuquerque Alternative Fuels Program	Circulation				
Objective TR-6 The City/County will support and promote the use of low and zero emission vehicles, and alternative fuels, and other measures to directly reduce emissions from motor vehicles.							
TR-6.1	Low and Zero Emission Vehicles	City of Olympia Sustainability City of Columbus Green Fleet	Circulation				
TR-6.1.1	Electric & Alt. Fuel Infrastructure	San Francisco Municipal Transportation Agency Clean Air Initiatives	Circulation				
TR-6.1.2	Charging Access in New Development		Circulation				
TR-6.1.3	Fleet Standards	San Jose Green Fleet Policy	Circulation				
TR-6.1.4	Elec./Alt Fuel Taxicab Incentives		Circulation				
TR-6.2	Vehicle Idling	Minneapolis Anti Idling Ordinance	Circulation				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Energy Efficiency Policies							
Goal: Reduce emissions from the generation of electricity by reducing electricity use through increased efficiency.							
Objective: EE-1 The City/County will establish green building requirements and standards for new development and redevelopment projects, and will work to provide incentives for green building practices and remove barriers that impede their use.							
Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
EE-1.1	Green Building Ordinance	Berkeley Residential Energy Conservation Ordinance; San Francisco Residential Energy Conservation Ordinance; Rohnert Park Green Building Ordinance; City of Los Angeles – Green Building	Conservation				
EE-1.2	Green Building Flexibility	Santa Monica	Conservation				
EE-1.3	Green Building Barriers		Conservation				
EE-1.4	Green Building Incentives	Arlington Green Building Incentives Matrix of Examples Build It Green Examples	Conservation				
EE-1.4.1	Information, Training, & Technical Assistance	Mothers of East LA Local group, environmental awareness, green business	Conservation				
EE-1.4.2	Guidelines for Green Building	Build It Green Guidelines and Checklist	Conservation				
EE-1.4.3	Financial Incentives		Conservation				
Objective: EE-2 The City/County will establish policies and standards to increase energy efficiency at new developments.							
EE-2.1	Improved Building Standards	City of Boulder Residential Building Guide	Conservation				
EE-2.1.1	"Cool Roofs" Standards	CA Title 24 2008 Update	Conservation				
EE-2.1.2	Building Envelope Heat Transfer		Conservation				
EE-2.1.3	High-Efficiency Plumbing	Alliance for Water Efficiency	Conservation				
EE-2.1.4	High-Efficiency Heating & Cooling	Solano County Green Building Ordinance	Conservation				
EE-2.1.5	Overall Lighting Efficiency	San Francisco Fluorescent Lighting Efficiency Ordinance Chittenden County, VT Lighting Program	Conservation				
EE-2.1.6	Energy Star® Appliances	Palm Desert Ord. 1124 Section 24.30.050	Conservation				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
EE-2.1.7	Orientation of New Lots		Conservation				
EE-2.2	Affordable Housing Energy Efficiency	The Chicago Housing Authority Energy Cost Savings Program City of Denver	Housing Conservation				
EE-2.2.1	Redevelopment Grants		Housing Conservation				
EE-2.3	Outdoor Lighting	Chittenden County, VT Lighting Program	Land Use Conservation*				
EE-2.3.1	Outdoor Lighting Efficiency Standards		Conservation See EE-2.3				
EE-2.3.1.1	Full Cut-off Fixtures		Conservation See EE-2.3				
EE-2.3.1.2	Photocells or Timed Switches		Conservation See EE-2.3				
EE-2.3.1.3	Directional/ Shielded LED Lights		Conservation See EE-2.3				
EE-2.3.2	Light Level Standards		Land Use Conservation				
EE-2.3.3	Urban/Rural Light Levels		Land Use Conservation				
EE-2.3.4	Prohibit Continuous Lighting		Land Use Conservation				
EE-2.4	Residential Wood Burning	Bay Area AQMD	Conservation*				
Objective: EE-3 The City/County will establish policies and standards to reduce exterior heat gain and heat island effects.							
EE-3.1	Exterior Heat Gain	Cool Houston Plan Page 5	Land Use Conservation*				
EE-3.1.1	50% Paved Surface Shading	City of Fresno Performance Standard for Parking Lot Shading	Land Use Conservation				
EE-3.1.2	Standards for Paving Materials	New Jersey Standard for Paving	Land Use Conservation				
EE-3.1.3	Standards for Roofing Materials	CA Title 24 2008 Update	Land Use Conservation				

* Best-judgment category, i.e. depending on city/county circumstances and scope of General Plan elements, policy could also be included in other mandatory element or in other optional element

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click on link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
EE-3.2	Heat Island Mitigation	Cool Houston Plan City of Chicago	Land Use Conservation				
Objective EE-4 The City/County will pursue policies and programs to improve energy efficiency of existing buildings.							
EE-4.1	Energy Audits	Austin Energy Audits	Energy*				
EE-4.2	Energy Efficiency Funding	City of Ann Arbor	Energy				
EE-4.3	Community Energy Program	Community Energy Services Corporation Portland Community Energy Project	Energy				
EE-4.3.1	"Energy Efficiency Challenge"		Energy				
EE-4.3.2	Low-income Weatherization Assistance	Portland Block by Block Weatherization Program	Energy, Housing				
EE-4.3.3	Conservation Campaigns	Ashland Conservation Program	Energy				
EE-4.3.4	Promote Energy Star®		Energy				
EE-4.3.5	Promote "Green Business"	Ashland Conservation Program San Francisco Green Business Program	Energy, Economic Development*				
EE-4.3.6	Distribute Free CFL Bulbs, etc.	Los Angeles Department of Water and Power	Energy				
EE-4.3.7	Exchange Programs for High-Energy Bulbs/Fixtures	Marin County (torchiere exchange), many cities, EPA Change A Light Campaign	Energy				
EE-4.3.8	Require Point of Sale Energy Upgrades	Berkeley RECO Berkely CECO San Francisco RECO	Energy				

* Best-judgment category, i.e. depending on city/county circumstances and scope of General Plan elements, policy could also be included in other mandatory element or in other optional element

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Alternative Energy Policies							
Goal: The City/County will seek to reduce emissions associated with electrical generation by promoting and supporting the generation and use of alternative energy.							
Objective: AE-1 The City/County will establish policies and programs that facilitate the siting of new renewable energy generation.							
Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
AE-1.1	Site Designation		Energy, Land Use				
AE-1.1.1	Renewable Energy Devel. Sites		Energy, Land Use				
AE-1.1.2	Evaluate & Mitigate Constraints		Energy, Land Use				
AE-1.1.3	Protect Renewable Energy Uses		Energy, Land Use				
AE-1.2	Removing Barriers	Ontario, Canada	Energy, Land Use				
AE-1.2.1	Revise Codes, Zoning, Guidance		Energy, Land Use				
AE-1.2.2	Work with Other Agencies		Energy				
AE-1.2.3	Develop Safety Protocols		Energy				
AE-1.3	Zoning Flexibility		Energy, Land Use				
Objective: AE-2 The City/County will promote and require renewable energy generation, and co-generation projects where feasible and appropriate.							
AE-2.1	On-site Renewable Energy Generation	US EPA Renewable Energy Generation Many examples, page 26	Energy				
AE-2.2	Co-Generation Projects	City of Boulder Co-Generation	Energy				
AE-2.3	Green Utilities	Austin Energy Green Riverside	Energy				
Objective AE-3 The City/County will promote, support, and require, as appropriate, the development of solar energy.							
AE-3.1	Solar-ready Buildings	Vancouver, Canada	Energy				
AE-3.1.1	Roof Orientation & Slope	Solar Santa Monica Santa Monica Community Energy Independence Initiative – part of the Solar Santa Monica program	Energy				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click on link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
AE-3.1.2	Clear Access on South Slope		Energy				
AE-3.1.3	Include Roof Framing Support		Energy				
AE-3.1.4	Include Electrical Conduit		Energy				
AE-3.1.5	Include Plumbing and Appliance Space		Energy				
AE-3.2	Solar Homes Partnership		Energy				
AE-3.3	Passive Solar Design	City of Santa Barbara	Energy				
AE-3.4	Protection of Solar Elements	San Jose Solar Access Design Guidelines	Energy, Land Use				
Objective AE-4 The City/County will pursue and provide economic incentives and creative financing for renewable energy projects, as well as other support for community members or developers seeking funding for such projects.							
AE-4.1	Renewable Energy Incentives	City of Santa Clara California Production Incentives for Renewable Energy					
AE-4.2	Creative Financing	City of Berkeley					
AE-4.3	Partnerships	Nevada Southwest Energy Partnership					
AE-4.4	Information & Support	City of Santa Monica page 49 San Diego Regional Energy Office Page 37					
Objective AE-5 The City/County will implement measures to support the purchase and use of renewable and alternative energy.							
AE-5.1	Green Electricity Purchasing	City of Santa Clara					
AE-5.2	Community Choice Aggregation	Marin County Clean Energy					

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Municipal Operations Policies							
Goal: Reduce GHG emissions from municipal facilities and operations, and by purchasing goods and services that embody or create fewer GHG emissions.							
Objective: MO-1 The City/County will enhance the energy efficiency of its facilities.							
Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
MO-1.1	Energy Efficiency Plan	California Energy Commission GHG Reporting Protocol	Energy*				
MO-1.1.1	Conduct Audits		Energy				
MO-1.1.2	Retrofit Facilities		Energy				
MO-1.1.3	Implement Tracking & Mgt.		Energy				
MO-1.1.4	Install Efficient Traffic Signs/ Lights		Energy				
MO-1.1.5	Retrofit Indoor Lighting		Energy				
MO-1.1.6	Retrofit Heating & Cooling Systems		Energy				
MO-1.1.7	Install Energy Star® Appliances		Energy				
MO-1.1.8	Increase Water Pumping Efficiency		Energy				
MO-1.1.9	Chilled, Filtered Water Fountains		Energy				
MO-1.1.10	Centralize, Optimize Irrigation		Energy				
MO-1.1.11	Accelerate Replacement Cycles		Energy				
MO-1.2	Efficiency Requirement for New Facilities		Energy				
MO-1.2.1	LEED Certify New Buildings		Energy				

* Best-judgment category, i.e. depending on city/county circumstances and scope of General Plan elements, policy could also be included in other mandatory element or in other optional element

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click on link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
MO-1.2.2	Energy Star® New Homes Program for Residential Units		Energy				
MO-1.2.3	Incorporate Passive Solar						
MO-1.2.4	Retrofit to Title 24 or Better		Energy				
MO-1.2.5	Decrease Heat Gain		Energy				
MO-1.3	Training & Support		Energy				
MO-1.3.1	Train Design, Engineering, Operations, Maintenance Staff		Energy				
MO-1.3.2	Provide Energy Use Data		Energy				
MO-1.3.3	Provide Energy Design Review		Energy				
Objective: MO-2 The City/County will improve efficiency at municipal systems and reduce GHG emissions from vehicle and equipment engines.							
MO-2.1	Wastewater System Efficiency		Energy*				
MO-2.2	Drinking Water System Efficiency		Energy				
MO-2.3	Fleet Replacement		Energy				
MO-2.4	Small Tools & Equipment		Energy				
Objective MO-3 The City/County will implement measures to reduce employee vehicle trips and to mitigate emissions impacts from municipal travel.							
MO-3.1	Trip Reduction Program		Circulation				
MO-3.1.1	Support Employee Van/ Carpools		Circulation				
MO-3.1.2	Subsidize Mass Transit for Staff		Circulation				

* Best-judgment category, i.e. depending on city/county circumstances and scope of General Plan elements, policy could also be included in other mandatory element or in other optional element

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click on link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
MO-3.1.3	Offer Alt. Work Schedules		Circulation				
MO-3.1.4	Offer Guaranteed Ride Home		Circulation				
MO-3.2	Bicycle Transportation Support		Circulation				
MO-3.2.1	Provide "Bicycle Stations"		Circulation				
MO-3.2.2	Provide Bicycles for Check-out		Circulation				
MO-3.2.3	Implement "Police on Bikes"		Circulation				
MO-3.2.4	Implement Bike Safety Program		Circulation				
MO-3.3	Municipal Parking Mgt.		Circulation				
MO-3.31	Parking for Van/Carpools		Circulation				
MO-3.3.2	Institute Parking Cash-out Program		Circulation				
MO-3.3.3	Eliminate Parking Subsidies		Circulation				
MO-3.3.4	Fees for Private Vehicle Parking		Circulation				
MO-3.3.5	Fees for Single Occ. Vehicles		Circulation				
MO-3.4	Travel Mitigation		Circulation				
MO-3.5	Transit Access to Municipal Facilities		Circulation				
Objective MO-4 The City/County will enhance renewable energy generation, and implement programs for load management and demand response.							
MO-4.1	Load Management & Demand Response		Energy				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
MO-4.2	Renewable Energy Installation		Energy				
MO-4.2.1	Solar Collections Systems		Energy				
MO-4.2.2	Solar Water Heating Systems		Energy				
MO-4.2.3	Waste-to-Energy Systems		Energy				
Objective MO-5 The City/County will manage its vegetation inventory to reduce GHG emissions.							
MO-5.1	Urban Tree Management	Million Trees Los Angeles (considered to be part of GHG program)	Land Use				
MO-5.2	Landscaping		Land Use				
Objective MO-6 The City/County will use its purchasing power to promote reductions in GHG emissions by the suppliers of its goods and services.							
MO-6.1	Purchasing Practices		Energy, Conservation, Municipal Ops*				
MO-6.2	Contracting Practices		See MO-6.1				

* Best-judgment category, i.e. depending on city/county circumstances and scope of General Plan elements, policy could also be included in other mandatory element or in other optional element

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Waste Reduction and Diversion Policies							
Goal: Reduce GHG emissions from waste through improved management of waste handling and reductions in waste generation.							
Objective: WRD-1 The City/County will improve emissions control at waste handling facilities.							
Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
WRD-1.1	Methane Recovery		Conservation				
WRD-1.2	Waste to Energy	California Energy Commission California Energy Commission Bioenergy Action Plan California Energy Commission Biomass White Paper See Policies, page 29	Conservation				
WRD-1.3	Best Management Practices		Conservation				
Objective: WRD-2 The City/County will implement enhanced programs to divert solid waste from landfill operations.							
WRD-2.1	Diversion Targets	City of San Francisco Zero Waste Targets	Conservation				
WRD-2.2	Diversion Services	Petaluma 2025 General Plan General Plan 4.4 Solid Waste, page 4-10 City of Albuquerque Recycling and Waste Reduction Programs Austin Recycling Ordinance Marin Countywide Plan GOAL PFS-4, Efficient Processing and Reduced Landfill Disposal of Solid Waste. page 3-206	Conservation				
WRD-2.3	Construction & Demolition Waste	San Francisco Construction and Demolition Debris Recovery Program 1 / 2	Conservation				
WRD-2.3.1	Recycle Targets for Large Projects		Conservation				
WRD-2.3.2	Construction Waste Mgt. Plan		Conservation				
WRD-2.3.3	Establish Compliance Methods & Guidelines		Conservation				
WRD-2.3.4	Establish Reuse Guidelines		Conservation				
WRD-2.4	Reuse Center		Conservation				
WRD-2.5	Program Promotion		Conservation				
Objective WRD-3 The City/County will enhance regional coordination on waste management.							
WRD-3.1	Regional Coordination		Conservation				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Conservation and Open Space Policies							
Goal: Conserve natural resources such as water and open space to minimize energy used and GHG emissions and to preserve and promote the ability of such resources to remove carbon from the atmosphere.							
Objective: COS-1 The City/County will adopt and implement a comprehensive strategy to increase water conservation and the use of recycled water.							
Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
COS-1.1	Water Consumption Reduction Target	City of Sacramento Urban Water Management Plan 1 / 2					
COS-1.2	Water Conservation Plan	Green County San Bernardino					
COS-1.2.1	Tiered Rate Structure						
COS-1.2.2	Time-of-use Restrictions						
COS-1.2.3	Performance Standards						
COS-1.2.4	Offset New Demand						
COS-1.3	Recycled Water Use	City of San Jose Water Conservation & Recycling Honolulu Ecology of Wastewater					
COS-1.3.1	Non-potable Use Inventory	City of Olympia					
COS-1.3.2	Promote Recycled Water Use	City of Olympia Reclaimed Water					
COS-1.3.3	Potable Recycled Water Use	City of Olympia					
COS-1.4	Water Conservation Outreach	Albuquerque Bernalillo County Water Utility Authority					
Objective: COS-2 The City/County will ensure that building standards and permit approval processes promote and support water conservation.							
COS-2.1	Water Efficient Design	City of Minneapolis Green Initiatives	Conservation				
COS-2.2	Water Efficient Infrastructure & Technology	City of Santa Barbara Water Conservation Sustainable Options	Conservation				
COS-2.3	Gray Water System Standards		Conservation				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
Objective COS-3 The City/County will establish programs and policies to ensure landscaping and forests are installed and managed to optimize their climate benefits.							
COS-3.1	Water-Efficient Landscapes	Stop Waste Model Ordinance Landscaping	Conservation				
COS-3.1.1	Drought Resistant Planting		Conservation				
COS-3.1.2	High-Efficiency Irrigation	City of Santa Barbara Water Conservation	Conservation				
COS-3.1.3	Installing Edible Landscapes		Conservation				
COS-3.2	Shade Tree Planting	City of Albuquerque Urban Forestry	Conservation				
COS-3.2.1	Recommend Plants by Land Use	City of Seattle Tree and Landscaping Regulations	Conservation				
COS-3.2.2	Consider Tree Characteristics	City of Albuquerque Tree Planting	Conservation				
COS-3.2.3	Recommend Placement		Conservation				
COS-3.3	Urban Forestry Management	City of Seattle Urban Forest Management Plan	Conservation, Open Space				
COS-3.3.1	Set Tree Planting Target	Raleigh Tree Planting Program	Conservation				
COS-3.3.2	Establish Planting Guidelines	City of Seattle Street Tree Planting Procedures	Conservation				
Objective COS-4 The City/County will establish policies and programs to develop and preserve conservation areas, including forested areas, agricultural lands, wildlife habitat and corridors, wetlands, watersheds, and groundwater recharge areas, that remove and sequester carbon from the atmosphere.							
COS-4.1	Conservation Area Development		Conservation, Open Space				
COS-4.1.1	Mitigation Fees on Development		Conservation, Open Space				
COS-4.1.2	Sales Tax for Conservation		Conservation, Open Space				
COS-4.2	Conservation Area Preservation	Honolulu Exceptional Tree Program	Conservation, Open Space				

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Education and Outreach Policies							
Goal: Increase public awareness of climate change and climate protection challenges, and support community reductions of GHG emissions through coordinated, creative public education and outreach, and recognition of achievements.							
Objective: EO-1 The City/County will establish a coordinated, creative public outreach campaign, including publicizing the importance of reducing GHG emissions and steps community members can take to reduce their individual impacts.							
Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
EO-1.1	Outreach Methods	City of San Mateo SMART Speakers	Climate Change or GHG, possibly Conservation				
EO-1.1.1	TV and Radio Spots	City of San Mateo SMART Media	See EO-1.1				
EO-1.1.2	"Green Tips" in Local Paper		See EO-1.1				
EO-1.1.3	Messages in Others' Newsletters, Billing Materials, etc.		See EO-1.1				
EO-1.1.4	Climate Protection Website	City of San Mateo SMART City of Palo Alto City of Minneapolis	See EO-1.1				
EO-1.2	Outreach Topics	City of San Mateo SMART Speakers	See EO-1.1				
EO-1.2.1	Energy Efficiency & Conservation	City of San Mateo SMART Carbon Counter	Energy, Conservation, GHG*				
EO-1.2.2	Trip Reduction & Alt. Modes	City of San Mateo SMART Carbon Counter City of Albuquerque Alternative Transportation	See EO-1.1				
EO-1.2.3	Green Building & Design	City of San Mateo Green Building	Conservation, Energy, Land Use				
EO-1.2.4	Waste Reduction, Recycling & Composting	San Francisco Composting Program City of San Mateo SMART Carbon Counter San Bernardino Reusable Bag Program	Conservation				
EO-1.2.5	Water Conservation & Efficient Design	Albuquerque Bernalillo County Water Utility Authority	Conservation, Land Use				

* Best-judgment category, i.e. depending on city/county circumstances and scope of General Plan elements, policy could also be included in other mandatory element or in other optional element

Table 2: Worksheet for Model Policies Evaluation (cont'd.)

Model Policy #	Policy Name/ Subject Area	Implementation Examples (click link to visit website)	Appropriate General Plan Element	Relative Effectiveness Reducing GHGs	Relative Difficulty to Implement	Relative Time for Reductions to Occur	Relative Cost
EO-1.2.6	Buying Local	San Francisco Farmers Market San Francisco Green Map City of Minneapolis Homegrown	See EO-1.1				
Objective: EO-2 The City/County will work with local businesses and energy providers on specific, targeted outreach campaigns and incentive programs.							
EO-2.1	Energy Efficiency Campaigns	City of Minneapolis Energy Challenge	Energy				
EO-2.2	Pedestrian and Bicycle Promotion	City of Berkeley Bike and Walking Maps 511 Bicycle Maps	Circulation				
Objective EO-3 The City/County will organize events and workshops to promote GHG-reducing activities.							
EO-3.1	Waste Reduction	Bay Area Green Business Program Shop Green City of Palo Alto Zero Waste Program	Conservation				
EO-3.2	Water Conservation	Bay Area Green Business Program Shop Green	Conservation				
EO-3.3	Energy Efficiency		Energy				
EO-3.4	Climate Protection Summit/Fair	Alameda County Downtown Menlo Park Goes Green Block Parties	Conservation, GHG				
EO-3.5	Schools Programs	City of Scottsdale EnviroKidsFest The Association for the Advancement of Sustainability in Higher Education	Energy, Conservation, GHG				
Objective EO-4 The City/County will sponsor competitions and awards to encourage GHG reductions and recognize success.							
EO-4-1	Climate Champions Awards	Climate All Stars Conference Columbus Green Spot	Conservation, Energy, GHG				
EO-4.2	GHG Reduction/ Climate Protection Competitions	Climate Protection Campaign Silicon Valley Leadership Group	See EO-4.2				
EO-4.2.1	Poster Contests at Schools, with Scholarships, Public Recognition	Climate Protection Campaign	See EO-4.2				
EO-4.2.2	Waste Diversion Contests between Schools or Other Groups	Waste Free Schools	See EO-4.2 (Especially Conservation)				
EO-4.2.3	Walkathons, Relays, & Other Challenges		See EO-4.2				

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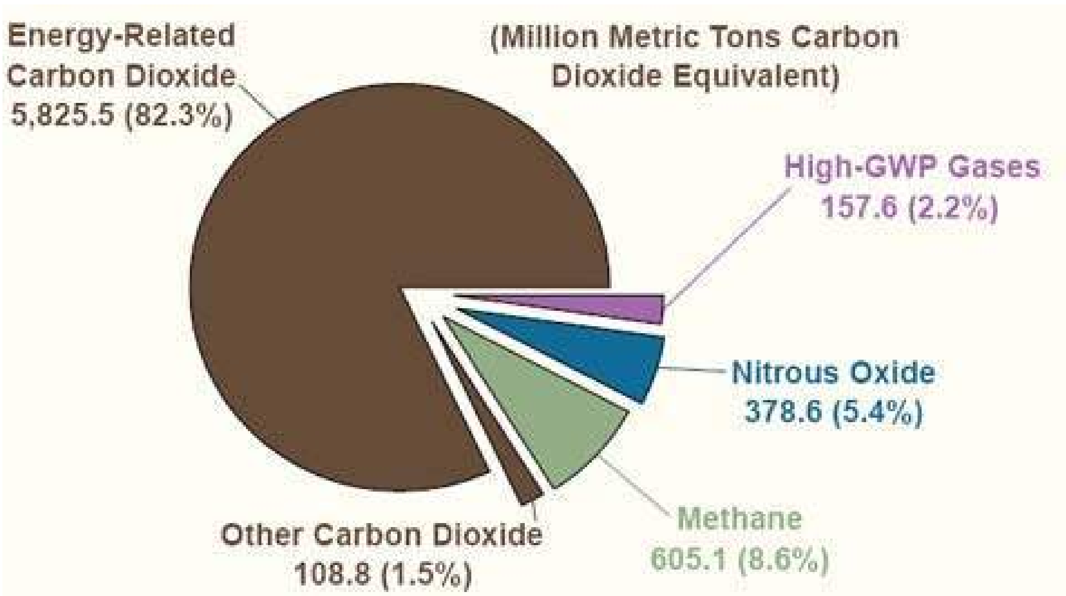
Appendix A

Greenhouse Gas Emissions in California

The characteristics, sources, and units used to quantify the six greenhouse gases (GHGs) listed in AB 32 are documented in this section in order of abundance in the atmosphere: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). (Water vapor, the most abundant GHG, is not included because natural concentrations and fluctuations far outweigh anthropogenic influences). Figure A-1 below shows U.S. emissions of these gases in 2006, with HFCs, PFCs and SF_6 collectively referred to as high-GWP (global warming potential) gases.

Figure A-1. U.S. Greenhouse Gas Emissions by Gas, 2006



Source: Energy Information Administration estimates,
http://www.eia.doe.gov/oiaf/1605/ggrpt/figure_1.html.
Note: High-GWP Gases include HFCs, PFCs, and SF_6.

In order to simplify reporting and analysis, methods have been set forth to describe emissions of GHGs in terms of a single gas. The most commonly accepted method to compare GHG emissions is the GWP methodology developed by the Intergovernmental Panel on Climate Change (IPCC). The IPCC defines the GWP of every GHG on a normalized scale of CO2e that compares the atmospheric heating potential of each GHG over a 100-year period to that of the same mass of CO2. (CO2 has a GWP of 1 by definition.) Generally, GHG emissions are quantified in terms of metric tons of CO2 equivalent (CO2e) emitted per year. For example, the IPCC finds that nitrous oxide has a GWP of 310 and methane has a GWP of 21. Thus, one ton of nitrous oxide emissions is represented as 310 tons of CO2e, and one ton of methane is 21 tons of CO2e. This allows for the summation of different GHG emissions into a single total.

Table A-1, below, lists the GWP of each GHG, its atmospheric life and concentration. Atmospheric concentration of a given compound is commonly described in units of parts per million (ppm), parts per billion (ppb) or parts per trillion (ppt), referring to the number of molecules of the compound in a sampling of one million, one billion or one trillion molecules of air.

Table A-1: Global Warming Potentials, Lifetimes and Abundances of Several Significant GHGs

Gas	Global Warming Potential (100 years)	Atmospheric Life (years)	1998 Atmospheric Concentration (ppt[1])
CO_2	1	50–200	365,000,000
CH_4	21	9–15	1,745
N_2O	310	120	314
HFC-23	11,700	264	14
HFC-134a	1,300	14.6	7.5
HFC-152a	140	1.5	0.5
CF_4	6,500	50,000	80
C_2F_6	9,200	10,000	3
SF_6	23,900	3,200	4.2

[1] ppt is a mixing ratio unit indicating the concentration of a pollutant in parts per trillion by volume.
Source: IPCC 1996; IPCC 2001.

Table A-2, below, lists the anthropogenic (man-made) emissions of GHGs as CO2e equivalents. As shown, CO2 is by far the largest component of worldwide CO2e emissions, followed by CH4, N2O, and high-GWP gases.

Table A-2: Global Anthropogenic Greenhouse Gas Emissions (CO_2 e)

Gas	CO_2e Percentage
CO_2 (deforestation, decay of biomass, etc)	17.3%
CO_2 (other)	2.8%
CO_2 (fossil fuel use)	56.6%
CH_4	14.3%
N_2O	7.9%
High-GWP[1] Gases (includes HFCs, PFCs, and SF6)	1.1%

[1] GWP stands for Global Warming Potential. Source: Olivier et al., 2005, 2006 in IPCC 2007b.

CO_2

CO2 is the most important GHG and accounts for more than 75% of all anthropogenic GHG emissions. Its long atmospheric lifetime (on the order of decades to centuries) ensures that atmospheric concentrations of CO2 will remain elevated for decades after

GHG mitigation efforts to reduce GHG concentrations are implemented (Olivier et al. 2005, 2006 in IPCC 2007b).

Increasing concentrations of CO2 in the atmosphere are largely due to emissions from the burning of fossil fuels, gas flaring, cement production, and land use changes. Three quarters of anthropogenic CO2 emissions are the result of fossil burning (and to a very small extent, cement production and gas flaring); the remainder results from land-use changes (IPCC 2007a).

Anthropogenic emissions of CO2 have increased concentrations in the atmosphere most notably since the industrial revolution; the concentration of CO2 has increased from about 280 ppm to 379 ppm over the last 250 years (IPCC 2001). IPCC estimates that the present atmospheric concentration of CO2 has not been exceeded in the last 650,000 years and is likely to be the highest ambient concentration in the last 20 million years (IPCC 2007a; IPCC 2001).

CH_4

CH4 , the main component of natural gas, is the second largest contributor to anthropogenic GHG emissions and has a GWP of 21 (Association of Environmental Professionals 2007; IPCC 1996). Anthropogenic emissions of methane primarily result from growing rice, raising cattle, combusting natural gas, and coal mining (National Oceanic and Atmospheric Administration 2005). Atmospheric methane has increased from a pre-industrial concentration of 715 parts per billion to 1,775 parts per billion in 2005 (IPCC 2001). Though it is unclear why, atmospheric concentrations of CH4 have not risen as quickly as anticipated (National Oceanic and Atmospheric Administration 2005).

N_2O

N2O is a powerful GHG, with a GWP of 310 (IPCC 1996). Anthropogenic sources of N2O include agricultural processes, nylon production, fuel-fired power plants, nitric acid production and vehicle emissions. Nitrous oxide is also used in rocket engines, racecars, and as an aerosol spray propellant. Agricultural processes which result in anthropogenic N2O emissions are fertilizer use and microbial processes in soil and water (Association of Environmental Professionals 2007). N2O concentrations in the atmosphere have increased from pre-industrial levels of 270 parts per billion to 319 parts per billion in 2005 (IPCC 2001).

HFCs

HFCs are man-made chemicals used in commercial, industrial and consumer products and have high GWPs (EPA 2006a). HFCs are generally used as substitutes for ozone depleting substances (ODS) in automobile air conditioners and refrigerants. As seen in Table A-1, the most abundant HFCs, in order from most abundant to least, are HFC-134a (35 parts per trillion), HFC-23 (17.5 parts per trillion), and HFC-152a (3.9 parts per trillion). Concentrations of HFCs have risen from zero to current levels. Because these chemicals are man-made, they do not exist naturally in ambient conditions.

PFCs

The most abundant PFCs include CF4 (PFC-14) and C2F6 (PFC-116). These man-made chemicals are emitted largely from aluminum production and semiconductor manufacturing processes. PFCs are extremely stable compounds that are only destroyed by very high-energy ultraviolet rays, which result in the very long lifetimes of these chemicals, as shown in Table A-1 (Environmental Protection Agency 2006). PFCs have large GWPs and have risen from zero to the current concentration levels shown in Table A-1.

SF_6

SF6, another man-made chemical, is used as an electrical insulating fluid for power distribution equipment, in the magnesium industry, in semiconductor manufacturing and also as a trace chemical for study of oceanic and atmospheric processes (Environmental Protection Agency 2006a). In 1998, atmospheric concentrations of sulfur hexafluoride were 4.2 parts per trillion, and steadily increasing in the atmosphere. SF6 is the most powerful of all GHGs listed in IPCC studies with a GWP of 23,900 (IPCC 1996).

Appendix B

AB 32 Programs

California's major law for reducing greenhouse gas (GHG) emissions is stipulated in Assembly Bill 32 (AB 32, Nunez) approved by Governor Schwarzenegger in 2006. The goals in AB 32 aim at reducing GHG emissions to 1990 levels by 2020 - a reduction of approximately 30 percent. The main strategies for making these reductions are outlined in the Scoping Plan adopted by the California Air Resources Board (ARB) in December 2008 and in the Discrete Early Action measures identified by ARB in 2007. The following are summaries of AB 32 Programs for reducing GHG emissions.

Discrete Early Action Measures

AB 32 established a statewide target for GHG reductions by 2020. AB 32 further required the ARB to adopt a plan and individual measures to achieve the maximum technologically feasible and cost-effective reductions in GHG emissions. AB 32 required ARB to identify a list of Discrete Early Action measures for implementation by January 1, 2010. ARB identified in 2007 nine Discrete Early Action measures, including potential regulations affecting landfills, motor vehicle fuels, refrigerants in cars, port operations and other sources. Refer to the ARB website at http://www.arb.ca.gov/cc/ccea/ccea.htm for detailed information about each measure and the timeline for implementation. Short descriptions of the Discrete Early measures follows.

Low Carbon Fuel Standard (LCFS)

The LCFS requires fuel providers to ensure that the mix of fuel they sell into the California market meets, on average, a declining standard for carbon intensity. By 2020, the LCFS will produce a 10 percent reduction in the carbon content of all passenger vehicle fuels sold in California. This is expected to replace 20 percent of on-road gasoline consumption with lower-carbon fuels, more than triple the size of the state’s renewable fuels market, and place more than 7 million alternative fuel or hybrid vehicles on California’s roads. The LCFS will use market-based mechanisms that allow providers to choose how they reduce emissions while responding to consumer demand. For example, providers may purchase and blend more low-carbon ethanol into gasoline products, purchase credits from electric utilities supplying low-carbon electrons (i.e., low carbon fuels used in the generation of electricity) to electric passenger vehicles, or diversify into low-carbon hydrogen as a product. In addition, new strategies yet to be developed will be included.

Landfill Methane Capture

This control measure will reduce methane emissions from municipal solid waste landfills by requiring gas collection and control systems on landfills where these systems are not currently required and will establish statewide performance standards to maximize methane capture efficiencies. Additionally, as part of this process, ARB and California Integrated Waste Management Board (CIWMB) staff will explore opportunities to increase energy recovery from landfill methane gas.

Reductions from Mobile Air Conditioning

These measures will control HFC release from do-it-yourself motor vehicle air conditioning (MVAC) servicing; require addition of leak tightness testing and repair during Smog Checks; enforce federal regulations on banning HFC release from MVAC servicing and dismantling; and require the use of low global warming potential (GWP) refrigerants for new MVAC.

Semiconductor Reduction

This measure proposes to reduce perfluorocarbon (PFC) and fluorinated gas from the semiconductor industry. The regulation will be designed to achieve the maximum reductions in PFC fluorinated gas emissions that are technically feasible and cost-effective.

SF_6 Reductions

SF6 is a potent GHG with a GWP of 23,900, one of the highest GWPs currently identified. SF6 is a versatile gas used in a multitude of sectors including the electric utility and semiconductor industries. (Utility and semiconductor industry-related emissions will be addressed under separate strategies.) This early action focuses on the non-utility and semiconductor-related emissions of SF6. Specifically, the strategy reduction measures will consider a potential ban on the use of SF6 where technologically feasible and cost-effective alternatives are available. The main uses of SF6 in California that are not directly related to utilities or semiconductor manufacturing include: magnesium casting operations; consumer products (tennis balls); medical uses (ultrasounds, eye surgery); tracer gas in leak testing (including fume hood testing), research and bioterrorism studies; insulator for particle accelerators; and etchant for flat panel display units.

High-GWP Consumer Products

Measures under this Discrete Early Action focus on reducing the use of compounds with high GWP in consumer products. This will be done by adding and modifying product category definitions in the existing consumer products regulation and establishing new or lower volatile organic compound (VOC) limits for multiple categories. The measures would also reduce the use of compounds with high GWP in pressurized gas duster products. A number of other modifications or clarifications are also proposed, including prohibiting the use of specified toxic air contaminants in carpet and upholstery cleaners, fabric protectants, multi-purpose lubricants, penetrants, sealant or caulking compounds, and spot removers. The consumer products measure is estimated to reduce CO2 equivalent emissions by 250,000 metric tons per year.

Heavy Duty Vehicle Measures

Under this Early Action measure, new and existing on-road tractors and trailers operating on California highways would need to be equipped with technologies to improve fuel efficiency. It is based on the U.S. EPA's SmartWay Program, which approves technologies, such as aerodynamic equipment and low-rolling resistance tires, and certifies tractors and trailers that incorporate these technologies. The proposed regulation would provide GHG and NOx emission reductions throughout California. Tractors and trailers that comply with the proposed regulation by proper use of aerodynamic equipment and low-rolling resistance tires are expected to achieve a fuel efficiency improvement ranging from 7 to 10 percent and provide GHG and oxides of nitrogen (NOx) emission reductions throughout California.

Tire Pressure Program

Maintaining proper tire pressure on vehicles improves fuel economy, and therefore reduces GHG emissions. This measure would place requirements on the automotive service industry regarding tire pressure checks and inflation pressure retention. While current federal law requires auto manufactures to install tire pressure monitoring systems in all new vehicles beginning September 1, 2007, owners of older vehicles lack this important tool.

Shore Power

Port electrification was identified as a Discrete Early Action measure. The proposed regulation, while reducing diesel PM and NOx emissions, would also result in significant reductions of CO2 emissions as a co-benefit of requiring cleaner grid supplied electrical generation for ocean-going vessels while docked. Auxiliary engines typically power lighting, ventilation, pumps, communication, and other onboard equipment while a ship is docked at a berth. The proposed regulations would require some vessels to turn off their auxiliary engines; it is expected, but not required, that many of those vessels would then receive their electrical power from shore while at berth.

AB 32 Scoping Plan

The Scoping Plan outlines a variety of measures and programs to reduce GHG emissions to 1990 levels by 2020. The plan includes development of a California cap-and-trade program that will be integrated with a broader regional market to maximize cost-effective opportunities to achieve GHG emissions reductions. The plan also includes transformational measures designed to help pave the path toward California’s clean energy future. The following are summaries of the proposed AB 32 measures and programs.

California Cap-and-Trade Program

A cap-and-trade program sets the total amount of GHG emissions allowable for facilities under the cap and allows covered sources, including producers and consumers of energy, to determine the least expensive strategies to comply. The emissions allowed under the cap will be denominated in metric tons of CO2e. The currency will be in the form of allowances which the State will issue based upon the total emissions allowed under the cap during any specific compliance period. Emission allowances can be banked for future use, encouraging early reductions and reducing market volatility. The ability to trade allows facilities to adjust to changing conditions and take advantage of reduction opportunities when those opportunities are less expensive than buying additional emissions allowances. California is working closely with other states and provinces in the Western Climate Initiative (WCI) to design a regional cap-and-trade program that can deliver reductions of GHG throughout the region. ARB will develop a cap-and-trade program for California that will link with the programs in the other WCI Partner jurisdictions to create a regional cap-and-trade program. In addition, a federal cap-and-trade program is being contemplated, and legislation (the Waxman-Markey Bill) is being developed. If the federal program is enacted, the development and implementation of the program will need to be closely coordinated with California. Federal preemption is a possibility.

California Light-Duty Vehicle GHG Standards

There are a number of programs identified under AB 32 that reduce GHGs by the way of light-duty vehicle emission standards. These programs include the AB 1493 (Pavley) GHG vehicle standards, zero-emission vehicle (ZEV) program, and the AB 118 (Nunez) Air Quality Improvement Program/Alternative and Renewable Fuel and Vehicle Technology Program.

AB 1493 directed ARB to adopt vehicle standards that lowered GHG emissions to the maximum extent technologically feasible, beginning with the 2009 model year. ARB adopted regulations in 2004 and applied to the U.S. EPA in 2005 for a waiver under the federal Clean Air Act to implement the regulation. The Pavley regulations incorporate both performance standards and market-based compliance mechanisms. To obtain additional reductions from the light-duty fleet, ARB plans to adopt a second, more stringent, phase of the Pavley regulations. U.S. EPA however, denied the California waiver in 2008 the issues entered litigation. As of February 2009, EPA began reconsidering the waiver request.

The ZEV program will play an important role in helping California meet its 2020 and 2050 GHG emissions reduction requirements. Through 2012, the program requires placement of hundreds of ZEVs (including hydrogen fuel cell and battery electric vehicles) and thousands of near-zero emission vehicles (including plug-in hybrids, conventional hybrids, compressed natural gas vehicles). In the mid-term (2012-2015), the program will require placement of increasing numbers of ZEVs and near-zero emission vehicles in California. In 2009, the Board will review the ZEV program to ensure it is optimally designed to help the State meet its 2020 target and put us on the path to meeting our 2050 target of an 80 percent reduction in GHG emissions from 1990 levels.

Under AB 118 (Núñez, Chapter 750, Statutes of 2007), ARB is administering the Air Quality Improvement Program, which provides approximately $50 million per year for grants to fund clean vehicle/equipment projects and research on the air quality impacts of alternative fuels and advanced technology vehicles. AB 118 also created the Alternative and Renewable Fuel and Vehicle Technology Program and authorized CEC to spend up to $120 million per year over seven years (2008-2015) to develop, demonstrate, and deploy innovative technologies to transform California's fuel and vehicle types.

Energy Efficiency Programs

The Scoping Plan relies heavily on energy efficiency to reach its GHG emissions reduction goals. Programs include the California Long Term Energy Efficiency Strategic Plan and the Solar Hot Water and Efficiency Act of 2007.

Renewables Portfolio Standard

California's current Renewables Portfolio Standard (RPS) is intended to increase procurement from eligible renewable energy resources to reach 20 percent by 2010. Increased use of renewables will decrease California's reliance on fossil fuels, thus reducing emissions of GHGs from the electricity sector. Based on Governor Schwarzenegger's call for a statewide 33 percent RPS, the Scoping Plan anticipates that California will have 33 percent of its electricity provided by renewable resources by 2020, and includes the reduction of GHG emissions based on this level. Achieving the 33 percent goal will require broad-based participation from many parties and the removal of certain barriers. The CEC, CPUC, California Independent System Operator (CAISO), and ARB are working with California utilities and other stakeholders to formally establish and meet this goal.

Regional Transportation-Related GHG Targets

On September 30, 2008, Governor Arnold Schwarzenegger signed SB 375 (Steinberg) which establishes mechanisms for the development of regional targets for reducing passenger vehicle GHG emissions. Through the SB 375 process, regions will work to integrate development patterns and the transportation network in a way that achieves the reduction of GHG emissions while meeting housing needs and other regional planning objectives. This new law reflects the importance of achieving significant additional reductions of GHG emissions from changed land use patterns and improved transportation to help achieve the goals of AB 32. SB 375 requires ARB to develop, in consultation with metropolitan planning organizations (MPOs), passenger vehicle GHG emissions reduction targets for 2020 and 2035 by September 30, 2010. It sets forth a collaborative process to establish these targets, including the appointment by ARB of a Regional Targets Advisory Committee (RTAC) to recommend factors to be considered and methodologies for setting GHG emissions reduction targets. RTAC members were appointed in January 2009. An explanation of SB 375 from bill author Darrell Steinberg can be found at the Institute for Local Government website at http://www.ca-ilg.org/sb375 .

Million Solar Roofs Program

The Million Solar Roofs Program is a ratepayer-financed incentive program aimed at transforming the market for rooftop solar systems by driving down costs over time. Created under Senate Bill 1, the Million Solar Roofs Program includes CPUC's California Solar Initiative and CEC's New Solar Homes Partnership, and requires publicly-owned utilities (POUs) to adopt, implement and finance a solar incentive program. This measure would offset electricity from the grid, thereby reducing GHG emissions.

Industrial Emissions

These measures would be implemented through a regulation requiring each facility to conduct an energy efficiency audit of individual combustion and other direct sources of GHGs within the facility to determine the potential reduction opportunities, including criteria air pollutants and toxic air contaminants. The audit would include an assessment of the impacts of replacing or upgrading older, less-efficient units such as boilers and heaters, or replacing units with combined heat and power units. In addition, ARB has identified four specific measures for development and implementation, two for oil and gas recovery operations and gas transmission, and two for refineries.

High-Speed Rail

The Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century was approved by California voters in 2008. A high-speed rail (HSR) system is part of the statewide strategy to provide more mobility choice and reduce GHG emissions. This measure supports implementation of plans to construct and operate an HSR system between northern and southern California. As planned, the HSR is a 700-mile-long rail system capable of speeds in excess of 200 miles per hour on dedicated, fully-grade separated tracks with state-of-the-art safety, signaling and automated rail control systems. The system would serve the major metropolitan centers of California in 2030 and is projected to displace between 86 and 117 million riders from other travel modes in 2030.

Green Building Strategy

A Green Building strategy offers a comprehensive approach to reducing direct and upstream GHG emissions that cross-cut multiple sectors including Electricity/Natural Gas, Water, Recycling/Waste, and Transportation. Green buildings are designed, constructed, renovated, operated, and maintained using an integrated approach that reduces GHG emissions by maximizing energy and resource efficiency. Employing a whole-building design approach can create synergies that result in multiple benefits at little or no net cost, allowing for efficiencies that would never be possible on an incremental basis.

Recycling and Waste

ARB will work with the California Integrated Waste Management Board (CIWMB) to develop and implement programs to reduce waste and materials at the source of generation and increase recycling which will result in the reduction of GHG emissions and other co-benefits. ARB will also work with the California Department of Food and Agriculture, the Department of Transportation, and others to provide direct incentives for the use of compost in agriculture and landscaping. Further, CIWMB will explore the use of incentives for all recycling and waste management measures, including commercial recycling, and for local jurisdictions to encourage the collection of residentially and commercially generated food scraps for composting and in-vessel anaerobic digestion.

Sustainable Forests

The 2020 Scoping Plan target for California's forest sector is to maintain the current 5 MMTCO2e of sequestration through sustainable management practices, including reducing the risk of catastrophic wildfire, and the avoidance or mitigation of land use changes that reduce carbon storage. California's Board of Forestry and Fire Protection has the existing authority to provide for sustainable management practices, and will, at a minimum, work to maintain current carbon sequestration levels. The Resources Agency and its departments will also have an important role to play in implementing this measure.

Water

Six GHG emission reduction measures are proposed for the water sector: water use efficiency; water recycling; water system energy efficiency; reuse urban runoff; increased renewable energy production; and public goods charge. Three of the measures target reducing energy requirements associated with providing reliable water supplies and two measures are aimed at reducing the amount of non-renewable electricity associated with conveying and treating water. The final measure focuses on providing sustainable funding for implementing these actions.

Agriculture

The Scoping Plan encourages the capture of methane (CH_4) through use of manure digester systems at dairies to provide emission reductions on a voluntary basis. This measure is also a renewable energy strategy to promote the use of captured gas for fuels or power production. Nitrogen fertilizer, which produces N2O emissions, is the other significant source of GHGs in the agricultural sector. ARB has begun a research program to better understand the variables affecting fertilizer N2O emissions, and based on the findings, will explore opportunities for emission reductions.

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Appendix C

Other Programs to Reduce GHG Emissions

There are many programs already underway in California at the state, regional and local levels to reduce GHG emissions. These programs seek new and innovative ways to require or promote reductions in GHG emissions through new standards and incentives designed to increase energy efficiencies and renewable energy production, advance green technologies and cleaner fuels, and improve our land use development patterns and waste management, among others. Such programs are occurring worldwide. Appendix C focuses only on the major GHG emission reduction programs in California.

State of California

Assembly Bill 118(Nunez) - Alternative and Renewable Fuel and Vehicle Technology Funding

This program is intended to increase the use of alternative and renewable fuels and innovative technologies that will transform California's fuel and vehicle types to help attain the state's climate change policies. Upon appropriation by the State, approximately $120 million will be allocated annually as incentives to public agencies, vehicle and technology consortia, businesses, public-private partnerships, workforce training partnerships and collaboratives, fleet owners, consumers, recreational boaters, and academic institutions, for projects that:

Develop and improve alternative and renewable low-carbon fuels;

- Optimize alternative and renewable fuels for existing and developing engine technologies;
- Produce alternative and renewable low-carbon fuels in California;
- Decrease the overall impact of an alternative and renewable fuel's life-cycle carbon footprint and increase sustainability;
- Expand fuel infrastructure, fueling stations, and equipment;
- Improve light-, medium-, and heavy-duty vehicle technologies;
- Retrofit medium and heavy-duty on-road and non-road vehicle fleets;
- Expand infrastructure connected with existing fleets, public transit, and transportation corridors; and
- Establish workforce training programs, conduct public education and promotion, and create technology centers.

Senate Bill 1368 (Peralta) - GHG Emissions Performance Standards

The law limits long-term investments in baseload generation by the state's utilities to power plants that meet an emissions performance standard (EPS) jointly established by the California Energy Commission (CEC) and the California Public Utilities Commission (PUC).

The CEC has designed regulations that:

- Establish a standard for baseload generation owned by, or under long-term contract to, publicly owned utilities, of 1,100 lbs CO_2 per megawatt-hour (MWh). This will encourage the development of power plants that meet California's growing energy needs while minimizing their emissions of GHGs;

- Require posting of notices of public deliberations by publicly owned utilities on long-term investments on the CEC website. This will facilitate public awareness of utility efforts to meet customer needs for energy over the long term while meeting the State's standards for environmental impact, and;

- Establish a public process for determining the compliance of proposed investments with the EPS.

California Solar Initiative

The California Solar Initiative a collaborative effort between the PUC and CEC initiated in 2006, has a statewide goal to install 3,000 MW of new solar electricity capacity by 2016 - moving the state toward a cleaner energy future and helping lower the cost of solar systems for consumers. The initiative has a statewide budget of $3.3 billion over 10 years. The California Solar Initiative provides solar incentives to customers in investor-owned utility territories of Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric. These three utilities represent about 75-80% of California's electricity use. The California Solar Initiative provides cash back for solar for existing homes, and existing and new commercial, industrial, government, non-profit, and agricultural properties.

Executive Order S-14-08

On November 17, 2008 Governor Schwarzenegger signed Executive Order (EO) S-14-08 directing all state agencies to work toward a 33% RPS by 2020. A 33% renewable energy target would further California’s efforts to address climate change and lead the nation in clean energy policy. Specifically, the Executive Order stated the following:

- The EO calls for a new, more aggressive renewable energy target, increasing the current goal of obtaining 20% of California’s energy from clean, renewable resources by 2010 to 33% by 2020.

- The EO directs a restructuring of the process for developing specific renewable energy sites. The EO has a goal of reducing permitting process times for developing renewable energy sites by 50 percent.

- The Governor will propose legislation that will codify the new higher standards and reform the renewable pricing structure at the PUC to make them competitive and get projects built sooner.

Landfill Methane Capture Strategies

The California Integrated Waste Management Board (CIWMB) has identified strategies for increasing landfill methane capture to reduce methane emissions by 2020. The Landfill Methane Capture Strategy includes three core components:

- Install New Methane Control Systems at Landfills Currently Without Control Systems. The control measure will reduce methane emissions from landfills by requiring gas collection and control systems on landfills generating significant methane where these systems are not currently required; it will also establish statewide performance standards to maximize methane capture efficiencies.

- Maximize Landfill Methane Capture Efficiencies. The CIWMB is developing a guidance document to help landfill operators and regulators evaluate potential actions to achieve additional GHG emission reductions from landfills beyond what are currently occurring with existing landfill practices. The study is based on an evaluation of existing state-of-the-practice technologies, as reflected in published literature, reports to regulatory agencies, and the project team's familiarity and experience with specific landfill and landfill gas practices and projects.

- Increase Recovery of Landfill Gas as a Biomass Renewable Energy Source. The CIWMB is providing technical assistance and incentives, and further developing options, in consultation with ARB, CEC, and PUC, to increase recovery of landfill gas. The CIWMB awarded two grants totaling $1 million to demonstrate commercial scale production of liquefied natural gas (LNG) vehicle fuel from landfill gas. The CIWMB is also providing matching funding to demonstrate an innovative anaerobic composting design and process sited at a landfill to increase recovery of biogas for energy and recover a residual compost product from yard wastes otherwise used as landfill alternative daily cover.

California Adaptation Strategy

The California Resources Agency is currently developing a California Adaptation Strategy. The strategy will be developed by collecting, synthesizing, and communicating to the greatest extent possible, how sea level rise, temperature rise and duration, and precipitation changes due to climate change will exacerbate existing fire, flood, water quality, air quality, habitat loss, human health and drought. The Strategy will also examine how risks associated with these changes will impact the state's economy, infrastructure, human populations, and environment. In addition, it will also outline those solutions which can be implemented that promote resiliency to climate change impacts posing the greatest risks to California and consider key economic, health, and environmental issues.

Caltrans Climate Action Program

The California Department of Transportation (Caltrans) Office of Policy Analysis and Research (OPAR) Climate Action Program coordinates the department's effort in response to AB 32, the Climate Action Team (CAT), the Governor's executive orders, Administration policies, and related legislative rulings. OPAR works with the CAT, ARB, regional agencies, and other stakeholders on cross-agency policy framework and research focusing on GHG emissions reduction and energy-efficiency measures. The program's functional responsibilities include:

- Coordinating and monitoring climate activities and strategies across departmental programs, including planning functions statewide;
- Serving as a primary point of contact for issues related to climate change and transportation energy; and
- Working to mainstream GHG emissions reduction and energy-efficiency measures into transportation planning and project development.

California Water Plan

The California Department of Water Resources (DWR) addresses climate change in its California Water Plan, which is updated every five years. The plan provides a framework for water managers, legislators, and the public to consider options and make decisions regarding California's water future. In addition, DWR in October 2008 released its report *Managing an Uncertain Future; Climate Change Adaptation Strategies for California's Water* which focuses discussion on the need for California's water managers to adapt to impacts of climate change. The report proposes 10 adaptation strategies in four categories which may be incorporated into the California Water Plan

Air Districts

Air Pollution Control Districts and Air Quality Management Districts throughout the state have implemented a variety of climate protection programs over the past several years. The following is a small sampling of some air district programs.

Bay Area Air Quality Management District

In 2005, the Bay Area Air Quality Management District (BAAQMD) initiated a Climate Protection Program that acknowledges the link between climate protection and programs to reduce air pollution in the greater San Francisco Bay Area. The Board of Directors also formed a standing Committee on Climate Protection to provide direction on BAAQMD climate protection activities. BAAQMD is continually seeking ways to integrate climate protection into current District functions, including grant programs, CEQA commenting, regulations, inventory development, and outreach. In addition, the District's climate protection program emphasizes collaboration with ongoing climate protection efforts at the local and State level, public education and outreach and technical assistance to cities and counties. The following are some of BAAQMD's Climate Protection Programs:

- *Climate Protection Grant Program:* In 2007 the BAAQMD awarded $3 million to fund 53 local projects that will significantly reduce the Bay Area's carbon footprint. This $3 million represents the largest single source of funding available for climate protection projects in the Bay Area, and makes the District one of the top funders of climate protection activities in the country.

  - *4th and 5th Grade Curriculum: Protect Your Climate* is a climate protection curriculum targeted at 4th and 5th graders. The curriculum's 16 lessons investigate the science and causes of climate change and how students can take action to protect our climate. Through hands-on activities, students learn ways to reduce GHG emissions from energy, waste, and transportation. Lessons are connected to the California state content standards. After successfully completing a pilot year in 2007-2008, the curriculum program was expanded to include 40 classrooms in the 2008-2009 school year. The participating teachers and approximately 1,000 students in the program are learning how to take action for climate protection in their classrooms, homes, and communities

  - *GHG Regional Inventory*: In 2006 the BAAQMD published *Source Inventory of Bay Area GHG Emissions*, the Bay Area Regional GHG Emission Inventory for base year 2002. The District is developing an updated regional GHG emission inventory which will reflect Bay Area emissions from the year 2005.

  - *ICLEI-BAAQMD Workshop Series:* The BAAQMD has an ongoing partnership with ICLEI-Local Governments for Sustainability to host a series of local government workshops on developing GHG emission inventories and selecting climate protection strategies. Workshops have been hosted for local governments in San Mateo, Santa Clara, and Marin counties. The District and partners ICLEI, PG&E and MTC have provided workshop participants with city-specific data sets and hands-on training. Over 30 local government staff have participated and developed GHG emission inventories for their communities.

- *GHG Fee for Stationary Sources Adopted:* On May 21, 2008, BAAQMD's Board of Directors approved a new fee on air pollution sources in the region to help defray the costs of the District's climate protection work. Industrial facilities and businesses that are currently required to submit an air quality permit to operate will have the modest fee of 4.4 cents per metric ton of GHG emissions added to their permit bill. The fee will apply to Climate Protection Program activities related to stationary sources.

Sacramento Metropolitan Air Quality Management District

The Sacramento Metropolitan Air Quality Management District (SMAQMD) has started a formal program to address climate change. Elements include GHG inventory, work practices, commute incentives, building retrofits and education. Currently SMAQMD is researching and developing enhancements to the District's Climate Protection Program. Those enhancements include: 1) the creation of a GHG emissions "bank," 2) the creation of a program which would facilitate GHG mitigation for CEQA purposes, 3) an enhanced reporting system and; 4) assurances that climate protection measures do not cause increases in criteria pollutants. In addition, SMAQMD has done the following in regards to the Climate Protection Program.

- *California Climate Action Registry (CCAR) and The Climate Registry* The SMAQMD joined the CCAR in March of 2006 and is a founding member of The Climate Registry. The Climate Registry consists of organizations that are voluntarily taking actions to reduce their GHGs. Among the required actions are annually tracking and reporting their GHGs and having them certified by an independent auditer. The District has completed its emissions inventory for 2005, 2006 and 2007 and all three years of data have been certified.

- *Greenergy® member* The SMAQMD subscribes to this Sacramento Metropolitan Utility District program which matches electricity use with renewable electricity sources.

- *Clean Vehicles* Most of the SMAQMD vehicles are hybrids. Employees regularly use these vehicles to conduct air quality inspections at the sites. (Currently, of the District's 23 vehicles, 19 are 2005 Toyota Priuses. When their lease ends in February 2011, the District will look to replace the Priuses with even greener vehicles.)

- *Alternate Transportation Policies* The SMAQMD provides incentives to employees to commute using public transit, car or van pools, and bicycles or by walking. Over 60% of the District's employee work trips are made by alternate modes instead of driving alone.

- *Building Retrofits* The SMAQMD has already implemented several measures at its main office building to improve energy efficiency and reduce its carbon footprint, including: 1) replacing light bulbs with more energy-efficient bulbs, 2) installing motion sensors on the majority of its light switches and placing other lights on timers and 3) installing a new digitally-based HVAC control system. The District is pursuing LEED EB (Existing Building) certification (level still TBD) for its building and a next step is to have a LEED EB Gap Analysis performed to determine what steps remain to achieve LEED EB certification.

San Joaquin Valley Unified Air Pollution Control District

In August 2008 the San Joaquin Valley Air Pollution (SJVAPCD) Control District's Governing Board adopted a Climate Change Action Plan (CCAP). The CCAP directed the Air Pollution Control Officer to develop guidance documents to assist land use and other permitting agencies in addressing GHG emissions as part of the CEQA process; investigate the development of a GHG banking program; enhance the existing emissions inventory process to include GHG emissions reporting consistent with new state requirements; and administer voluntary GHG emission reduction agreements. These items would then be brought before the District's Governing Board for their consideration in late summer 2009. The goals of the CCAP are to assist local land use agencies comply with CEQA for projects with GHG emissions, assist Valley businesses in complying with state law related to GHGs, and to ensure that collateral emissions from GHG emission reduction projects do not adversely impact public health or environmental justice communities in the Valley. The following are potential programs considered within the CCAP: (1) GHG guidance for CEQA; (2) carbon exchange program; (3) GHG emissions reporting; and (4) voluntary GHG mitigation agreements. The implementation of these actions, if determined to be warranted and feasible, will be determined with extensive stakeholder input.

South Coast Air Quality Management District

The South Coast Air Quality Management District (SCAQMD) is actively engaged in Climate Change activities to maximize the synergies between strategies to reduce criteria pollutants, toxics, and greenhouse gases (GHG). The following highlights selected SCAQMD efforts:

- *Climate Change Committee*: In Spring 2008, the SCAQMD established a Board-level Climate Change Committee to oversee SCAQMD's efforts related to implementation of AB 32 and provide enhanced guidance to local governments regarding climate change issues.

- *Climate Change Policy*: In September 2008, the SCAQMD Board approved a formal Climate Change Policy. It states: *"It is the policy of the South Coast Air Quality Management District (SCAQMD) to actively seek opportunities to reduce emissions of criteria, toxic, and climate change pollutants and maximize synergistic effects of strategies that reduce emissions in more than one of these categories. It is the policy of the SCAQMD to assist businesses and local governments implementing climate change measures, decrease the agency's* *carbon footprint and provide information regarding climate change to the public. If greenhouse gas reduction strategies have potential negative impacts or slow progress in reducing criteria or toxic pollutants, the impacts must be carefully evaluated and disclosed. In these instances, public health protection should prevail in the majority of circumstances. This policy provides additional direction to staff relative to future actions related to greenhouse gas emission reductions and climate change."*

The Policy includes 8 specific action areas to implement the above policy.

- *Inventory*: To show its support for efforts to inventory and reduce GHG emissions, SCAQMD has voluntarily prepared a GHG inventory. The SCAQMD has also reported voluntarily to the California Climate Action Registry (CCAR) for the last several years.

- *SoCal Climate Solutions Exchange*: The objective of the SoCal Climate Solutions Exchange is to ensure real, surplus, verifiable GHG reductions from voluntary, early actions. This provides incentives for local investments and assists local businesses in capturing voluntary early GHG reductions. Added benefits are the retention of co-pollutant benefits and stimulus for the local economy. Three rules were adopted in late 2008 and early 2009 to implement this program – Rule 2700 – General; Rule 2701 – SoCal Climate Solutions Exchange; and Rule 2702 – GHG Reduction Program. SCAQMD staff serves as the verifiers for emission reductions that follow pre-approved protocols.

- *California Environmental Quality Act (CEQA)*: To provide guidance to local lead agencies on determining significance for GHG emissions in their CEQA documents, the SCAQMD convened a GHG CEQA Significance Threshold Working Group. Members of the working group include government agencies implementing CEQA and representatives from various stakeholder groups that will provide input to the SCAQMD staff on developing GHG CEQA significance thresholds. On December 5, 2008, the SCAQMD Governing Board adopted an interim GHG significance threshold for projects where the SCAQMD is lead agency. Work is underway regarding recommendations for a GHG threshold for other applications.

- *Technology Advancement Assistance:* SCAQMD oversees a comprehensive program to co-sponsor public-private demonstration and deployment projects for lower-emission fuels, vehicles, and technologies in local fleets. Co-funded fleet acquisitions include low-emission natural gas school & transit buses, clean heavy-duty vehicles, plug-in hybrid electric conversions, and other advanced propulsion vehicles & equipment.

- *Technical and Policy Forums*: The SCAQMD periodically holds clean-energy forums and roundtables to bring together experts on a variety of topics, including GHG reduction strategies. Archived event materials can be viewed at the

SCAQMD website: visit aqmd.gov, click on upper tab "Technology," then select "Technology Forums" from the drop-down menu.

- *Leading by Example*: The SCAQMD headquarters facility is considered a “green building” because of its unique design and state-of-the art features such as fuel cells, 60-kilowatt micro turbines, high efficiency chillers, and energy efficient lighting. The building’s exterior design includes windows of a high-efficiency glass which allows light in, but keeps heat out. The building roof is a reflective material which aids in reducing air conditioning load during sunny days. The SCAQMD maintains one of the largest alternatively-fueled fleets in the country, with vehicles running on electricity, compressed natural gas, gasoline, hydrogen or other hybrid combinations.

San Luis Obispo County Air Pollution Control District

In November 2005, the SLOAPCD Board adopted its Climate Protection Plan. Implementation of the plan has been given a high priority and resulted in the following activities and accomplishments:

- *Community Outreach:* A comprehensive outreach program for climate protection was developed, with a countywide survey conducted to determine the level of public knowledge and action on the issue. Presentations have been made to every city council and the county as well as at various public forums regarding the impacts of climate change and how to reduce greenhouse gas emissions locally. A community stakeholder group has been formed with representatives from all local jurisdictions meeting regularly to discuss development of GHG inventories and action plans.

- *GHG Inventory Development:* Municipal and communitywide GHG inventories are being compiled for all local jurisdictions in the region, with a regional emissions report and action plan to be developed based on the inventories.

- *Grant Funding for GHG Reduction Programs:* The District has allocated $440,000 in grant funds for climate protection to provide incentive grants for reducing GHGs in the county; a third of those funds will be used as seed money for implementation of community climate action plans initiated by local jurisdictions.

- *Evaluation of Existing District Programs:* District staff have completed a review of existing regulations and programs to determine the level of GHG reductions already achieved by those programs and what changes can be made to enhance those reductions.

- *Regional Planning:* The District is working with the Council of Governments, LAFCO and the County to develop a preliminary Sustainable Communities

Strategy to include in the 2010 update of the Regional Transportation Plan.

- *Community Partnerships and Programs:* The District is a founding member or on the steering committee for several community groups working to reduce energy consumption and GHG emissions, including the following: The Strategic Energy Alliance for Change (SEAChange) which sponsors public forums and outreach on renewable energy and clean fuels; the Central Coast Clean Cities Coalition, which fosters the advancement and use of clean fuels; the 2030 Challenge Task Force, whose mission is to promote the achievement of carbon free, zero energy buildings by 2030; and SLO Car Free, whose goal is to promote car-free tourism throughout the County.

Ventura County APCD

- *Air – the search for one clean breath*: a 41-minute award-winning high-definition film produced by the District and funded primarily by a U.S. Environmental Protection Agency grant, features information on climate change via a visit to the British Antarctic Core Survey Program at Cambridge, England, to interview Dr. Robert Mulvaney, an international ice core expert. DVD copies were given to every air district in the country, and the film is being screened throughout the United States and internationally. Teacher lessons for the film will be available online this summer at www.airthefilm.org. They will be aligned with the California State content standards for science, history, and social science. Several of the lessons will concentrate on global climate change.

- *Climate Change Presentations:* The District markets a 20-minute PowerPoint presentation on Global Climate Change to service organizations, senior groups, schools and other organizations. Since its inception in 2008, the program has been presented to over 600 individuals.

- *District Legislative Platform*: The District has amended its legislative platform to allow for the support legislation that implements cost-effective measure to reduce greenhouse gases.

- *Green Urban Fleets*: The District is providing funding to support low-carbon alternative fuel fleets operating in urban environments.

Northern Sonoma County APCD

The Northern Sonoma County Air Pollution Control District participates in climate protection programs on its own as an air district and through CAPCOA. Most District efforts, however, are undertaken in partnership with the County of Sonoma, its nine cities, the Sonoma County Water Agency, and the Agriculture and Open Space Preservation District. Key District efforts include:

- Offering small grants for projects that reduce GHG emissions through its "Sustainability and Trip Reduction Program," approved by the District's Board in 2008.

- Working with local high schools and the Sonoma County Climate Protection Campaign to incorporate climate change awareness and analysis of student travel patterns into the curriculum, and to support campaigns to reduce VMT associated with commute to school.

- Participation in the steering committee overseeing the efforts to achieve the commitment made by Sonoma County and all of its nine cities to reduce GHG emissions by 25% by 2015.

- Participation in the county-wide effort to deploy a vehicle charging network to support electric vehicle technology.

- Participation in the partnership with Nissan to deploy 1,000 electric vehicles in Sonoma County by 2011.

Regional GHG Reduction Programs

The Western Climate Initiative (WCI)

The WCI is a cooperative effort of seven U.S. states and four Canadian provinces that are collaborating to identify, evaluate, and implement policies to reduce GHG emissions, including the design and implementation of a regional cap-and-trade program. The Initiative began in February 2007 with the governors of Arizona, California, New Mexico, Oregon, and Washington, who have since been joined by the premiers of British Columbia, Manitoba, Ontario, and Quebec, and the governors of Montana and Utah. Participation in the WCI reflects each partner's strong commitment to identify, evaluate, and implement collective and cooperative actions addressing climate change. In addition, WCI was created to focus on a market-based cap-and-trade system.

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Appendix D

Projected Climate Change Impacts to California

In California and throughout western North America, signs of a changing climate are evident. During the last 50 years, winter and spring temperatures have been warmer, spring snow levels in lower- and mid-elevation mountains have dropped, snowpack has been melting one to four weeks earlier, and flowers are blooming one to two weeks earlier. These regional changes are consistent with global trends. If left unchecked, by the end of the century CO2 concentrations could reach levels at which climate change impacts would severely impact our public health, economy, and environment.

State of the art climate modeling was performed for the California Energy Commission (CEC) to determine potential future impacts of climate change in California under three different scenarios: a low emissions scenario that assumes aggressive action is taken to reduce GHG emissions, a medium emissions scenario assuming moderate level GHG reductions, and a high emissions scenario that assumes little action is taken to reduce emissions. The range of potential impacts modeled was summarized in a 2006 CEC document called: “Our Changing Climate: Assessing the Risks to California.” The document details the growing severity of consequences predicted statewide as temperature rises, and also identifies those impacts that may be unavoidable and for which we will need to develop coping and adaptation strategies. That information is summarized below to aid jurisdictions in determining the scope and focus of the policies needed to address climate change through the General Plan process.

Increase in the Number of Extreme Heat Days

Current models predict that extreme heat events in California will worsen in both frequency and intensity over the next several decades. Heat waves that once lasted days could last for weeks or even most of an entire season. Heat waves are especially dangerous to vulnerable groups, such as infants, the elderly and those with pre-existing health conditions.

The impacts of heat waves tend to be greater in urban areas because of the “heat island” effect and higher levels of air pollution from transportation. The heat island effect occurs when urban areas replace natural land cover with darker man-made materials such as pavement for parking lots and roads. These materials tend to collect and retain heat at a higher rate than a natural landscape, which causes the urban areas to be hotter than nearby open spaces. Heat island area impacts are expected to increase the frequency, duration, and intensity of conditions conducive to air pollution formation. Health impacts may be influenced by the timing and characteristics of heat waves. Extreme heat events that happen early in the summer tend to result in more deaths than those that occur later in the summer, as people have not yet acclimatized to warmer weather. Moreover, nighttime minimum temperatures are increasing more rapidly than daytime maximum temperatures, which can further increase temperature stress to the elderly and people with pre-existing health conditions, such as circulatory, respiratory and nervous system problems. Furthermore, extreme heat related illnesses place stress on health infrastructure and can lead to significant economic costs.

Increased electricity demand is an additional concern associated with extreme heat days, as the heavy demand to operate air conditioning raises the risk of power shortages. Heavy electricity usage, which is often generated using fossil fuels, means more pollutant emissions, including GHGs.

Increase in the Number and Intensity of Wildfires

Wildfires can have a severe impact on California's air quality and public health. In the coming years, wildfires are expected to increase in intensity and frequency due to climate change, producing more extreme bad air days and longer fire seasons. This negatively impacts the health of the population and results in higher economic costs to California.

Smoke is made up of a mixture of gases and fine particles produced when wood and other organic matter burn. Fine particulate matter (PM) from smoke can cause a variety of adverse health effects ranging from eye and respiratory tract irritation to serious illness, such as reduced lung function, bronchitis, aggravation of asthma, and premature death. aggravation of pre-existing respiratory and cardiovascular disease and increased mortality. PM can also affect the body's immune system and make it more difficult to remove inhaled foreign materials from the lungs, such as pollen and bacteria.

Wildfires also have major economic impacts, costing California hundreds of millions of dollars in firefighting and medical costs; damage to property, natural areas and agricultural lands; loss in tourism, other businesses and employment; increased insurance rates; and a host of other impacts.

Rise in Sea Level and Increased Risk of Flooding

California sea levels have risen about 7 inches over the past 150 years and are projected to rise an additional 4 to 28 inches over the next century as a result of climate change. As sea levels rise, California can expect species and habitat shifts, changes in intensity and frequency of rainfall and coastal storms, increased flooding and changes in runoff patterns. A rise in coastal water temperatures is also anticipated, which will affect water quality and conditions for all marine life that depend on oxygen.

California coastal areas are especially vulnerable to rising sea levels. Increasingly severe winter storms, high tides, and rising mean sea levels are expected to cause more frequent and severe erosion, flooding, and damage to coastal structures. California coastal areas are at risk for the following:

- Erosion of beaches and bay shores;
- Inundation of low-lying uplands;
- Increased flooding and erosion of marshes, wetlands and tidal flats;
- Increased flooding and storm damage in low-lying coastal areas;

- Vulnerable to episodic storm surges and destructive waves that penetrate further inland; and
- Increased salinity in estuaries, marshes, coastal rivers, and coastal aquifers.

Water supplies are also at risk. Rising sea levels would aggravate saltwater intrusion which would degrade California's estuaries, coastal aquifers, wetlands, and groundwater aquifers, and threaten the quality and reliability of the Sacramento-San Joaquin River Delta water transfer system. Higher tide levels caused by higher sea levels could also pose problems to the Delta levee systems with a risk of more inland inundation and the corresponding threat to water quality.

Decrease in Snowpack and Early Run-Off: Effects on Water Supply

Water is already a scarce resource in California and is likely to become more scarce in the coming decade. Water demand is expected to increase because of rising temperatures and increasing population; at the same time, water supply is expected to decrease. California's water supply system relies on a network of dams, reservoirs and canals which are dependent upon water supplied by the snowpack in the Sierra Nevada Mountains. The Sierra Nevada snowpack provides natural water storage, storing winter precipitation in the form of snow and releasing it in the spring and early summer as the snow melts. This system is estimated to hold about half the storage capacity of California's major reservoirs.

Recent studies show that if heat-trapping GHG emissions continue unabated, more precipitation will fall as rain instead of snow, and the snow that does fall will melt earlier, reducing the Sierra Nevada spring snowpack by as much as 70 to 90 percent by the end of this century. Decreasing snowmelt and spring stream flows coupled with increasing demand for water could lead to increasing water shortages, which could exacerbate drought conditions and increase the diversion of rivers in California. The Central Valley relies heavily on Sierra Nevada snowmelt in the summer for drinking water and agriculture. As river flows decrease, competition for scarce water resources increases. California Energy Commission reports project a 15% to 30% reduction in surface water supply to California's cities and farms over this century as a result of climate change.

Increase in the Intensity of Severe Storms

The IPCC predicts changes in precipitation due to increasing global surface temperatures. Rising global surface temperatures are expected to increase the activity of the world's hydrologic cycle and increase the moisture content of the atmosphere. In addition, rising temperatures are expected to increase water vapor in the atmosphere which is a GHG and will likely provide a positive feedback mechanism for climate warming. Global average precipitation is expected to increase during this century; however, it will not be distributed evenly. Certain areas are expected to receive extra precipitation while others, including California and the southwestern deserts, are expected to receive less.

Research indicates that climate change can cause hurricanes and tropical storms to become more intense, last longer, and have stronger winds. Scientists hypothesize that higher water temperatures are one of the causes of longer and stronger storms, since hurricanes and tropical storms get their energy from warm water. As sea surface temperatures rise, developing storms will contain more energy. Weather patterns have also become more variable, causing longer and drier droughts and longer winter and spring flooding. In recent years, due to high-intensity storms, water flows on many California rivers have been the largest on record. Levees, dams, and flood bypasses are forced to manage flows for which they weren't designed.

Specifically to California, the Sacramento-San Joaquin River Delta is susceptible to flooding. The Delta is composed of 70 islands and tracts and has land surfaces at or below mean sea level. Some Delta Islands are now 25 feet below mean sea level as a result of farming and soil erosion. Levee failure is a significant threat and could result in potential loss of human life, damage to property, and agricultural crops, significant harm to the Delta's fragile ecosystem, disruption of utilities and highways, and water supply disruption due to levee failure and changes in salinity levels.

Effects on Human Health Due to Climate Change

Summer temperatures in California under some climate models are projected to increase by 2°C to 7°C (3.6°F to 12.6°F) by the end of this decade. These temperature increases are expected to affect human health in a number of ways including negative effects on air pollution, heat-related mortality, effects on various infectious diseases, and increase in wildfires.

Higher temperatures are expected to increase the frequency, duration, and intensity of conditions conducive to ozone formation, a pervasive air pollution problem in California causing a wide range of respiratory and cardiovascular problems, particularly for the elderly and very young. Considerable improvement in ozone levels has been achieved over the past three decades as a result of California's aggressive anti-pollution programs. However, under a moderate warming scenario, climate models predict a potential increase of 75 to 85 percent more days with weather conducive to ozone formation in Los Angeles and the San Joaquin Valley, relative to today's conditions.

Likewise, if temperatures rise to the higher warming range, by 2100 there could be up to 100 more days per year with temperatures above 90°F in Los Angeles and above 95°F in Sacramento. Extremely high temperatures increase the number of people who die on a given day by causing the cardiovascular system to work harder to keep the body cool, aggravating existing heart problems; increasing respiratory distress; and causing heat exhaustion. This is predicted to result in two to three times more heat-related deaths than occur today.

Climate change may also increase the risk of some infectious diseases, particularly those that thrive in warm areas. Diseases often associated with hot weather, including the West Nile virus, cholera, and Lyme disease are spreading rapidly throughout North America and Europe because increased temperatures in these areas allow disease carriers such as mosquitoes, ticks, and mice to thrive.

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Appendix E

Top 10 Actions by Local Governments and Communities

Top Ten Actions by Local Governments and Communities

The most effective and efficient greenhouse gas reductions within the control of local governments will depend on the particular greenhouse gas (GHG) profile within each community, the status of GHG reduction planning to date, and the economic conditions relative to different strategies. Not all strategies will work equally within the diversity of cities and counties in California. However, the following ten strategies are widely applicable throughout California in varying degrees and are the recommended initial local government focus for future General Plan policies, Climate Action Plan development, and Blueprint Planning:

1) promotion of smart growth, jobs/housing balance, transit-oriented development, and infill development through land use designations, zoning, and public-private partnerships;

2) support for and funding of transit, bicycle, and pedestrian connections through transit and trail planning and regional cooperation;

3) promotion of energy- and water-efficient buildings (e.g., LEED buildings) through green building ordinances, project timing prioritization, and other implementing tools;

4) promotion of green procurement and alternative fuel vehicle use through municipal mandates and voluntary bid incentives;

5) support for alternative fuel facilities and infrastructure through land use designations, zoning, and public-private partnerships;

6) support for renewable energy generation (utility and residential) through feasibility evaluations, land use designations, and zoning;

7) promotion of waste diversion, recycling, energy efficiency and energy recovery in cooperation with public services districts and private entities;

8) support for urban and rural forestry through tree planting requirements and programs;

9) community outreach and education to foster community involvement, input, and support for GHG reduction planning and implementation; and

10) regional cooperation to find cross-regional efficiencies in GHG reduction investments and to plan for regional transit, energy generation, and waste recovery facilities.

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Appendix F

Agency Responsibilities for Programs on Climate and GHGs

Appendix F provides information on California State agencies and how they are addressing climate change and GHG reductions in their policies and programs. The following are thumbnail summaries of State programs for reducing GHG emissions. Links are provided at the end of each summary where additional information can be found.

Climate Action Team (CAT)

Established by Governor Schwarzenegger under an Executive Order S-05-05 on June 1, 2005, the CAT coordinates state-level actions relating to Climate Change. The Team is led by the Secretary of the California Environmental Protection Agency and includes the Secretary of the Business, Transportation and Housing Agency, Secretary of the Department of Food and Agriculture, Secretary of the Resources Agency, Chairperson of the Air Resources Board, Chairperson of the Energy Commission and President of the Public Utilities Commission. The CAT is charged with implementing global warming emission reduction programs and reporting on the progress made toward meeting the statewide GHG reduction targets that were established in the Executive Order. The CAT is divided into 11 subgroups which are focused on supporting the Scoping Plan--the roadmap to meet the state's GHG reduction goals. The CAT members will play a key role in developing and implementing the reduction measures adopted in the Scoping Plan. Furthermore, the Executive Order mandated the preparation of a biennial assessment on climate change science, impacts, and adaptation. The CAT has released the draft Climate Action Team Biennial Report for 2009. The draft report can be found at this link: http://www.energy.ca.gov/2009publications/CAT-1000-2009-003/CAT-1000-2009-003-D.PDF . The draft report addresses four climate change topics which include: impacts of climate change on California's public health, infrastructure and natural resources; economic impacts of climate change on California; climate change research in California; and state efforts to adapt to current and future effects of climate change.
http://www.climatechange.ca.gov/climate_action_team/index.html

California Air Resources Board (CARB)

CARB is tasked to oversee California's major initiatives for reducing climate change or GHG emissions as outlined in AB 32, and 2005 Executive Order S-3-05. These efforts aim at reducing GHG emissions to 1990 levels by 2020 - a reduction of approximately 30 percent, and then an 80 percent reduction below 1990 levels by 2050. The main strategies for making these reductions are outlined in the Scoping Plan which was adopted by the Board in December 2008.

The Scoping Plan provides an outline for actions to reduce California's GHG emissions. The Scoping Plan now requires the CARB and other state agencies to adopt regulations and other initiatives reducing GHGs. Many of these measures will be developed in 2009 and 2010 and go into effect in 2012. The following are some of the regulations and activities that CARB will be implementing: energy efficiency/co-benefits audits of large stationary sources; refinery flare recovery; SF6 emission reduction from the electrical

sector and particle accelerators; landfill methane control measures; stationary equipment refrigerant management program; and foam recovery and destruction program. For a complete list of regulations and measures that CARB is considering, please see the Scoping Plan at:
http://www.arb.ca.gov/cc/scopingplan/scopingplan.htm .

In addition to AB 32, CARB is involved with other state climate change programs which include SB 375 and Clean Car Standards (AB 1493—Pavley). As described in Chapter 2, SB 375 is a state law that requires CARB to set regional targets to reduce greenhouse gas emissions from passenger vehicles for 2020 and 2035. If regions develop integrated land use, housing and transportation plans that meet the SB 375 targets, new projects in these regions can be relieved of certain review requirements under CEQA. The targets apply to the regions in the State covered by the 18 metropolitan planning organizations (MPOs).

Under AB 1493, CARB adopted regulations that achieve the maximum feasible and cost-effective reduction in greenhouse gas emissions from motor vehicles. The regulations would reduce GHG emissions from California passenger vehicles by about 22 percent by 2012 and about 30 percent by 2016. For these regulations, however, the Federal Clean Air Act requires a waiver from the U.S. EPA. Initially, the request was denied, but the U.S. EPA as of February 2009 is currently reconsidering rehearing of the waiver request.
http://www.arb.ca.gov/cc/cc.htm

Board of Forestry

The Board of Forestry (BOF) has been involved in the development of forest protocols and how the Forest Practices Act could better address climate mitigation and adaptation policies. BOF has worked with Cal Fire to update the 2003 Assessment of Forests and Rangelands to provide more discussions and analysis on climate change; BOF also helps develop the State's Fire Management Plan which provides policy direction for the state on combating fires. In developing this plan, BOF will consider climate change in its considerations. Furthermore, CARB's Scoping Plan states that the forest sector must achieve a "no net loss" target, which means it must achieve reductions in CO2 equivalent to the current statewide forest carbon budget. BOF has further been tasked by CARB to implement approaches to reach this target. BOF plans to use a combination of regulatory, statutory and incentive-based approaches to meet these goals.
http://www.fire.ca.gov/resource_mgt/resource_mgt_EPRP_Climate/climate_change_board.php

California Coastal Commission

The California Coastal Commission is developing a planning manual for how stakeholders should address climate change within the California Coastal Act (CCA). The Coastal Commission is planning to develop a document and website that will help stakeholders interpret and implement projects under the CCA. In addition the Commission completed the following in connection with its climate change activities: a

workshop on climate change for the Commission Board; establishment of an internal climate change task force to better understand the relationship between climate change and the CCA; addressing how to incorporate GHG mitigation requests into permit conditions within large projects before the Commission; and participation on the Coastal States Organization Climate Change Work Group, which developed a report, "The Role of Coastal Zone Management Programs in Adaptation to Climate Change."
http://www.coastal.ca.gov/climate/climatechange.html

California Coastal Conservancy

The California Coastal Conservancy has taken the following actions in regards to climate change: developing Climate Change Grant Assessment Criteria for project design; reduction of the Conservancy's overall carbon footprint; and improved planning for future climate impacts to land and water management efforts. The Conservancy is also interested in the "permanent protection or restoration of important habitat corridors affecting significant populations of various species" as an important measure of success. The Conservancy will assess both land and freshwater species as pertaining to climate change impacts.
http://www.scc.ca.gov/index.php?cat=26

California Conservation Corps (CCC)

The CCC has taken the following actions in regards to climate change: implementing a number of programs to reduce its carbon footprint; promoting a more environmentally-friendly labor force by increasing spikes (work from mobile camps) to project work sites to reduce vehicle mileage and maximize time on tasks; increasing fleet vehicle use; developing demonstration projects that sequester carbon and reduce energy and water use; engaging in additional urban and wildland forestry projects, such as tree planting and fuel reduction activities and; participating in climate education that furthers climate action awareness through highly visible project work and public education strategies.
http://www.ccc.ca.gov/#

California Department of Food and Agriculture (CDFA)

The CDFA is addressing the issues of global warming through development of carbon sequestration strategies and GHG reduction strategies for agriculture, promotion of energy and water use efficiency in agriculture, biological control measures, and support for biofuels development. Some specific programs administered include the Rice Straw Utilization Program, which ties into carbon sequestration and biofuels production. Other projects in the Minor Crops Block Grant Program address carbon sequestration and energy efficiency in agriculture. The CDFA is also seeking to reduce the use of petrochemical-based pesticides and fertilizers, which release GHG to the atmosphere, through the Biological Control Program, which substitutes biological organisms for pesticides, and the Fertilizer Research and Education Program, which reduces fertilizer use and promotes carbon sequestration. The Drainage Water Reduction Program and

Reuse and Salt Utilization Program result in more efficient use of irrigation water, resulting in less energy used for water pumping. The CDFA promotes the California production and use of bioethanol and biodiesel as renewable fuels. The Dairy Digester Cost Share Program expands the use of dairy digesters, which convert dairy manure and the methane gas derived from it into electricity, process heat, compost, and carbon dioxide. The conversion of dairy methane to carbon dioxide reduces the global warming potential by about 90% while providing energy.
http://www.cdfa.ca.gov/AHFSS/Emergency_Preparedness/Climate_Change.html

California Department of Forestry and Fire Protection (Cal Fire)

Cal Fire has taken the following actions in regards to climate change: reducing Cal Fire's carbon footprint; participating as an active member of the CAT Forest and Land-Use Sector Groups; assisting in the development of the original forest carbon protocols that were recently adopted by CARB; actively developing new protocols on public lands, urban forestry, and working forests; developing the climate strategy for the Forestry CAT that included detailed descriptions on Reforestation/Afforestation, Forest Conservation, Forest Management, Urban Forestry, and Fuels Reduction/Biomass Production; and participating in several current programs that improve the ability of our forests to adapt to the projected impacts of climate change in California. These programs include the California Forest Improvement Program, the Vegetation Management Program, the Nursery and Seed Bank Program, the Urban Forestry Program, the Forest Legacy Program, and Fuel Hazard Reduction.
http://www.fire.ca.gov/index.php

California Energy Commission (CEC)

The CEC has played an important role in coordinating and implementing state activities addressing climate change. These activities include the following: involvement in a number of activities supporting implementation of AB 32 and other climate activities such as reductions in GHG emissions through energy efficiency, renewable energy and alternative transportation fuel programs; serving on the CAT and leading the Land Use Subgroup of the Climate Action Team (LUSCAT); participating on 11 CAT subgroups responsible for developing action items that will result in quantifiable greenhouse gas emission reductions; conducting a joint proceeding with the CPUC on AB 32 implementation in the electric sector and making joint recommendation to the ARB in February 2008; conducting scientific research on climate change through the Public Interest Energy Research Program (PIER) and the California Climate Change Center; developing climate research and a Development, Demonstration and Deployment Road Map with the ARB and other state agencies to achieve GHG emission reduction and adaptation goals; providing technical support to the California Climate Action Registry in developing greenhouse gas emission protocols; qualifying third-party organizations to provide technical assistance and certification of emissions baselines and inventories; supporting CARB's statewide greenhouse gas emissions inventory for updates and accuracy; participating in the working groups of the Western Climate Initiative to identify, evaluate and implement collective and cooperative ways to reduce GHGs in the West; and providing policy guidance and monitoring international, national and regional developments and activities impacting clean energy and climate change issues.

Furthermore, the CEC's PIER Program supports research to produce environmentally sound, safe, reliable and affordable energy services and products. In conjunction with other state agencies, PIER is addressing climate change by leading the development of a long-term climate change research plan for California. Under PIER, energy efficiency and generation technologies are under development that could significantly contribute to the decline of in-state greenhouse gas emissions. In addition, PIER is seeking to improve understanding of the implications of climate change by supporting research on potential costs and impacts was well as possible adaptation and mitigation measures. http://www.energy.ca.gov/climatechange/index.html

California Environmental Protection Agency (Cal/EPA)

Under existing law, the CARB, CEC, and the California Climate Action Registry all have responsibilities with respect to control of greenhouse gas emissions. New legislation requires the Secretary for Environmental Protection to coordinate greenhouse gas emission reductions and climate change activity in state government. Cal/EPA is addressing climate change through its assessment of environmental indicators in the Environmental Protection Indicators for California (EPIC) project. EPIC was created to develop scientifically based measures that convey complex information on environmental status and trends in an easily understandable format. EPIC supports Cal/EPA's commitment to using measurable results in judging the effectiveness of the state's efforts directed at environmental protection. In its first year, EPIC developed a framework in which to select indicators that are important in tracking the state of California's environment. For climate change, the indicators selected were carbon dioxide emissions, air temperature, Sierra Nevada snowmelt runoff, and sea level rise in California. In the future, EPIC will investigate other greenhouse gas emissions, such as methane and nitrous oxides, and correlate different data sets that show increasing climate patterns in California. Cal/EPA will continue to evaluate, improve, and expand on the EPIC project to ensure that it provides meaningful information for understanding the state of the California environment for planning and decision making.
http://www.climatechange.ca.gov/

California Integrated Waste Management Board (CIWMB)

The CIWMB is addressing climate change issues through recycling programs, which avoid emissions from the energy-intensive processing of virgin raw materials; through sustainable building activities, which emphasize energy, water, and materials efficiency thereby reducing emissions from their production and transport; and through landfill gas collection, which directly uses landfill greenhouse gas emissions for fuel. The CIWMB is implementing the State Agency Buy Recycled Campaign (SABRC) program which,

under state law, requires all state agencies to use recycled products when available and increase acceptance and awareness of recycled-content product use in the private sector as well as state and local government. CIWMB runs the one of the largest recycled-content databases on the web, including construction and demolition recycling databases. The CIWMB has played a key role in the Sustainable Buildings Task Force, and is currently developing the Sustainable Building Training Program. In an interagency study, the CIWMB will develop a methodology to incorporate life-cycle costing into the state's capital outlay design. CIWMB participated in the Collaborative for High Performance Schools to assist in building energy and resource-efficient California schools and runs a program to promote efficient landscape design and maintenance practices among landscaping professionals. CIWMB also has been instrumental in the U.S. Green Building Council's Green Building Rating System. The CIWMB is pursing conversion technologies such as gasification and hydrolysis of solid waste to produce alternative fuels such as ethanol, thereby offsetting greenhouse gas emissions from fossil fuel sources. The conversion of solid waste destined for landfills to useful products such as ethanol reduces the organic fraction going into landfills. It is the organic fraction which generates landfill gas, a significant source of greenhouse gas emissions. The CIWMB also directly benefits greenhouse gas reduction by ensuring compliance with state minimum standards for landfill gas monitoring, collection, and control.
http://www.ciwmb.ca.gov/climate/

California Ocean Protection Council (OPC)

OPC has taken the following actions in regards to climate change: coordinating ocean impacts; establishing policies that will guide those agencies responsible for ocean protection; and helping to coordinate the state's efforts to adapt to the ocean impacts of climate change. OPC is working on determining potential impacts along the coast due to sea level rise, including impacts to public infrastructure.
http://www.opc.ca.gov/

California Public Utilities Commission (CPUC)

The CPUC is responsible for a number of energy-related policies and initiatives that benefit consumers and the economy, and have corresponding reductions in GHGs. Some of these policies and initiatives are described as follows:

- Energy Efficiency - The CPUC launched an energy efficiency and conservation campaign in which the agency allocated almost $3 billion in funding for energy efficiency programs in 2006-2008.

- Renewable Energy - California has the most ambitious goals in the nation for renewable energy. The State’s Renewable Portfolio Standard requires utilities to obtain 20% of their power from renewable resources by 2010, as mandated under SB 107 (Simitian). The CPUC oversees utility progress toward this goal and identifies steps toward meeting the Governor’s target of 33% by 2020.

- Emissions Performance - The CPUC instituted a new GHG emissions performance standard to regulate contracts with electricity generation facilities. Mandated by SB 1368 (Perata), the standard, known as EPS, ensures that any long-term power commitments to meet California's energy needs are at least as clean as California's existing energy portfolio.

- Emerging Technologies - The CPUC approved $11 million per year in funding support for emerging energy efficiency technologies from 2006 through 2008.

- Advanced Metering - The CPUC has authorized distribution tariffs since 2001 to fund utility incentives for customer-owned clean generation such as fuel cells and solar energy. This is a part of a plan for replacing conventional customer electric meters with an Advanced Metering Infrastructure (AMI), giving customer new access to information and greater control over their energy use and bills. http://www.cpuc.ca.gov/PUC/energy/climate+change/

California Resources Agency

The California Resources Agency is providing leadership in promoting and implementing climate policies across the state through its 25 departments, commissions, boards and conservancies, through the Governor's Climate Action Team efforts, and through engagement in national and international climate policy dialogues. These efforts range from working to reduce the Resource Agency's overall carbon footprint, to setting state climate policy direction through the development of a state climate adaptation strategy, to representing California in the recent U.N. Framework Convention on Climate Change Convention in Indonesia. The Resources Agency has been active in developing a climate adaptation strategy (CAS) for the state that begins to address how California can and should prepare for short-, medium-, and long-term risks from expected climate impacts. Mitigating carbon emissions has and should be a central focus of California climate policies, but helping California adapt to known climate impacts will need to be on equal footing to address climate risks to the state's resources. In addition, the Resources Agency is:

- In the process of accounting for all Resources-wide GHG emissions. At the same time, the Agency is working with all of its departments, commissions, boards, and conservancies to reduce its overall carbon footprint in internal operations, project activities, and amongst its grantees and contractors when possible;

- Leading the Forestry Climate Action Team Scoping Group. The Resources Agency has been Chairing the Forestry Climate Action Team (FCAT) sector group that has focused on developing a forest sector strategy for the Scoping Plan, revising the state's greenhouse gas inventory for the forests, developing new forest protocols, discussing offsets, and the climate adaptation strategy for the forest sector;

- Revising CEQA Guidelines to address greenhouse gas mitigation and adaptation. Under SB 97 (Dutton), the Resources Agency is working with the Governor's Office of Planning and Research to develop Technical Guidelines for how GHGs should be considered in the California Environmental Quality Act (CEQA). It is planned that this effort will be completed by 2010;

- Providing Climate Policy Coordination and Leadership within the Agency. Monthly "Climate Leaders" meetings with the Lead Climate person within each Resources organization are held to discuss recent happenings on climate-related topics;

- Revising bond-money grant guidelines to incorporate climate change. The Resources Agency is developing climate change grant criteria for several programs within its organization to begin to track the carbon emissions and sequestration from Resources programs;

- Initiating a forestry sub-group as part of the Western Climate Initiative, with Washington and Oregon;

- Partnering with the Coastal States Organization (CSO). The Resources Agency chairs the CSO where the Chair's Initiative proposes that coastal climate change be one of the three top priorities of the CSO. The organization has adopted the Adaptation to Climate Change Policy to better coordinate state and national efforts. The Coastal States Stewardship Foundation, in collaboration with the Coastal States Organization, is creating the Coastal States Campaign to Adapt to Climate Change;

- Involved with the West Coast Governors' Agreement on Ocean Health. Part of the recommendations from the West Coast Governors Agreement on Ocean Health Action Plan will be to address climate change adaptation by conducting a west-coast-wide assessment of anticipated impacts of climate change over the next several decades and setting a plan for how to adapt to such changes. http://resources.ca.gov/energy_and_climate_change.html

California Department of Transportation (Caltrans)

Caltrans is addressing climate change by reducing emissions through energy efficiency measures and use of alternative technologies to lessen the emissions from the state transportation system, vehicle fleet, and reduction of time spent in cars and in traffic. In fiscal year 2001/2002 Caltrans surpassed energy efficiency goals by saving $7.5 million, primarily due to the statewide Light Emitting Diode (LED) Traffic Signal upgrade project. This achievement has led to significant emissions reductions in energy generation, and is being expanded through implementation of non-vehicular energy conservation activities, such as reducing the energy to traffic signals, roadway and sign lighting, facility operations and procedures, and bridge and tunnel operations. Caltrans' Greening the Fleet Initiative uses viable, emerging technologies to reduce mobile source

emissions. So far, nineteen hybrids and 758-gas/propane bi-fuel trucks were purchased. Low emission trucks have replaced 54 diesel-powered trucks, and zero emission static inverters have replaced generators on 34 trucks. Solar panels have replaced fossil fuel-powered accessories. These efforts will continue with the goal of making significant emissions reductions and leading California fleet operators. Caltrans will also reduce mobile source emissions through its transportation energy efficiency program, the Smart Transportation and Livable Community Initiative, with the goal of reduced fuel consumption and vehicle miles traveled, and increased transit ridership and vehicle occupancy. The Transportation System Management and Congestion Relief programs seek to reduce emissions by minimizing travel demand and congestion while maximizing traffic efficiency. Applications include electronic toll collection on bridges, traffic signals, ramp meters, and many more. The New Technology Program will continue to research, demonstrate, and deploy new technologies to increase travel efficiency.
http://www.dot.ca.gov/hq/tpp/offices/opar/climate.html

Department of Conservation (DOC)

The DOC is addressing climate change issues and GHG reductions through a number of actions and programs which include the following:

- The DOC is working with The Climate Registry and several of its members in devising documentation procedures for several emission sources, such as work travel in personal vehicles and rental cars that are currently not required but strongly encouraged.

- Both the Division of Recycling and the Division of Land Resource Protection have revised their grant programs to include GHG reduction as a means to encourage and support lower-emitting projects.

- DOC participates on the following CAT subcommittees: Land Use, Recycling and Waste, Agriculture, Water, Energy and Economic.

- DOC's Division of Oil, Gas and Geothermal Resources is working with the California Energy Commission and other state and federal agencies, as mandated by AB 1925 (Blakesee). DOC is helping to assess the technical and economic feasibility of carbon sequestration in California.

- DOC established a department-wide Climate Action Team (CoolCATS) consisting of representatives from each Division. This team will measure DOC's carbon footprint and identify meaningful and feasible strategies to reduce that footprint.

- Each division within DOC is systematically educating their staff on the principles of sustainability. http://www.conservation.ca.gov/Index/Pages/Index.aspx

Delta Protection Committee (DPC)

The DPC has identified sea level rise as a central threat facing the Delta in the DPC 2006-2011 Strategic Plan. The DPC has initiated a process to update its 1995 Land Use and Resource Management Plan for the Primary Zone of the Delta and will include findings on climate change policies and recommendations for action that local and state government can take to address the impacts of climate change on the Delta.
http://www.delta.ca.gov/

Department of Fish and Game (DFG)

The DFG is addressing climate change issues and GHG reductions through a number of actions and programs which include the following:

- Implementing California's Wildlife Action Plan which identifies climate change as one of DFG's four primary stressors affecting wildlife (along with growth and development, water management conflicts, and invasive species) and makes recommendations to incorporate climate change science in restoration work.

- Providing climate leadership through personnel additions.

- Taking a lead among the state fish and wildlife agencies to begin to address the uncertainty associated with a changing climate through landscape scale efforts that support managing robust populations and healthy habitats. The Department also has many targeted efforts underway focused at climate change research, monitoring and other more specific actions.

- Creating a task force to provide the leadership to reduce or mitigate the production of greenhouse gases by the Department, and to prepare for the current and future harmful impacts of climate change on California's natural resources through policy and meaningful action.

- Convening stakeholders and partners from the NGO community, academia, state and federal agencies. This stakeholder group will provide direct input to the Director's Task Force as well as maintaining and increasing communication and collaboration among stakeholders and Department of Fish and Game.

- Developing a website that will serve as both a resource to Department employees as well as a message to the public and partners about the Department of Fish and Game's commitment to addressing the challenges of a changing climate in all of its endeavors.

- Evaluating the carbon impact of all departmental operations as part of the Climate Change Registry and as a Resources Agency-wide effort.

- Participating with the Resources Agency on the forestry, land-use and water, energy and transportation CAT subgroups, and advising the state on factors relating to adaptation and mitigation for climate change effects on wildlife and natural resources.

- Working with State Parks, Cal Fire and other Resources Agency departments and the Biodiversity Council to build a comprehensive library of published literature, popular articles, and other information on climate change effects that will be made available to the public. DFG has also developed complementary data and enhanced close collaboration with sister state agencies to help inform decisions ranging from levee placement to park management to highway interchange placement.

- Representing wildlife interests on the climate action working group of the Western Governors Association and the Climate Change subcommittee for the Association of Fish and Wildlife Agencies. http://www.dfg.ca.gov/climatechange/

Department of General Services (DGS)

The DGS is addressing climate change issues and GHG reduction through a number of actions and programs which include the following:

- Developing and implementing energy savings strategies such as the Better Buildings Program, ensuring energy savings in state building projects and schools.

- Assisting, through the Office of Fleet Administration's (OFA) Alternative Fuel Vehicle (AFV) Program, state agencies in meeting federal AFV purchasing requirements, which helps reduce dependence on foreign oil and help reduce GHG emissions.

- Establishing a vehicle purchase policy which requires gasoline vehicles purchased for the state fleet to meet the Air Resources Board’s ultra low-emission vehicle standard.

- Promoting the use of recycled products in the construction and maintenance of state buildings

- Monitoring in real time the energy use in state facilities to foster conservation efforts. http://www.green.ca.gov/default.htm

Department of Toxic Substances Control (DTSC)

The DTSC is addressing climate change issues through its Pollution Prevention and Technology Development Program. Hazardous waste reduction and recycling activities reduce impacts on the environment as well as the impacts from transportation, management and disposal. As one example, the development of water-based cleaning systems in lieu of solvent-based systems reduces resource consumption and promotes sustainability. Through the incorporation of life-cycle thinking, DTSC's pollution prevention activities take a holistic, multi-media approach, incorporating energy and materials efficiency as well as air, land and water emissions reductions.
http://www.dtsc.ca.gov/

Department of Water Resources (DWR)

The DWR is addressing climate change issues through a number of actions and programs which include the following:

- Developing a DWR Renewable Resources Policy that would meet the intent of the State's Renewable Portfolio Standards by establishment of a goal under which a percentage of load would be met by use of renewable resources.
- Refurbishing generating and pumping units to increase their efficiency as part of the State Water Project Energy Efficiency Improvements.
- Promoting combined-cycle plants and renewable resources at its facilities.
- Developing an adaptation plan for the state's water resources within the State Water Plan effort.
- Serving as a co-leader and actively participating in the CAT Water and Energy Scoping Group.
- Actively pursuing projects and research that promote carbon sequestration on DWR lands. www.water.ca.gov/climatechange/

Office of Planning and Research (OPR)

OPR is addressing climate change through education about using renewable energy sources, and through Smart Growth, and Vital Communities Initiatives. Innovative Clean Air Technologies (ICAT), GIS State Energy Map, Energy Educational Forum, and Stationary Fuel Cell Collaborative are among the initiatives led by the office. OPR held renewable energy forums from May through November of 2001 in an effort to meet the Governor's goal to increase renewable sources to supply twenty percent of all California's energy needs by 2010. The forums focused on biomass, wind, geothermal, solar, and fuel cell energy, which lead to significant reductions in greenhouse gas emissions as

compared to fossil fuel generated energy. OPR led an Interagency Task Force on Green Accounting that revised the 1987 Standard Practices Manual (2001) which provided finance and accounting procedures for using life-cycle analysis for state projects. The same Task Force is worked on a Comprehensive Energy Efficiency and Renewable Plan for the State On-Site State Buildings and a "Renewable Grid Connected Generation Plan" which supports the financial potential of the Governor's Renewable Portfolio Standard. Furthermore, addressing climate change and GHGs in CEQA projects has emerged as a major issue. Pursuant to Senate Bill 97 (Dutton)(Chapter 185, 2007) OPR is in the process of developing CEQA guidelines “for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions.” OPR is required to “prepare, develop, and transmit” the guidelines to the Resources Agency on or before July 1, 2009. As part of its continuing service to professional planners, land use officials, and CEQA practitioners, OPR, in collaboration with the California Resources Agency, Cal/EPA, and ARB, has published a technical advisory containing informal guidance for public agencies as they address the issue of climate change in their CEQA documents.
http://opr.ca.gov/index.php?a=ceqa/index.html

State and Consumer Services Agency (SCSA)

SCSA which also houses the Department of General Services (DGS) and the Department of Consumer Affairs, has used the emissions reductions of energy savings programs such as the Building Better Buildings program, energy conservation awareness programs such as the Flex Your Power campaign, as well as emissions reduced from mobile sources in the "Green Fleet" program to address climate change in California. Along with the CIWMB, the SCSA has ensured significant energy and resource savings in major state building projects which amount to over $1 billion, substantially cutting emissions from energy generation. An example of this is the Capitol Area East End project. DGS, as property managers for numerous state government buildings, is cutting energy use through building electricity metering, energy control systems, and extensive recycling. Through the DGS, the Alternative Fuel Vehicle Program is creating a government fleet that produces less greenhouse gas emissions than standard gasoline powered cars by relying on Ultra Low Emission and Super Ultra Low Emission vehicles. The program is also working to deploy fuel cell vehicles as part of the state fleet and to promote the use of electric vehicles. SCSA also promotes energy conservation and efficiency in homes and schools through education and awareness programs. An example is the Flex Your Power campaign implemented by the Department of Consumer Affairs.
http://www.scsa.ca.gov/

State Lands Commission

The State Lands Commission is addressing climate change issues through a number of actions and programs which include the following:

- Inclusion of GHG emissions from leases in environmental impact reports (EIRs). The Commission is requiring greenhouse gas reports for leases involving major projects. For projects that completed their EIRs before AB 32, the Commission is requiring a supplemental report on greenhouse gases. For example, a supplemental greenhouse gas report was produced for the Poseidon desalination project since the EIR was completed before passage of AB 32.

- Sea Level Rise Planning. The Commission is requiring that oil terminals be modified so that they can accommodate anticipated sea level rise over the life of the terminal. The Commission is beginning to consider the effects rising sea levels will have on the mean high tide line and, consequently, State Lands' jurisdiction. http://www.slc.ca.gov/

State Parks

The State Parks is addressing climate change issues and GHG reductions through a number of actions and programs which include the following:

- Planning a reduction strategy by using solar power systems, installing better insulation, and by buying lower-emission vehicles. In addition, the buildings Parks hopes to build (e.g., restrooms, visitor centers, etc., using bond funds) will have to meet high energy-efficiency standards by Executive Order of the Governor.

- Promoting carbon sequestration in State Park projects. Because forests and other plants absorb and store carbon dioxide from the atmosphere, Parks is trying to reduce its total amount of GHGs affecting our climate through Parks land stewardship and land acquisition strategies.

- Working with universities to monitor the success of different species at different altitudes in the face of climate change. And, consistent with Parks' educational mission, the entire project will be interpreted to visitors as a working example of climate change adaptation and mitigation.

- Modifying its land stewardship priorities to help species adapt to the effects of climate change. The available science suggests Parks need to be purchasing and protecting habitat corridors that move up in elevation so species have somewhere to migrate as the temperatures increase. State Parks also have to consider how an increase in sea level could affect our properties, in particular coastal properties. Sea level rise may require relocating our coastal infrastructure.

- Hosting a seminar with UC Berkeley's California Center for Environmental Law and Policy and the Resources Legacy Fund that brought together public land managers, non-profits and significant donors (who collectively will be spending hundreds of millions of dollars in the coming several years) together with scientists, academics and other experts to develop new acquisition priorities and restoration practices.

- Engaging the public in a meaningful way to help them understand the issue of climate change and to inspire them to constructive action. Parks can teach visitors about the impacts of climate change on parks and inspire them to adapt to climate change by making positive lifestyle changes. Parks can become models of climate-change best practices showcasing both what is at risk and what can be done about it. Parks is beginning to consider how climate change fits into existing planning efforts. http://www.parks.ca.gov/?page_id=21491

State Water Resources Control Board (SWRCB)

The SWRCB is addressing adaptation to climate change with increased environmental data collection and information management that assist in determining correlation between climate change, water supply changes and water quality effects. Through the Surface Water Ambient Monitoring Program (SWAMP), water quality monitoring has increased the gathering of data about overall surface water conditions. SWRCB is also implementing the System for Water Information Management (SWIM) that will increase the availability of such information to researchers, the public, and other interests. The SWRCB is working through the Joint Agency Climate Team and other forums, to identify and coordinate water quality related issues. Increased climate variability and warming has the potential to significantly affect water quality in the state, therefore this data collection and management system will assist in the planning of adaptations to meet water quality objectives.
http://www.waterboards.ca.gov/water_issues/programs/climate/

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Appendix G

Examples and Resources

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Appendix G: Examples and Resources

Appendix G provides an example of a General Plan approach from Marin County. A link has been provided at the end of the Marin County excerpt for readers who wish to view the Marin County General Plan in its entirety. In addition there are several additional reference links for General Plans and Climate Action Plans. The intent is to augment the guidance in the main body of this report with real-world examples of what others have done.

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2.7 Atmosphere and Climate

Background

Although air quality in Marin County is generally very good, emissions from within the county may contribute to pollution problems elsewhere in the region and climate changes that are occurring on a global scale. In some parts of the Bay Area, ozone levels exceed National Ambient Air Quality Standards and particulate concentrations exceed State standards (Figures 2-9 and 2-13). Vehicle traffic produces most of the emissions leading to increased ozone levels, while construction activities, wood burning, off-road travel, and agriculture generate some measured particulate matter.

The Bay Area Air Quality Management District (BAAQMD) encourages local jurisdictions to implement policies that will help improve regional air quality, and to especially recognize sensitive receptors. This Section of the Countywide Plan provides a regulatory framework for articulating air quality objectives consistent with regional air quality programs. The Transportation, Energy and Green Building, Public Facilities and Services, and Community Development sections of the Built Environment Element also include policies and programs intended to reduce the impact of future development on air quality and global warming.

On a global scale, data indicate an increase in mean surface air temperatures over historic levels and climate models predict this warming will continue. Scientists expect that the average global surface temperature could rise 1°F to 4.5°F in the next 50 years, and 2.2° to 10°F in the next century. A rise of this magnitude is significant: For example, the difference in temperature between 1995 and the temperature during the ice ages was 5°F to 8°F. Mounting scientific evidence suggests that the discharge by human activities of gases that trap heat in the atmosphere is largely responsible for this trend. A major consequence of global warming is melting glaciers and warmer waters, which cause the oceans to expand and rise. Sea level rise and higher evaporation rates are expected to increase storm frequency and severity. The resulting economic loss from increased storm activity will be equally dramatic: It has already increased tenfold over the past 40 years. Climate change will amplify existing environmental problems, such as erosion, storm-surge floods, and landslide risk, and changes to the water cycle will further stress domestic water supply as well as indigenous plant and animal populations. Further complicating the issue of climate change is the high level of complexity and uncertainty associated with modeling and predicting climate behavior. While it is clear that damage resulting from weather-related events is already on the rise, it is not known whether future changes will be gradual or abrupt. Nor is it clearly understood what the full spectrum of impacts will be. Given the global risks to economic, environmental, and social stability, it is imperative that climate change be addressed at all levels of government.

> *"Everybody talks about the weather, but nobody does anything about it."*
>
> – Mark Twain

Fortunately, local governments can play a meaningful role in addressing climate change, by instituting measures that reduce the vulnerability and increase the adaptability of Marin's physical infrastructure, economic activities, and natural systems. Furthermore, steps taken to address climate change will yield positive benefits in local efforts to improve air quality, as vehicle traffic and energy generation are major contributors to both greenhouse gases and air pollution. For example, construction of a modern world class transportation system in Marin County will contribute to further reducing greenhouse gas emissions and improving air quality.

The issue of climate change is ultimately part of the larger challenge of fostering sustainable communities. Climate change goals are more effectively accomplished when efforts are focused on integrating principles of sustainability within sectors such as transportation, buildings, ecosystems, and water systems. While the aim of this Section is to provide a framework for addressing atmosphere and climate change, the detailed policies and programs that address climate protection are located throughout the Countywide Plan and are referenced here in this section.

Key Trends and Issues

How clean is the air in Marin?

Air quality indicators show improvement. Marin has experienced a drop both in the total number of days exceeding State Ambient Air Quality Standards and in the number of days exceeding safe levels of ozone since 1996. Marin also has had a reduction in the number of days that safe levels of particulate matter have been exceeded in the county since 1996 (Figure 2-9). Ozone precursor pollutants have decreased locally, and are expected to continue to decline.

Figure 2-9 Summary of Measured Air Quality Exceedances

Pollutant	Standard	Monitoring Station	Days Exceeding Standard				
			2000	2001	2002	2003	2004
Ozone (O_3)	NAAQS 1-hr	San Rafael	0	0	0	0	0
		BAY AREA	3	1	2	1	0
	NAAQS 8-hr	San Rafael	0	0	0	0	0
		BAY AREA	4	7	7	7	0
	CAAQS 1-hr	San Rafael	0	0	0	0	0
		BAY AREA	12	15	16	19	7
Fine Particulate Matter (PM_{10})	NAAQS 24-hr	San Rafael	0	0	0	0	0
		BAY AREA	0	0	0	0	0
	CAAQS 24-hr	San Rafael	0	2	2	0	1
		BAY AREA	7	10	6	6	7
Fine Particulate Matter ($PM_{2.5}$)	NAAQS 24-hr	San Rafael	0	--	--	--	--
		BAY AREA	1	5	7	0	1
All Other (CO, NO_2, Lead, SO_2)	All Other	San Rafael	0	0	0	0	0
		BAY AREA	0	0	0	0	0

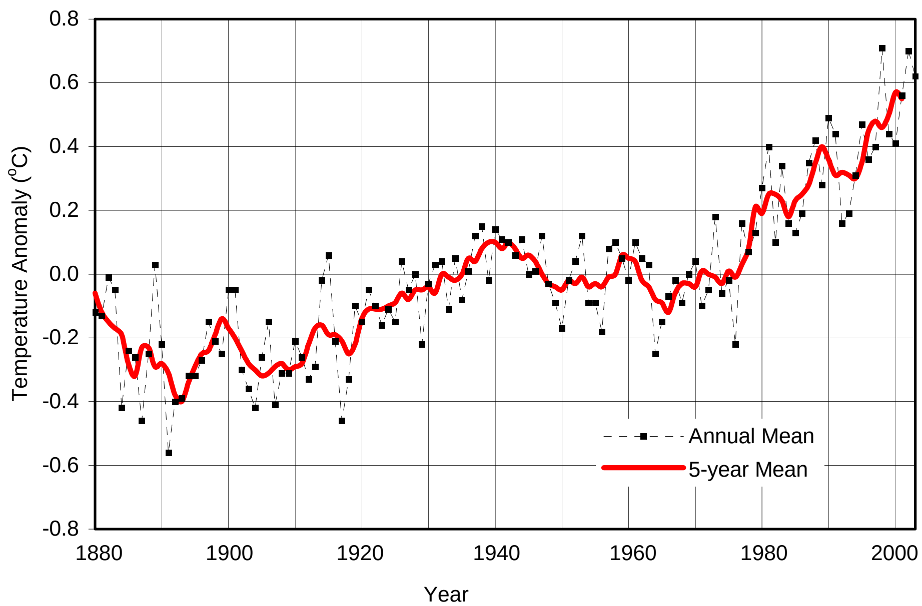
Source: 2000-2004 Bay Area Air Quality Management District.

Pollution levels can be reduced. Most particulate matter comes from areawide sources, such as combustion of wood and other nonclean fuels, and from homes and businesses without emission-control devices. Simple measures such as requiring clean-burning stoves can achieve improvements in air quality. Reducing motor vehicle use can result in significantly cleaner air.

Are temperatures rising globally?

The 10 warmest years of the 20th century all occurred after 1985, with 1998 the warmest year on record. The average of all global climate models suggests about a 3°F to 10°F rise in global temperature over the next 50 to 100 years. Global surface temperatures have increased about 1°F over the 20th century, with approximately 70% (or 0.7°F) of that change occurring in the last 25 years. The following graph illustrates the increasing rate and magnitude of global surface air temperatures.

Figure 2-10 Global Temperature



Source: NASA Goddard Institute for Space Studies.

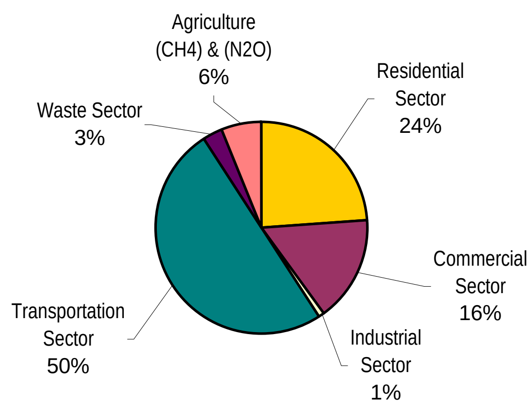
Is sea level rising?

Globally, sea level has risen 4 to 8 inches over the past century. The Intergovernmental Panel on Climate Change (IPCC) notes it is very likely that the 20th-century warming has contributed significantly to rising sea levels, through thermal expansion of seawater and loss of land ice. The EPA estimates that sea level is likely to rise 1.8 feet along most of the West Coast by 2100. By comparison, the San Francisco Bay level has increased about 4 inches since 1850. Given a 1-foot rise in sea level, the current 100-year high in the storm surge felt on the levee system of inland San Francisco Bay and Delta would become the 10-year high. In other words, the frequency of a 100-year event would increase tenfold.

What activities are contributing to the greenhouse gases in Marin?

Marin emits nearly 3 million tons of carbon dioxide every year. Vehicle traffic accounts for 50% of the total emissions, and energy use by buildings (residential, commercial and industrial combined) accounts for 41%.

Figure 2-11 Countywide Emissions Analysis



Source: Community Development Agency,
Greenhouse Gas Emissions Analysis Report 2000.

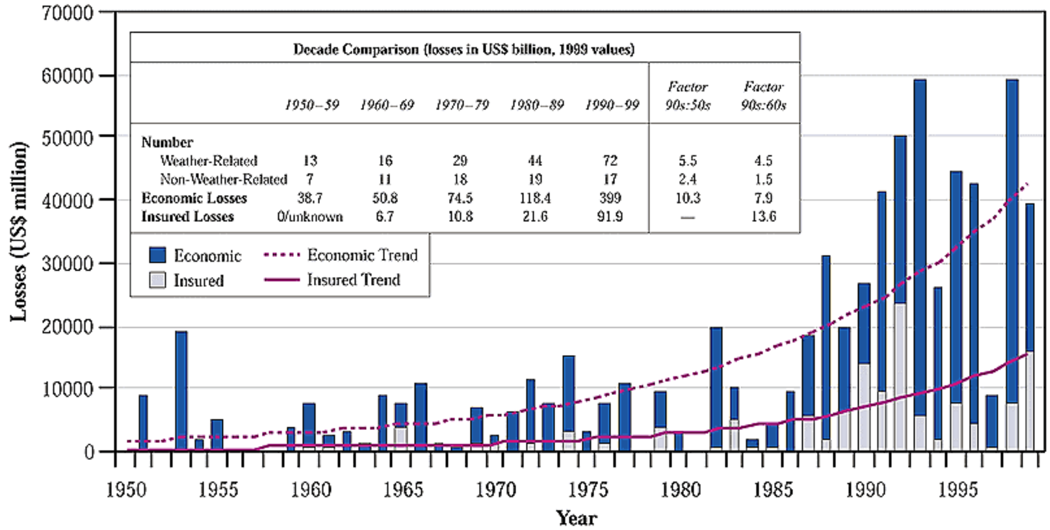
Has climate change affected the global economy?

Challenges resulting from weather- and climate-related events include changes to world food production and supply, migration, and access to clean water and energy. As indicated in the table below, costs have increased substantially since 1980.

"The climate system is being pushed hard enough that change will become obvious to the man in the street in the next decade."

—James E. Hansen, director of NASA's Goddard Institute for Space Studies, quoted in *Newsweek,* January 22, 1996

Figure 2-12
Cost to Society of Insurable, Weather-Related Damages from 1950 through 1999



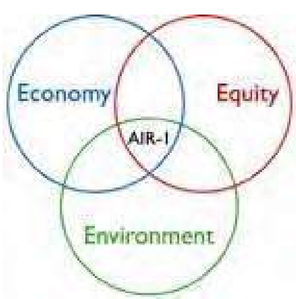
Decade Comparison (losses in US$ billion, 1999 values)

	1950–59	1960–69	1970–79	1980–89	1990–99	Factor 90s:50s	Factor 90s:60s
Number							
Weather-Related	13	16	29	44	72	5.5	4.5
Non-Weather-Related	7	11	18	19	17	2.4	1.5
Economic Losses	38.7	50.8	74.5	118.4	399	10.3	7.9
Insured Losses	0/unknown	6.7	10.8	21.6	91.9	—	13.6

Source: International Panel on Climate Change, 2001.

What Are the Desired Outcomes?

GOAL AIR-1



Improved Regional Air Quality. Promote planning and programs that result in the reduction of airborne pollutants measured within the county and the Bay Area.

Policies

AIR-1.1 Coordinate Planning and Evaluation Efforts. Coordinate air quality planning efforts with local, regional, and State agencies, and evaluate the air quality impacts of proposed plans and development projects.

AIR-1.2 **Meet Air Quality Standards.** Seek to attain or exceed the more stringent of federal or State Ambient Air Quality Standards for each measured pollutant (Figure 2-13).

AIR-1.3 **Require Mitigation of Air Quality Impacts.** Require projects that generate potentially significant levels of air pollutants, such as quarry, landfill operations, or large construction projects, to incorporate best available air quality mitigation in the project design.

Why is this important?

It is essential to use a regional approach to improving air quality, since polluted air flows from one place to another.

Environment: Cleaner air and water mean healthier marine and terrestrial ecosystems.

Economy: Poor air quality is linked to a higher incidence of public health costs associated with respiratory illnesses. The California Air Resources Board (CARB) suggests that the annual health impacts of exceeding state health-based standards for ozone and particulate matter include 6,500 premature deaths, 4,000 hospital admissions for respiratory disease, and 350,000 asthma attacks. The loss of productive workdays also affects the local economy. The American Lung Association (ALA) states that asthma accounts for an estimated three million lost workdays for adults nationally.

Equity: Poor air quality is linked to a higher incidence of respiratory illnesses. Asthma, which can be triggered and/or caused by poor air quality, currently affects 2.3 million Californians. In Marin, there were 17,083 cases of asthma in 2004, which translates to an impact on 7% of the population.

How will results be achieved?

Implementing Programs

AIR-1.a ***Inform Local and Regional Agencies.*** Notify local and regional jurisdictions of proposed projects in unincorporated areas that may affect regional air quality, as identified by project type and size thresholds in the *BAAQMD CEQA Guidelines, Assessing the Air Quality Impacts of Projects and Plans* (Figure 2-14).

AIR-1.b ***Evaluate Air Quality Impacts of Proposed Projects and Plans.*** As part of the Environmental Review Process, use the current BAAQMD CEQA Guidelines to evaluate the significance of air quality impacts from projects or plans, and to establish appropriate minimum submittal and mitigation requirements necessary for project or plan approval.

AIR-1.c ***Take Part in Regional Programs.*** Continue to participate in the Cities for Climate Protection and Spare the Air programs.

AIR-1.d ***Cooperate to Enforce Air Quality Standards.*** Cooperate with the U.S. Environmental Protection Agency (EPA), the California Air Resources Board, and the BAAQMD to measure air quality at emission sources (including transportation corridors) and to enforce the provisions of the Clean Air Act and State as well as regional policies and established standards for air quality.

Figure 2-13 California and National Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards	National Standards [a]	
			Primary [b,c]	Secondary [b,d]
Ozone	8-hour	0.07 ppm (154 μg/m³)	0.08 ppm (176 μg/m³)	—
	1-hour	0.09 ppm (180 μg/m³)	— [e]	Same as primary
Carbon Monoxide	8-hour	9 ppm (10 μg/m³)	9 ppm (10 μg/m³)	—
	1-hour	20 ppm (23 μg/m³)	35 ppm (40 μg/m³)	—
Nitrogen Dioxide	Annual	—	0.053 ppm (100 μg/m³)	Same as primary
	1-hour	0.25 ppm (470 μg/m³)	—	—
Sulfur Dioxide	Annual	—	0.03 ppm (80 μg/m³)	—
	24-hour	0.04 ppm (105 μg/m³)	0.14 ppm (365 μg/m³)	—
	3-hour	—	—	0.5 ppm (1,300 μg/m³)
	1-hour	0.25 ppm (655 μg/m³)	—	—
PM_{10}	Annual	20 μg/m³	50 μg/m³	Same as primary
	24-hour	50 μg/m³	150 μg/m³	Same as primary
$PM_{2.5}$	Annual	12 μg/m³	15 μg/m³	—
	24-hour	—	65 μg/m³	—
Lead	Calendar quarter	—	1.5 μg/m³	Same as primary
	30-day average	1.56 μg/m³	—	—

Notes: (a) Standards, other than four ozone and those based on annual averages, are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than one.
(b) Concentrations are expressed first in units in which they were promulgated. Equivalent units given in parenthesis.
(c) Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the EPA.
(d) Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
(e) The national one-hour ozone standard was revoked by U.S. EPA on June 15, 2005.

Source: 2004 Bay Area Air Quality Management District.

Figure 2-14
Projects with Potentially Significant Emissions

Land Use Category	Trip Generation Rate	Size of Project Likely to Generate 80 lb/day NOx
Housing		
Single Family	9.4/d.u.	320 units
Apartments	5.9/d.u.	510 units
Retail		
Discount Store	48.3/1000 sq.ft.	87,000 sq.ft.
Regional Shopping Center	96.2/1000 sq.ft.	44,000 sq.ft.
Supermarket	178/1000 sq.ft.	24,000 sq.ft.
Office		
General Office	10.9/1000 sq.ft.	280,000 sq.ft.
Government Office	68.9/1000 sq.ft.	55,000 sq.ft.
Office Park	12.8/1000 sq.ft.	210,000 sq.ft.
Medical Office	37.1/1000 sq.ft.	110,000 sq.ft.
Other		
Hospital	13.8/1000 sq.ft.	240,000 sq.ft.
Hotel	8.7/room	460 rooms

Note: Trip rates for many land uses will vary depending upon size of project. See latest edition of Trip Generation, Institute of Transportation Engineers.

Source: 1999 Bay Area Air Quality Management District.

AIR-1.e *Conduct Public Education Program.* Educate regarding the reason for requiring using best management practices to improve air quality.

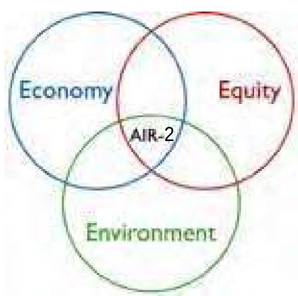
AIR-1.f *Limit Residential Wood Burning.* Continue to implement the ordinance that phases out the use of older, polluting wood-burning appliances and limits the installation of wood-burning devices in new or renovated homes to pellet stoves, EPA-certified woodstoves and fireplace inserts, or natural gas or propane appliances.

AIR-1.g *Require Control Measures for Construction and Agricultural Activity.* Require reasonable and feasible measures to control particulate emissions (PM-10 and PM-2.5) at construction sites and during agricultural tilling activity, pursuant to the recommendations in the BAAQMD CEQA Guidelines, which may include the following:

- Watering active construction or agricultural tilling areas.
- Covering hauled materials.
- Paving or watering vehicle access roads.
- Sweeping paved and staging areas.

What Are the Desired Outcomes?

GOAL AIR-2



Protection from Emissions. Minimize the potential impacts from land uses that may emit pollution and/or odors on residential and other land uses sensitive to such emissions (see Map 2-16, Sensitive Receptor Sites in Unincorporated Marin County).

Policy

AIR-2.1 Buffer Emission Sources and Sensitive Land Uses. Consider potential air pollution and odor impacts from land uses that may emit pollution and/or odors when locating (a) air pollution sources, and (b) residential and other pollution-sensitive land uses in the vicinity of air pollution sources (which may include freeways, manufacturing, extraction, hazardous materials storage, landfill, food processing, wastewater treatment, and other similar uses).

Why is this important?

People and sensitive plants and animals need to be protected from sources of air pollution.

Environment: Air pollution creates stress on fragile and sensitive ecosystems by reducing reproductive capacity and food sources.

Economy: Lowering pollutants from area-wide and point sources would lower public health costs associated with respiratory illnesses and lead to fewer sick days at the workplace.

Equity: Children, people who are ill, and elderly people are particularly sensitive to air pollution. Places where they congregate need protection from polluted air.

How will results be achieved?

Implementing Programs

AIR-2.a *Require Separation Between Air Pollution Sources and Other Land Uses.* Only allow (a) emission sources or (b) other uses in the vicinity of air pollution or odor sources if the minimum screening distances between sources and receptors established in the BAAQMD CEQA Guidelines can be met, unless detailed project-specific studies demonstrate compatibility with adjacent uses despite separations that do not meet the screening distance requirements.

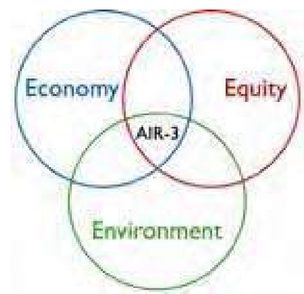
AIR-2.b *Protect Sensitive Receptors Near High-Volume Roadways.* Amend the Development Code to require mitigation measures such as increased indoor air filtration to ensure the protection of sensitive receptors (facilities where individuals are highly susceptible to the adverse effects of air pollutants, such as housing, child care centers, retirement homes, schools, and hospitals) near freeways, arterials, and other major transportation corridors.

AIR-2.c *Health Risk Analysis for Sensitive Receptors.* Require that projects involving sensitive receptors proposed within 150 feet of freeways shall include an analysis of the potential health risks. Mitigation measures that comply with adopted standards of the BAAQMD for control of odor/toxics for sensitive receptors shall be identified in order to reduce these risks to acceptable levels.

What Are the Desired Outcomes?

GOAL AIR-3

Reduction of Vehicle-Generated Pollutants. Reduce vehicle trips and emissions, and improve vehicle efficiency, as means of limiting the volume of pollutants generated by traffic.



Policy

AIR-3.1 **Institute Transportation Control Measures.** Support a transportation program that reduces vehicle trips, increases ridesharing, and meets or exceeds the Transportation Control Measures recommended by BAAQMD in the most recent Clean Air Plan to reduce pollutants generated by vehicle use.

Why is this important?

Vehicle emissions are a major source of air pollution, and reduction of vehicle trips will improve air quality.

Environment: Vehicle travel is responsible for 54% of nitrogen oxides, 73% of carbon monoxide, and 79% of the particulate matter released in Marin. These pollutants create stress on Marin's marine and terrestrial ecosystems through a loss of species diversity and reproduction capacity.

Economy: In addition to alleviating the economic burden of public health costs, a reduction in vehicle trips will reduce traffic congestion. In 2006, over 9,400 productive hours were lost each weekday as a result of traffic congestion and delay.

Equity: Based on EPA's most current data, vehicle generated sources are responsible for 91% of the air-related cancer risk in Marin County. Furthermore, lower income neighborhoods tend to be nearest to major transportation routes; thus, these residents are exposed to higher levels of mobile source pollutants. One study finds that in the Bay Area, prevalence of asthma and bronchitis symptoms is about 7% higher for children in neighborhoods with higher levels of traffic pollutants compared with other children in the study.

How will results be achieved?

Implementing Programs

AIR-3.a *Support Voluntary Employer-Based Trip Reduction.* Provide assistance to regional and local ridesharing organizations, and advocate legislation to maintain and expand employer ridesharing incentives, such as tax deductions or credits.

AIR-3.b *Utilize Clean Vehicle Technology.* Promote new technologies and other incentives, such as allowing zero or partial zero emission vehicles rated at 45 miles or more per gallon in Marin County carpool lanes, and replacing fleet vehicles with these and similar clean vehicles.

AIR-3.c *Consider Model Clean Vehicle Requirements.* Research and consider adoption of an ordinance or standards that provide a set of voluntary measures to incorporate clean vehicles in fleets and promote the use of clean alternative fuels.

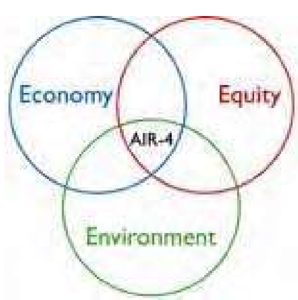
> *"Adding lanes to solve traffic congestion is like loosening your belt to solve obesity."*
>
> – Glen Hemistra

AIR-3.d *Reduce Peak-Hour Congestion.* Implement recommended Bay Area Air Quality Management District (BAAQMD) Transportation Control Measures in the Clean Air Plan to reduce vehicle emissions and congestion during peak commute periods.

AIR-3.e *Improve Arterial Traffic Management.* Modify arterial roadways to allow more-efficient bus operation, including possible signal preemption, and expand signal-timing programs where air quality benefits can be demonstrated.

What Are the Desired Outcomes?

GOAL AIR-4



Minimization of Contributions to Greenhouse Gases. Prepare policies that promote efficient management and use of resources in order to minimize greenhouse gas emissions. Incorporate sea level rise and more extreme weather information into the planning process.

Policies

AIR-4.1 **Reduce Greenhouse Gas Emissions.** Adopt practices that promote improved efficiency and energy management technologies; shift to low-carbon and renewable fuels and zero emission technologies.

AIR-4.2 **Foster the Absorption of Greenhouse Gases.** Foster and restore forests and other terrestrial ecosystems that offer significant carbon mitigation potential.

Why is this important?

Major contributors to greenhouse gas emissions, such as vehicle traffic and building energy use, can be reduced on a local level through the implementation of sustainable development policies.

Environment: Increased greenhouse gas emissions lead to climate change, which could include increases in temperature and shifting amounts of rainfall. Changes in temperature and water availability affect terrestrial and marine ecosystems. Furthermore, higher temperatures lead to higher evaporation rates, as well as reductions in stream flow and an increased frequency of droughts. Droughts are a problem in Marin, where 80% of our water comes from rainfall.

Economy: Mitigation measures that reduce emissions can result in substantial savings. The Tellus Institute estimates that California can save 1.9 billion dollars annually by 2020 through adoption of more stringent building codes and standards, efficiency programs, and increased supply of energy from renewable sources.

Equity: Access to clean water, energy, and mineral resources, and availability of productive arable land are all threatened by changes in climate. Weather- and temperature-related issues will add strain to an already overburdened public health system. Furthermore, low income families will be disproportionately impacted as they will be the least able to adapt to the effects of climate change.

How will results be achieved?

Implementing Programs

AIR-4.a ***Reduce Greenhouse Gas Emissions Resulting from Energy Use in Buildings.*** Implement energy efficiency programs and use of renewable energy. (Also see EN-1, EN-2, PFS-2, and TR-4.)

Carbon Dioxide

The Ecological Footprint shows that the single largest human demand on ecosystems comes from carbon dioxide emissions. The land area required to absorb this waste product makes up over half the Ecological Footprint of the average Marin resident. If Marin County reduced its carbon dioxide emissions by 20%, it could reduce its total footprint by an area equal to almost the entire size of Marin County.

Changing Scientific Understanding of Human Influences on Climate Change

1990: “Our judgment is that global mean surface air temperature has increased [though] the unequivocal detection of the enhanced greenhouse effect is not likely for a decade or more.”

1995: “The balance of evidence suggests a discernible human influence on global climate.”

2001: “The Earth's climate system has demonstrably changed on both global and regional scales. There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities.”

AIR-4.b ***Reduce Greenhouse Gas Emissions Resulting from Transportation.*** Increase clean-fuel use, promote transit-oriented development and alternative modes of transportation, and reduce travel demand. (Also see TR-4, AIR-3, DES-2, HS-2, HS-3, CD-2, CD-3, and EC-1.)

AIR-4.c ***Reduce Methane Emissions Released from Waste Disposal.*** Encourage recycling, decrease waste sent to landfills, require landfill methane recovery, and promote methane recovery for energy production from other sources. (See PFS-3.)

Cities for Climate Protection Milestones

In August 2002, the Board of Supervisors partnered with the Cities for Climate Protection Campaign to address climate change through five actions:

1. Analyze baseline greenhouse gas emissions.
2. Set a target for reducing emissions.
3. Develop a local action plan for pursuing emissions reductions measures.
4. Implement local action plan.
5. Monitor progress.

Source: www.iclei.org.

"New analyses suggest that 15%–37% of a sample of 1,103 land plants and animals would eventually become extinct as a result of climate changes expected by 2050."

— *Nature Medicine*, 2004

AIR-4.d ***Reduce Greenhouse Gas Emissions from Agriculture.*** Compile an inventory of agricultural greenhouse gas emissions. Partner with AgStar, the U.S. Department of Agriculture, and the U.S. Department of Energy to encourage the use of methane recovery technologies and determine potential use in energy production.

AIR-4.e ***Reduce County Government Contributions to Greenhouse Gas Emissions.*** Where feasible, replace fleet vehicles with hybrid fuel and other viable alternative fuel vehicles, increase energy efficiency of County-maintained facilities, increase renewable energy use at County-maintained facilities, adopt purchasing practices that promote emissions reductions, and increase recycling at County-maintained facilities. (Also see EN-1, EN-2, PFS-3, TR-4, EC-1 and PH-1.)

AIR-4.f ***Establish a Climate Change Planning Process.*** Continue implementation of the approved Marin County Greenhouse Gas Reduction Plan. Integrate this plan into long-range and current planning functions of other related agencies. Establish and maintain a process to implement, measure, evaluate, and modify implementing programs, using the Cities for Climate Protection Campaign as a model (see the sidebar).

AIR-4.g ***Work with Bay Area Governments to Address Regional Climate Change Concerns.*** Play a leading role to encourage other local governments to commit to addressing climate change. Participate in programs such as the Cities for Climate Protection Campaign to address local and regional climate change concerns.

AIR-4.h *Evaluate the Carbon Emissions Impacts of Proposed Developments.* Incorporate a carbon emissions assessment into land use plans and the environmental impact report for proposed projects.

AIR-4.i *Work with Appropriate Agencies to Determine Carbon Uptake and Storage Potential of Natural Systems.* Study Marin's wetlands, forests, baylands, and agricultural lands to determine the potential to sequester carbon over time. Determine their value as carbon sinks.

AIR-4.j *Acquire and Restore Natural Resource Systems.* Take and require all technically feasible measures to avoid or minimize potential impacts on existing natural resource systems that serve as carbon sinks. (Also see CD-1, BIO-2, BIO-3, BIO-4, BIO-5, OS-1, and OS-2.)

AIR-4.k *Encourage the Planting of Trees.* Adopt urban forestry practices that encourage re-forestation as a means of storing carbon dioxide. (Also see BIO-1, DES-3.)

AIR-4.l *Preserve Agricultural Lands.* Protect agricultural lands and soils that serve as carbon sinks. (Also see AG-1.)

AIR-4.m *Focus Development in Urban Corridors.* Build in urban corridors and limit development in natural resource areas. Encourage green spaces that serve as carbon sinks in urban corridors. (Also see CD-1, CD-2, and DES-3.)

AIR-4.n *Monitor for Carbon Storage Research.* Monitor federal and international research on technological approaches to carbon storage.

AIR-4.o *Implement Proposed State Programs to Reduce Greenhouse Gas Emissions.* Implement proposed State programs to reduce greenhouse gas emissions, including the Renewable Portfolio Standards, California Fuel Efficiency (CAFE) standards, and carbon cap and trade programs.

What Are the Desired Outcomes?

GOAL AIR-5

Adaptation to Climate Change. Adopt policies and programs that promote resilient human and natural systems in order to ease the impacts of climate change.

Policies

AIR-5.1 **Determine Marin-Specific Climate Change.** Participate in research that examines the effects of climate change on human and natural systems in Marin.

AIR-5.2 **Prepare Response Strategies for Impacts.** Prepare appropriate response strategies that aid systems in adapting to climate change based on sound scientific understanding of the potential impacts.

Why is this important?

Adapting to climate change will require accurate scientific understanding as well as an institutionalized policy framework.

Environment. Wildlife distributions, population size, population density, and behavior are directly affected by changes in climate and indirectly through changes in vegetation. As wildlife tries to adapt to changes in the environment caused by shifting temperature and precipitation patterns, the already high number of threatened and endangered species could see a marked increase. New analyses suggest that 15% to 37% of a sample of 1,103 land plants and animals would eventually become extinct as a result of climate changes expected by 2050.

> *"My interest is in the future, because I am going to spend the rest of my life there."*
>
> — Charles Kettering

Economy. Aquaculture products brought $2.4 million into Marin's economy, representing 5.4% of Marin's entire agriculture industry. Warmer ocean waters and saltwater inundation due to climate change may impact coastal ecosystems by speeding the decline in fish populations and marine ecosystems already stressed from habitat loss and reduced freshwater flows. A report sponsored by the United Nations stated that worldwide economic losses could soar to $150 billion a year within the next 10 years.

Equity. Adopting and fostering resilience within the natural and built environments will save significant resources, speed recovery, and protect public health and safety for people of all income levels.

How will results be achieved?

Implementing Programs

AIR-5.a ***Coordinate with Local and Regional Agencies.*** Coordinate with the U.S. Geological Survey, Bay Conservation and Development Commission, California Coastal Commission and other monitoring agencies to study near-term and long-term high-probability climate change effects. Explore funding and collaborations with Bay Area partners in the Cities for Climate Protection Campaign in order to share resources, achieve economies of scale, and develop plans and programs that are optimized to address climate change on a regional scale.

AIR-5.b ***Study the Effect of Climate Change.*** Determine how climate change will affect the following:

Natural Systems: Changes in water availability, shifting fog regimes (and the effect on coastal redwoods and fire ecology), temperature changes, and shifting seasons.

Biological Resources: Changes in species distribution and abundance in estuary ecosystems resulting from salinity changes and flooding. For marine ecosystems, determine changes in distribution and abundance resulting from warmer waters, rising sea level, and changes in ocean currents and freshwater inflows.

Environmental Hazards: Runoff, fire hazards, floods, landslides and soil erosion, and the impact on coastal and urban infrastructure.

Built Environment: Effect of flooding and rising sea level on sewage systems, property, and infrastructure.

Water Resources: Runoff, changes in precipitation, increases and decreases in drought, salinity changes, sea level rise, and shifting seasons.

Agricultural and Food Systems: Food supply, economic impacts, and effect on grazing lands.

Public Health: Temperature-related health effects, air quality impacts, extreme weather events, and vector-, rodent-, water-, and food-borne diseases.

AIR-5.c *Prepare Response Strategies.* In coordination with the California Coastal Commission, the Bay Conservation and Development Commission, water districts, wildlife agencies, and flood control districts, prepare response strategies for Marin's human and natural systems. Current response strategies include the following:

Water Resources: Improve drainage systems, harvesting flows, and recharge designs in order to direct runoff to landscaped areas where the water can percolate into the soil. (See WR-1.)

Biological Resources: Limit development such that coastal wetlands are able to migrate inland in response to sea level rise, wildlife corridors and ecotones are protected, and development impacts are minimized. Promote the restoration of wetlands and riparian areas to provide capacity for high water and flood flows. (Also see BIO-2, BIO-4, BIO-5, OS-2, DES-1, and DES-5.)

Public Health: General strengthening of public health infrastructure and health-oriented environmental management, such as with air and water quality, and community and housing design.

Built Environment: Assess development located in coastal areas that are subject to sea level rise and increased flooding, and develop a response strategy, such as a planned retreat program, for the relocation of facilities in low-lying areas. Work with the County flood control and water districts to prepare a plan for responding to a potential rise in the sea level, consider developing flood control projects, and amend County Code Chapters 11, 22, 23, and 24 to include construction standards for areas potentially subject to increased flooding from a rise in sea level.

Environmental Hazards: Develop response strategies that cope with increasing storm events, flooding, fire, landslides, and soil erosion. Establish surveillance systems. With the development of advanced (spatial) surveillance technology, it is conceivable that such systems will be expanded to address forest health and productivity, monitoring biotic vectors and natural elements, as well as tree and storm responses. (Also see EH-3, EH-4, BIO-1, and PH-1.)

> *"The causes and effects of climate change occur around the world. Individuals, communities, and nations must work together cooperatively to stop global climate change."*
> — The Environmental Justice and Climate Change Initiative

AIR-5.d ***Monitor Local Climate Change.*** Encourage appropriate local and regional agencies to track the following environmental indicators of climate change:

- Sea level (also see EH-3)
- Minimum and maximum temperature
- Precipitation
- Timing and volume of river flow
- River temperatures
- Sea surface temperatures
- Diversity and abundance of fish stocks and sea birds

AIR-5.e ***Seek Resources for Response Strategies.*** Explore funding and collaborative opportunities that share resources, to develop plans and programs that are optimized on a regional scale.

AIR-5.f ***Protect and Enhance Native Habitats and Biodiversity.*** Effectively manage and enhance native habitat, maintain viable native plant and animal populations, and provide for improved biodiversity throughout Marin. Require identification of sensitive biological resources and commitment to adequate protection and mitigation. (Also see BIO-1 and BIO-2.)

> *"It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change."*
> — Charles Darwin

AIR-5.g ***Conduct Public Outreach and Education.*** Increase public awareness about climate change, and encourage Marin residents and businesses to become involved in activities and lifestyle changes that will aid in reducing greenhouse gas emissions.

AIR-5.h ***Implement Floodplain Ordinances.*** Continue to implement ordinances that regulate floodplain development to ensure that project-related and cumulative flooding impacts are minimized or avoided through conditions of project approval as required by the ordinances.

AIR-5.i ***Modify Construction Standards.*** Amend the Marin County Code to include construction standards for areas threatened by future sea level rise.

Figure 2-15 Relationships of Goals to Guiding Principles

This figure illustrates the relationships of each goal in this Section to the Guiding Principles.

Goals / Guiding Principles	1. Link equity, economy, and the environment locally, regionally, and globally.	2. Minimize the use of finite resources and use all resources efficiently and effectively.	3. Reduce the use and minimize the release of hazardous materials.	4. Reduce greenhouse gas emissions that contribute to global warming.	5. Preserve our natural assets.	6. Protect our agricultural assets.	7. Provide efficient and effective transportation.	8. Supply housing affordable to the full range of our workforce and diverse community.	9. Foster businesses that create economic, environmental, and social benefits.	10. Educate and prepare our workforce and residents.	11. Cultivate ethnic, cultural, and socioeconomic diversity.	12. Support public health, safety, and social justice.
AIR-1 Improved Regional Air Quality	•		•	•	•							•
AIR-2 Protection from Emissions	•		•	•	•							•
AIR-3 Reduction of Vehicle-Generated Pollutants	•		•	•	•		•					•
AIR-4 Minimization of Contributions to Greenhouse Gases	•	•	•	•		•	•		•			•
AIR-5 Adaptation to Climate Change					•	•				•		•

How Will Success Be Measured?

Indicator Monitoring

Nonbinding indicators, benchmarks, and targets[1] will help to measure and evaluate progress. This process will also provide a context in which to consider the need for new or revised implementation measures.

Indicators	Benchmarks	Targets
Number of days of poor air quality.	No exceedences in 2000.	No increase through 2015.
Amount of greenhouse gas emissions countywide.	2,849,000 tons CO_2 in 1990.	Reduce 15% by 2015.
Amount of greenhouse gas emissions from County government sources.	15,200 tons CO_2 in 1990.	Reduce 15% – 20% by 2015.

[1]Many factors beyond Marin County government control, including adequate funding and staff resources, may affect the estimated time frame for achieving targets and program implementation.

Program Implementation

The following table summarizes responsibilities, potential funding priorities, and estimated time frames for proposed implementation programs. Program implementation within the estimated time frame[1] will be dependent upon the availability of adequate funding and staff resources.

Figure 2-16
Atmosphere and Climate Program Implementation

Programs	Responsibility	Potential Funding	Priority	Time Frame
AIR-1.a – Inform Local and Regional Agencies.	CDA	Existing budget	High	Ongoing
AIR-1.b – Evaluate Air Quality Impacts of Proposed Projects and Plans.	CDA	Existing budget	High	Ongoing
AIR-1.c – Take Part in Regional Programs.	CDA	Existing budget	High	Ongoing
AIR-1.d – Cooperate to Enforce Air Quality Standards.	CDA, EPA, CA Air Resources Board, BAAQMD	Existing budget, State and federal funds	High	Ongoing
AIR-1.e – Conduct Public Education Program	CDA, BAAQMD	Existing budget and may require additional grants or revenue[2]	High	Ongoing
AIR-1.f – Limit Residential Wood Burning.	CDA	Existing budget, Tobacco Settlement Funds	Medium	Ongoing
AIR-1.g – Require Control Measures for Construction and Agricultural Activity.	CDA, Agricultural Commissioner	Existing budget	High	Ongoing
AIR-2.a – Require Separation Between Air Pollution Sources and Other Land Uses.	CDA, BAAQMD	Existing budget	High	Ongoing
AIR-2.b – Protect Sensitive Receptors Near High-Volume Roadways.	CDA	Existing budget	Medium	Long term
AIR-2.c – Health Risk Analysis for Sensitive Receptors.	CDA	Existing budget	Medium	Short term

[1]Time frames include: Immediate (0–1 years); Short term (1–4 years); Med. term (4–10 years); Long term (10–20 years); and Ongoing.

[2]Completion of this task is dependent on acquiring additional funding. Consequently, funding availability could lengthen or shorten the time frame and ultimate implementation of this program.

Programs	Responsibility	Potential Funding	Priority	Time Frame
AIR-3.a – Support Voluntary Employer-Based Trip Reduction.	DPW, Transportation Authority of Marin (TAM), CDA	Existing Budget, will require additional grants or other revenue[2]	Medium	Med. Term
AIR-3.b – Utilize Clean Vehicle Technology.	1. CDA/CalTrans- carpool lanes, 2. DPW- County fleet	1. Existing budget, 2. Will require additional grants or other revenue[2]	1. Medium, 2. Medium	1. Ongoing, 2. Long term
AIR-3.c – Consider Model Clean Vehicle Requirements.	DPW	Will require additional grants or other revenue[2]	Medium	Long term
AIR-3.d – Reduce Peak-Hour Congestion.	TAM	TFCA	Medium	Ongoing
AIR-3.e – Improve Arterial Traffic Management.	DPW, TAM	Grants, traffic mitigation fees, transportation sales tax[2]	Medium	Ongoing
AIR-4.a – Reduce Greenhouse Gas Emissions Resulting from Energy Use in Buildings.	CDA	Existing budget and may require additional grants or revenue[2]	Medium	Med. Term
AIR-4.b – Reduce Greenhouse Gas Emissions Resulting from Transportation.	1. TAM, CDA, 2. DPW	General Fund, TAM budget, TLC/HIP Grants, and will require additional grants or other revenue[2]	1. Medium, 2. Medium	1. Ongoing, 2. Long term
AIR-4.c – Reduce Methane Emissions Released from Waste Disposal.	DPW	Will require additional grants or other revenue[2]	Medium	Long term
AIR-4.d – Reduce Greenhouse Gas Emissions from Agriculture.	Agricultural Commissioner, CDA, USDA, USDOE	Grants, existing budget	Medium	Ongoing
AIR-4.e – Reduce County Government Contributions to Greenhouse Gas Emissions.	DPW	Will require additional grants or other revenue[2]	High	Pending
AIR-4.f – Establish a Climate Change Planning Process.	CDA	Existing budget and may require additional grants or revenue[2]	High	Immediate
AIR-4.g – Work with Bay Area Governments to Address Regional Climate Change Concerns.	CDA, ABAG, International Council for Local Environmental Initiatives (ICLEI)	Existing budget and may require additional grants or revenue[2]	High	Ongoing
AIR-4.h – Evaluate the Carbon Emissions Impacts of Proposed Developments.	CDA	Existing budget and may require additional grants or revenue[2]	High	Ongoing

Programs	Responsibility	Potential Funding	Priority	Time Frame
AIR-4.i – Work with Appropriate Agencies to Determine Carbon Uptake and Storage Potential of Natural Systems.	CDA, California Energy Commission (CEC), BAAQMD, other municipalities	Will require additional grants or revenue[2]	Low	Long term
AIR-4.j – Acquire and Restore Natural Resource Systems.	MCOSD	Will require additional grants or revenue[2]	High	Ongoing
AIR-4.k – Encourage the Planting of Trees.	CDA, NGO's, CBO's	Will require additional grants or revenue[2]	Medium	Ongoing
AIR-4.l – Preserve Agricultural Lands.	CDA, MALT, CBO's	Will require additional grants or revenue[2]	High	Ongoing
AIR-4.m – Focus Development in Urban Corridors.	CDA	Existing budget	High	Ongoing
AIR-4.n – Monitor for Carbon Storage Research.	CDA, ICLEI	Existing budget and may require additional grants or revenue[2]	Medium	Ongoing
AIR-4.o – Implement Proposed State Programs to Reduce Greenhouse Gas Emissions.	CDA	Existing budget and may require additional grants or revenue[2]	Medium	Ongoing
AIR-5.a – Coordinate with Local and Regional Agencies.	CDA, Bay Conservation and Development Commission (BCDC), CCC, BAAQMD, USGS, ICLEI	Existing budget and may require additional grants or revenue[2]	High	Ongoing
AIR-5.b – Study the Effect of Climate Change.	CDA, BCDC, CCC, BAAQMD, USGS, ICLEI	Will require additional grants or revenue[2]	Medium	Ongoing
AIR-5.c – Prepare Response Strategies.	CDA, CCC, BCDC, Water Districts, Resource Protection Agencies, ICLEI	Existing budget, will require additional grants or revenue[2]	High	Ongoing
AIR-5.d – Monitor Local Climate Change.	CDA, CCC, BCDC, Water Districts, Resource Protection Agencies, ICLEI	Existing budget and may require additional grants or revenue[2]	Medium	Ongoing
AIR-5.e – Seek Resources for Response Strategies.	CDA, CCC, BCDC, Water Districts, Resource Protection Agencies, ICLEI	Existing budget and may require additional grants or revenue[2]	Medium	Ongoing

Programs	Responsibility	Potential Funding	Priority	Time Frame
AIR-5.f – Protect and Enhance Native Habitats and Biodiversity.	Parks & Open Space, CDA, CBO's	Existing budget and may require additional grants or revenue[2]	High	Ongoing
AIR-5.g – Conduct Public Outreach and Education.	CDA, CBO's, ICLEI	Existing budget and may require additional grants or revenue[2]	Medium	Ongoing
AIR-5.h – Implement Floodplain Ordinances.	CDA/DPW	Existing budget	High	Ongoing
AIR-5.i – Modify Construction Standards.	CDA/DPW	Existing budget and may require additional grants or revenue[2]	Medium	Long term

(Note: This is an extract of the Marin County General Plan that highlights the applicability to air quality and greenhouse gases. The entire Marin County General Plan 2020 can be found at:
(http://www.co.marin.ca.us/depts/cd/main/fm/cwpdocs/CWP_CD2.pdf)

Additional Links to General Plans and Climate Action Plans:

The following examples of general plans and climate action plans were reviewed and were also found to be good resources. These examples have addressed climate change and have provided good goals, objectives, policies, standards and/or implementations measures for their jurisdiction and environment. These goals, objectives, policies, standards and implementation measures have been addressed in a stand-alone document as in the San Francisco Climate Action Plan, Sonoma County Climate Action Plan, and the City of Riverside General Plan; or the goals, objectives, policies, standards and implementation measures have been incorporated into the existing general plan elements as in the City of Beverly Hills Draft General Plan, City of Sacramento General Plan and Sonoma County General Plan.

City of Beverly Hills Draft General Plan can be found at:
http://www.ci.beverly-hills.ca.us/services/planning/plan/draft_general_plan.asp

City of Riverside General Plan can be found at:
http://www.riversideca.gov/planning/2008-0909/GP/13_Air_Quality_Element.pdf

City of Sacramento General Plan can be found at:
http://www.sacgp.org/

San Francisco Climate Action Plan can be found at:
http://www.sfenvironment.org/downloads/library/climateactionplan.pdf

Sonoma County General Plan can be found at:
http://www.sonoma-county.org/prmd/gp2020/adopted/index.htm

Sonoma County Community Climate Action Plan can be found at:
http://www.coolplan.org/

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Appendix H

California Attorney General Guidance on General Plans

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Appendix H: California Attorney General Guidance on General Plans

The California Attorney General's Office has compiled a list of General Plan, CEQA-related Frequently Asked Questions and their answers to assist cities and counties in their General Plan updates. The following is the Attorney General Office's document entitled *'Climate Change, the California Environmental Quality Act, and General Plan Updates: Straightforward Answers to Some Frequently Asked Questions.'*

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Climate Change, the California Environmental Quality Act, and General Plan Updates: Straightforward Answers to Some Frequently Asked Questions California Attorney General's Office

At any given time in this State, well over one hundred California cities and counties are updating their general plans. These are complex, comprehensive, long-term planning documents that can be years in the making. Their preparation requires local governments to balance diverse and sometimes competing interests and, at the same time, comply with the Planning and Zoning Law and the California Environmental Quality Act (CEQA).

Local governments have decades of experience in applying state planning law and excellent resources to assist them – such as the "General Plan Guidelines" issued by The Governor's Office of Planning and Research (OPR).[1] They are also practiced in assessing whether general plans may have significant localized environmental effects, such as degradation of air quality, reductions in the water supply, or growth inducing impacts. The impact of climate change, however, has only fairly recently shown up on the CEQA radar.

The fact that climate change presents a new challenge under CEQA has not stopped local governments from taking action. A substantial number of cities and counties already are addressing climate change in their general plan updates and accompanying CEQA documents. These agencies understand the substantial environmental and administrative benefits of a programmatic approach to climate change. Addressing the problem at the programmatic level allows local governments to consider the "big picture" and – provided it's done right – allows for the streamlined review of individual projects.[2]

Guidance addressing CEQA, climate change, and general planning is emerging, for example, in the pending CEQA Guideline amendments,[3] comments and settlements by the Attorney General, and in the public discourse, for example, the 2008 series on CEQA and Global Warming organized by the Local Government Commission and sponsored by the Attorney General. In addition, the Attorney General's staff has met informally with officials and planners from numerous jurisdictions to discuss CEQA requirements and to learn from those who are leading the fight against global warming at the local level.

Still, local governments and their planners have questions. In this document, we attempt to answer some of the most frequently asked of those questions. We hope this document will be useful, and we encourage cities and counties to contact us with any additional questions, concerns, or comments.

- **Can a lead agency find that a general plan update's climate change-related impacts are too speculative, and therefore avoid determining whether the project's impacts are significant?**

  No. There is nothing speculative about climate change. It's well understood that (1) greenhouse gas (GHG) emissions increase atmospheric concentrations of GHGs; (2) increased GHG concentrations in the atmosphere exacerbate global warming; (3) a project that adds to the atmospheric load of GHGs adds to the problem.

  Making the significance determination plays a critical role in the CEQA process.[4] Where a project may have a significant effect on the environment, the lead agency must prepare an Environmental Impact Report (EIR).[5] Moreover, a finding of significance triggers the obligation to consider alternatives and to impose feasible mitigation.[6] For any project under CEQA, including a general plan update, a lead agency therefore has a fundamental obligation to determine whether the environmental effects of the project, including the project's contribution to global warming, are significant.

- **In determining the significance of a general plan's climate change-related effects, must a lead agency estimate GHG emissions?**

  Yes. As OPR's Technical Advisory states:

  > Lead agencies should make a good-faith effort, based on available information, to calculate, model, or estimate the amount of CO2 and other GHG emissions from a project, including the emissions associated with vehicular traffic, energy consumption, water usage and construction activities.[7]

  In the context of a general plan update, relevant emissions include those from government operations, as well as from the local community as a whole. Emissions sources include, for example, transportation, industrial facilities and equipment, residential and commercial development, agriculture, and land conversion.

  There are a number of resources available to assist local agencies in estimating their current and projected GHG emissions. For example, the California Air Resources Board (ARB) recently issued protocols for estimating emissions from local government operations, and the agency's protocol for estimating community-wide emissions is forthcoming.[8] OPR's Technical Advisory contains a list of modeling tools to estimate GHG emissions. Other sources of helpful information include the white paper issued by the California Air Pollution Control Officers Association (CAPCOA), "CEQA and Climate Change"[9] and the Attorney General's website,[10] both of which provide information on currently available models for calculating emissions. In addition, many cities and counties are working with the International Council for Local Environmental Initiatives (ICLEI)[11] and tapping into the expertise of this State's many colleges and universities.[12]

- **For climate change, what are the relevant "existing environmental conditions"?**

  The CEQA Guidelines define a significant effect on the environment as "a substantial adverse change in the physical conditions which exist in the area affected by the proposed project."[13]

  For local or regional air pollutants, existing physical conditions are often described in terms of air quality (how much pollutant is in the ambient air averaged over a given period of time), which is fairly directly tied to current emission levels in the relevant "area affected." The "area affected," in turn, often is defined by natural features that hold or trap the pollutant until it escapes or breaks down. So, for example, for particulate matter, a lead agency may describe existing physical conditions by discussing annual average PM10 levels, and high PM10 levels averaged over a 24-hour period, detected at various points in the air basin in the preceding years.

  With GHGs, we're dealing with a global pollutant. The "area affected" is both the atmosphere and every place that is affected by climate change, including not just the area immediately around the project, but the region and the State (and indeed the planet). The existing "physical conditions" that we care about are the current atmospheric concentrations of GHGs and the existing climate that reflects those concentrations.

  Unlike more localized, ambient air pollutants which dissipate or break down over a relatively short period of time (hours, days or weeks), GHGs accumulate in the atmosphere, persisting for decades and in some cases millennia. The overwhelming scientific consensus is that in order to avoid disruptive and potentially catastrophic climate change, then it's not enough simply to stabilize our annual GHG emissions. The science tells us that we must <u>immediately and substantially reduce</u> these emissions.

- **If a lead agency agrees to comply with AB 32 regulations when they become operative (in 2012), can the agency determine that the GHG-related impacts of its general plan will be less than significant?**

  <u>No.</u> CEQA is not a mechanism merely to ensure compliance with other laws, and, in addition, it does not allow agencies to defer mitigation to a later date. CEQA requires lead agencies to consider the significant environmental effects of their actions and to mitigate them today, if feasible.

  The decisions that we make today do matter. Putting off the problem will only increase the costs of any solution. Moreover, delay may put a solution out of reach at any price. The experts tell us that the later we put off taking real action to reduce our GHG emissions, the less likely we will be able to stabilize atmospheric concentrations at a level that will avoid dangerous climate change.

- **Since climate change is a global phenomenon, how can a lead agency determine whether the GHG emissions associated with its general plan are significant?**

  The question for the lead agency is whether the GHG emissions from the project – the general plan update – are considerable when viewed in connection with the GHG emissions from past projects, other current projects, and probable future projects.[14] The effects of GHG emissions from past projects and from current projects to date are reflected in current atmospheric concentrations of GHGs and current climate, and the effects of future emissions of GHGs, whether from current projects or existing projects, can be predicted based on models showing future atmospheric GHG concentrations under different emissions scenarios, and different resulting climate effects.

  A single local agency can't, of course, solve the climate problem. But that agency can do its fair share, making sure that the GHG emissions from projects in its jurisdiction and subject to its general plan are on an emissions trajectory that, if adopted on a larger scale, is consistent with avoiding dangerous climate change.

  Governor Schwarzenegger's Executive Order S-3-05, which commits California to reducing its GHG emissions to 1990 levels by 2020 and to eighty percent below 1990 levels by 2050, is grounded in the science that tells us what we must do to achieve our long-term climate stabilization objective. The Global Warming Solutions Act of 2006 (AB 32), which codifies the 2020 target and tasks ARB with developing a plan to achieve this target, is a necessary step toward stabilization.[15] Accordingly, the targets set in AB 32 and Executive Order S-3-05 can inform the CEQA analysis .

  One reasonable option for the lead agency is to create community-wide GHG emissions targets for the years governed by the general plan. The community-wide targets should align with an emissions trajectory that reflects aggressive GHG mitigation in the near term and California's interim (2020) [16] and long-term (2050) GHG emissions limits set forth in AB 32 and the Executive Order.

  To illustrate, we can imagine a hypothetical city that has grown in a manner roughly proportional to the state and is updating its general plan through 2035. The city had emissions of 1,000,000 million metric tons (MMT) in 1990 and 1,150,000 MMT in 2008. The city could set an emission reduction target for 2014 of 1,075,000 MMT, for 2020 of 1,000,000 MMT, and for 2035 of 600,000 MMT, with appropriate emission benchmarks in between. Under these circumstances, the city could in its discretion determine that an alternative that achieves these targets would have less than significant climate change impacts.

- **Is a lead agency required to disclose and analyze the full development allowed under the general plan?**

  Yes. The lead agency must disclose and analyze the full extent of the development allowed by the proposed amended general plan,[17] including associated GHG emissions.

This doesn't mean that the lead agency shouldn't discuss the range of development that is likely to occur as a practical matter, noting, for example, the probable effect of market forces. But the lead agency can't rely on the fact that full build out may not occur, or that its timing is uncertain, to avoid its obligation to disclose the impacts of the development that the general plan would permit. Any other approach would seriously underestimate the potential impact of the general plan update and is inconsistent with CEQA's purposes.

- **What types of alternatives should the lead agency consider?**

  A city or county should, if feasible, evaluate at least one alternative that would ensure that the community contributes to a lower-carbon future. Such an alternative might include one or more of the following options:

  - higher density development that focuses growth within existing urban areas;
  - policies and programs to facilitate and increase biking, walking, and public transportation and reduce vehicle miles traveled;
  - the creation of "complete neighborhoods" where local services, schools, and parks are within walking distance of residences;
  - incentives for mixed-use development;
  - in rural communities, creation of regional service centers to reduce vehicle miles traveled;
  - energy efficiency and renewable energy financing (see, e.g., AB 811)[18]
  - policies for preservation of agricultural and forested land serving as carbon sinks;
  - requirements and ordinances that mandate energy and water conservation and green building practices; and
  - requirements for carbon and nitrogen-efficient agricultural practices.

  Each local government must use its own good judgment to select the suite of measures that best serves that community.

- **Can a lead agency rely on policies and measures that simply "encourage" GHG efficiency and emissions reductions?**

  <u>No</u>. Mitigation measures must be "fully enforceable."[19] Adequate mitigation does not, for example, merely "encourage" or "support" carpools and transit options, green building practices, and development in urban centers. While a menu of hortatory GHG policies is positive, it does not count as adequate mitigation because there is no certainty that the policies will be implemented.

  There are many concrete mitigation measures appropriate for inclusion in a general plan and EIR that can be enforced as conditions of approval or through ordinances. Examples are described in a variety of sources, including the CAPCOA's white paper,[20] OPR's Technical Advisory,[21] and the mitigation list on the Attorney General's website.[22] Lead agencies should also consider consulting with other cities and counties that have recently completed general plan updates or are working on Climate Action Plans.[23]

- **Is a "Climate Action Plan" reasonable mitigation?**

  Yes. To allow for streamlined review of subsequent individual projects, we recommend that the Climate Action Plan include the following elements: an emissions inventory (to assist in developing appropriate emission targets and mitigation measures); emission targets that apply at reasonable intervals through the life of the plan; enforceable GHG control measures; monitoring and reporting (to ensure that targets are met); and mechanisms to allow for the revision of the plan, if necessary, to stay on target.[24]

  If a city or county intends to rely on a Climate Action Plan as a centerpiece of its mitigation strategy, it should prepare the Climate Action Plan at the same time as its general plan update and EIR. This is consistent with CEQA's mandate that a lead agency must conduct environmental review at the earliest stages in the planning process and that it not defer mitigation. In addition, we strongly urge agencies to incorporate any Climate Action Plans into their general plans to ensure that their provisions are applied to every relevant project.

- **Is a lead agency also required to analyze how future climate change may affect development under the general plan?**

  Yes. CEQA requires a lead agency to consider the effects of bringing people and development into an area that may present hazards. The CEQA Guidelines note the very relevant example that "an EIR on a subdivision astride an active fault line should identify as a significant effect the seismic hazard to future occupants of the subdivision."[25]

  Lead agencies should disclose any areas governed by the general plan that may be particularly affected by global warming, e.g.: coastal areas that may be subject to increased erosion, sea level rise, or flooding; areas adjacent to forested lands that may be at increased risk from wildfire; or communities that may suffer public health impacts caused or exacerbated by projected extreme heat events and increased temperatures. General plan policies should reflect these risks and minimize the hazards for current and future development.

Endnotes

[1]For a discussion of requirements under general planning law, see OPR's General Plan Guidelines (2003). OPR is in the process of updating these Guidelines. For more information, visit OPR's website at http://www.opr.ca.gov/index.php?a=planning/gpg.html.

[2]OPR has noted the environmental and administrative advantages of addressing GHG emissions at the plan level, rather than leaving the analysis to be done project-by-project. See OPR, Preliminary Draft CEQA Guideline Amendments, Introduction at p. 2

(Jan. 8, 2009), available at
http://opr.ca.gov/download.php?dl=Workshop_Announcement.pdf.

[3] OPR issued its Preliminary Draft CEQA Guidelines Amendments on January 8, 2009. Pursuant to Health and Safety Code, § 21083.05 (SB 97), OPR must prepare its final proposed guidelines by July 1, 2009, and the Resources Agency must certify and adopt those guidelines by January 1, 2010.

[4]Cal. Code Regs., tit. 14 (hereinafter "CEQA Guidelines"), § 15064, subd. (a).

[5]CEQA Guidelines, § 15064, subd. (f)(1).

[6]CEQA Guidelines, § 15021, subd. (a).

[7]OPR, CEQA and Climate Change: Addressing Climate Change Through California Environmental Quality Act (CEQA) Review (June 2008), available at http://opr.ca.gov/ceqa/pdfs/june08-ceqa.pdf.

[8] ARB's protocols for estimating the emissions from local government operations are available at http://www.arb.ca.gov/cc/protocols/localgov/localgov.htm.

[9] CAPCOA, CEQA and Climate Change, Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act (January 2008) (hereinafter, "CAPCOA white paper"), available at http://www.capcoa.org/.

[10] http://ag.ca.gov/globalwarming/ceqa/modeling_tools.php

[11] http://www.iclei-usa.org

[12] For example, U.C. Davis has made its modeling tool, UPlan, available at http://ice.ucdavis.edu/doc/uplan; San Diego School of Law's Energy Policy Initiatives Center has prepared a GHG emissions inventory report for San Diego County http://www.sandiego.edu/EPIC/news/frontnews.php?id=31; and Cal Poly, San Luis Obispo City and Regional Planning Department is in the process of preparing a Climate Action Plan for the City of Benicia, see http://www.beniciaclimateactionplan.com/files/about.html.

[13]CEQA Guidelines, § 15002, subd. (g).

[14] CEQA Guidelines, § 15064(h)(1).

[15]See ARB, Scoping Plan at pp. 117-120, available at http://www.arb.ca.gov/cc/scopingplan/document/psp.pdf. (ARB approved the Proposed Scoping Plan on December 11, 2008.)

[16]In the Scoping Plan, ARB encourages local governments to adopt emissions reduction goals for 2020 "that parallel the State commitment to reduce greenhouse gas emissions by approximately 15 percent from current levels . . . ." Scoping Plan at p. 27; see *id.* at Appendix C, p. C-50. For the State, 15 percent below current levels is approximately equivalent to 1990 levels. *Id.* at p. ES-1. Where a city or county has grown roughly at

the same rate as the State, its own 1990 emissions may be an appropriate 2020 benchmark. Moreover, since AB 32's 2020 target represents the State's *maximum* GHG emissions for 2020 (see Health & Safety Code, § 38505, subd. (n)), and since the 2050 target will require substantial changes in our carbon efficiency, local governments may consider whether they can set an even more aggressive target for 2020. See Scoping Plan, Appendix C, p. C-50 [noting that local governments that "meet or exceed" the equivalent of a 15 percent reduction in GHG emissions by 2020 should be recognized].

[17] *Christward Ministry v. Superior Court* (1986) 184 Cal.App.3d 180, 194 [EIR must consider future development permitted by general plan amendment]; see also CEQA Guidelines, §§ 15126 [impact from all phases of the project], 15358, subd. (a) [direct and indirect impacts].

[18] See the City of Palm Desert's Energy Independence Loan Program at http://www.ab811.org.

[19] Pub. Res. Code, § 21081.6, subd. (b); CEQA Guidelines, § 15091, subd. (d); see also *Federation of Hillside and Canyon Assocs.* (2000) 83 Cal.App.4th 1252, 1261 [general plan EIR defective where there was no substantial evidence that mitigation measures would "actually be implemented"].

[20]CAPCOA white paper at pp. 79-87 and Appendix B-1.

[21]OPR Technical Advisory, Attachment 3.

[22]See http://ag.ca.gov/globalwarming/pdf/GW_mitigation_measures.pdf [mitigation list];http://ag.ca.gov/globalwarming/pdf/green_building.pdf [list of local green building ordinances].

[23]See http://opr.ca.gov/ceqa/pdfs/City_and_County_Plans_Addressing_Climate_Change.pdf.

[24]See Scoping Plan, Appendix C, at p. C-49.

[25]CEQA Guidelines, § 15126.2, subd. (a).

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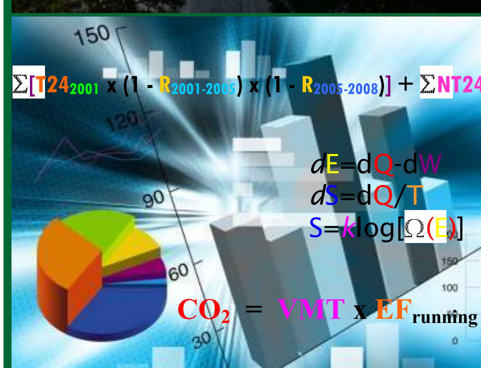

Quantifying Greenhouse Gas Mitigation Measures

A Resource for Local Government
to Assess Emission Reductions from
Greenhouse Gas Mitigation Measures

August, 2010

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California Air Pollution Control Officers Association

with

Northeast States for Coordinated Air Use Management

National Association of Clean Air Agencies

Environ

Fehr & Peers

Acknowledgements

This Report benefited from the hard work and creative insights of many people. CAPCOA appreciates the efforts of all who contributed their time and energy to the project. In particular, the Association thanks the following individuals:

Principal Author

Barbara Lee, NSCAPCD

Project Coordination

Jill Whynot, SCAQMD

Project Oversight Panel

Larry Allen, SLOAPCD
Aeron Arlin-Genet, SLOAPCD
Dan Barber, SJVAPCD
Jeane Berry, SMAQMD
Elaine Chang, SCAQMD
Yusho Chang, PCAQMD
Joseph Hurley, SMAQMD
Aaron Katzenstein SCAQMD
Barbara Lee, NSCAPCD (Chair)
Paul Miller, NESCAUM
Ian Peterson, BAAQMD
Tim Taylor, SMAQMD
Tom Thompson, PCAQMD
David Vintze, BAAQMD
Barry Wallerstein, SCAQMD
David Warner, SJVAPCD
Jill Whynot, SCAQMD (Vice Chair)
Abby Young, BAAQMD
Mel Zeldin, CAPCOA
Yifang Zhu, SCAQMD

External Reviewers

Martha Brook, CEC
Pete Parkinson, County of Sonoma
Bill Loudon, DKS Associates

Editing, Proofing & Layout

Fernando Berton, CAPCOA
Jessica DePrimo, NSCAPCD
Arlene Farol, SCAQMD

Technical Analysis & Discussion of Methods

Shari Libicki, Environ
David Kim, Environ
Jennifer Schulte, Environ
Jerry Walters, Fehr & Peers
Meghan Mitman, Fehr & Peers
Tien-Tien Chan, Fehr & Peers

Disclaimer

The California Air Pollution Control Officers Association (CAPCOA) has prepared this report on quantifying greenhouse gas emissions from select mitigation strategies to provide a common platform of information and tools to support local governments.

This paper is intended as a resource, not a guidance document. It is not intended, and should not be interpreted, to dictate the manner in which a city or county chooses to address greenhouse gas emissions in the context of projects it reviews, or in the preparation of its General Plan.

This paper has been prepared at a time when California law and regulation, as well as accepted practice regarding how climate change should be addressed in government programs, is undergoing change. There is pending litigation that may have bearing on these decisions, as well as active legislation at the federal level. In the face of this uncertainty, local governments are working to understand the new expectations, and how best to meet them. This paper is provided as a resource to local policy and decision makers to enable them to make the best decisions they can during this period of uncertainty.

Finally, in order to provide context for the quantification methodologies it describes, this report reviews requirements, discusses policy options, and highlights methods, tools, and resources available; these reviews and discussions are not intended to provide legal advice and should not be construed as such. Questions of legal interpretation, or requests for legal advice, should be directed to the jurisdiction's counsel.

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Appendices

This report on *Quantifying Greenhouse Gas Mitigation Measures: A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures* was prepared by the California Air Pollution Control Officers Association with the Northeast States for Coordinated Air Use Management and the National Association of Clean Air Agencies, and with technical support from Environ and Fehr & Peers. It is primarily focused on the quantification of project-level mitigation of greenhouse gas emissions associated with land use, transportation, energy use, and other related project areas. The mitigation measures quantified in the Report generally correspond to measures previously discussed in CAPCOA's earlier reports: *CEQA and Climate Change*; and *Model Policies for Greenhouse Gases in General Plans*. The Report does not provide policy guidance or advocate any policy position related to greenhouse gas emission reduction.

The Report provides a discussion of background information on programs and other circumstances in which quantification of greenhouse gas emissions is important. This includes voluntary emission reduction efforts, project-level emission reduction efforts, reductions for regulatory compliance, and reductions for some form of credit. The information provided covers basic terms and concepts and again, does not endorse or provide guidance on any policy position.

Certain key concepts for quantification are covered in greater depth. These include baseline, business-as-usual, types of emission reductions, project scope, lifecycle analysis, accuracy and reliability, additionality, and verification.

In order to provide transparency and to enhance the understanding of underlying strengths and weaknesses, the Report includes a detailed explanation of the approaches and methods used in developing the quantification of the mitigation measures. There is a summary of baseline methods (which are discussed in greater detail in Appendix B) as well as a discussion of methods for the measures. This includes the selection process for the measures, the development of the quantification approaches, and limitations in the data used to derive the quantification.

The mitigation measures were broken into categories, and an overview is provided for each category. The overview discusses specific considerations in quantifying emissions for measures in the category, as well as project-specific data the user will need to provide. Where appropriate and where data are readily available, the user is directed to relevant data sources. In addition, some tables and other information are included in the appendices.

The mitigation measures are presented in Fact Sheets. An overview of the Fact Sheets is provided which outlines their organization and describes the layout of information. The Report also includes a step-by-step guide to using a Fact Sheet to quantify a project, and discusses the use of Fact Sheets outside of California. The Report also discusses the grouping of the measures, and outlines procedures and limitations for quantifying projects where measures are combined either within or across categories. These limitations are critical to ensure that emission reductions are appropriately quantified and are not double counted. As a general guide, approximate ranges of effectiveness are provided for each of the measures, and this is presented in tables at the end of Chapter 6. These ranges are for reference only and should not be used in lieu of the actual Fact Sheets; they do not provide accurate quantification on a project-specific basis.

The Fact Sheets themselves are presented in Chapter 7, which includes an index of the Fact Sheets and cross references each measure to measures described in CAPCOA's earlier reports: *CEQA and Climate Change*; and *Model Policies for Greenhouse Gases in General Plans*. Each Fact Sheet includes a description of the measure, assumptions and limitations in the quantification, a baseline methodology, and the quantification of the measure itself. There is also a sample project calculation, and a discussion of the data and studies used in the development of the quantification.

In the Appendices, there is a glossary of terms. The baseline methodology is fully explained, and there is additional supporting information for the transportation methods and the non-transportation methods. Finally, the Report includes select reference tables that the user may consult for select project-specific factors that are called for in some of the Fact Sheets.

Background

The California Air Pollution Control Officers Association (CAPCOA) prepared the report, *Quantifying Greenhouse Gas Mitigation Measures: A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures* (Quantification Report, or Report), in collaboration with the Northeast States for Coordinated Air Use Management (NESCAUM) and the National Association of Clean Air Agencies (NACAA), and with contract support from Environ, and Fehr & Peers, who performed the technical analysis. The Report provides methods for quantifying emission reductions from a specified list of mitigation measures, primarily focused on project-level mitigation. The emissions calculations include greenhouse gases (GHGs), particulate matter (PM), carbon monoxide (CO), oxides of nitrogen (NOx), sulfur dioxide (SO2), and reactive organic gases (ROG), as well as toxic air pollutants, where information is available.

The measures included in this Report were selected because they are frequently considered as mitigation for GHG impacts, and standardized methods for quantifying emissions from these projects were not previously available. Measures were screened on the basis of the feasibility of quantifying the emissions, the availability of robust and meaningful data upon which to base the quantification, and whether the measures (alone or in combination with other measures) would result in appreciable reductions in GHG emissions. CAPCOA does not mean to suggest that other measures should not be considered, or that they might not be effective or quantifiable; on the contrary, there are many options and approaches to mitigate emissions of GHGs. CAPCOA sought to provide a high quality quantification tool to local governments with the broadest applicability possible, given the resource limitations for the project. CAPCOA encourages local governments to be bold and creative as they approach the challenge of climate change, and does not intend this Report to limit the scope of measures considered for mitigation.

The majority of the measures in the Report have been discussed in CAPCOA's previous resource documents: *CEQA and Climate Change*, and *Model Policies for Greenhouse Gases in General Plans*. The measures in this Report are cross-referenced to those prior reports. The quantification methods provided here are largely project-level in nature; they can certainly inform planning decisions, however a complete planning-level analysis of mitigation strategies will entail additional quantification.

In developing the quantification methods, CAPCOA and its contractors conducted an extensive literature review. The goal of the Report was to provide accurate and reliable quantification methods that can be used throughout California and adapted for use outside of the state as well.

Intent and Audience

This document is intended to further support the efforts of local governments to address the impacts of GHG emissions in their environmental review of projects and in their planning efforts. Project proponents and others interested in quantifying mitigation measures will also find the document useful.

The guidance provided in this Report specifically addresses appropriate procedures for applying quantification methods to achieve accurate and reliable results. The Report includes background information on programs and concepts associated with the quantification of GHG emissions. The Report does not provide policy guidance on any of these issues, nor does it dictate how any jurisdiction should address questions of policy. Policy considerations are left to individual agencies and their governing boards. Rather, this Report is intended to support the creation of a standardized approach to quantifying mitigation measures, to allow emission reductions and measure effectiveness to be considered and compared on a common basis.

Because the quantification methods in this Report were developed to meet the highest standards for accuracy and reliability, CAPCOA believes they will be generally accepted for most quantification purposes. The decision to accept any quantification method rests with the reviewing agency, however. Further, while the Report discusses the quantification of GHG emissions for a variety of purposes, including the quantification of reductions for credit, using these methods does not guarantee that credit will be awarded.

Using the Document

Chapters 2 and 3 of this Report discuss programs and concepts associated with GHG quantification. They are intended to provide background information for those interested in the context in which reductions are being made. Chapter 4 discusses the underpinnings of the quantification methods and specifically addresses limitations in the data used as well as limitations in applying the methods; it is important for anyone using this Report to review Chapter 4. Chapter 5 provides an overview of the mitigation measure categories, including key considerations in the quantification of emission reductions in those categories. Chapter 6 explains how to use the fact sheets for each measure's quantification method, and also discusses the effectiveness of the measures and how combining measures changes the effectiveness.

Once the user understands the quantification context, and the limitations of the methods, the fact sheets can be used like recipes in a cookbook . In using the fact sheets, however, CAPCOA strongly advises the reader to pay careful attention to the assumptions and limitations set forth for each individual measure, and to make sure that these are respected and appropriately considered.

The fact sheets with the actual quantification methods for each individual measure are contained in Chapter 7. The baseline methods are explained in Appendix B. It is the responsibility of the user to ensure that all data inputs are provided as called for in the methods, and that the data are of appropriate quality.

CAPCOA will not be able to provide case-by-case review or adjustments for specific projects outside of the provision for project-specific data inputs that is part of each fact sheet. Questions about individual projects may be referred to your local air district.

As a final note, the methods contained in this document include generalized information about the measures themselves. This information includes emission factors, usage rates, and other data from various sources, most commonly published data from public agencies. The data were carefully reviewed to ensure they represent the best information available for this purpose. The use of generalized information allows the quantification methods to be used across a range of circumstances, including variations in geographical location, climate, and population density, among others.

Where good quality, project-specific data is available that provides a superior characterization of a particular project, it should be used instead of the more generalized data presented here. The methods provided for baseline and mitigated emissions scenarios allow for such substitution. The local agency reviewing the project should review the project-specific data, however, to ensure that it meets standards for data quality and will not result in an inappropriate under- or overestimation of project emissions or mitigation.

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Quantification Framework

The Quantification Report has been prepared to support a range of quantification needs. It is based on the premise that quantification of GHG emissions and reductions should rest on a foundation of clear assumptions, limits, and calculations. When these elements and the methods of applying them are transparent, a common "language" is created that allows us to talk about, compare, and evaluate GHGs with confidence that we are looking at "apples to apples."

For the purpose of this report, GHGs are the six gases identified in the Kyoto Protocol: carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). GHGs are expressed in metric tons (MT) of CO_2e (carbon dioxide equivalents). Individual GHGs are converted to CO_2e by multiplying values by their global warming potential (GWP). Global warming potentials represent a ratio of a gas' heat trapping characteristics compared to CO_2, which has a global warming potential of 1.

As a general rule, the quantification methods in this report are only accurate to the degree that the project adheres to the assumptions, limitations, and other criteria specified for a given measure. Where specific data inputs are indicated for either the baseline or the project scenario calculations, those data must be provided for the calculations to be valid. Further, the quality of the data used will substantially impact the quality of the results achieved. For example, if a calculation method calls for a traffic count, the calculations can't be made without supplying a traffic count number. However, the number used could be a rough estimate, could be based on a small, one-time sample, or could be derived through a full traffic study over a representative period of time or times. Clearly, using a rough estimate for any of the data inputs will yield results that are less accurate than they would be if higher quality data inputs were provided.

This does not mean that rough estimates cannot be used. There will be times when the quantification does not need to be precise. In order to speak the common language, however, it is important to identify how precise your data inputs are. It is also important to give careful consideration to the intended use of the quantification, to make sure that the results you achieve will be sufficiently rigorous to support the conclusions you draw from them.

The quantification methods in this report rely on very specific assumptions and limitations for each mitigation measure. Unlike the discussion of data inputs, the measure assumptions and limits affect more than the precision of the calculations: they determine whether the calculation is valid at all. For example, there is a method for calculating GHG reductions for each percentage in improvement in building energy use beyond the performance standards in California's Title 24; that method states that the measure is specifically for electricity and natural gas use in residential and commercial buildings subject to Title 24. If the building is located outside of California, where Title 24 is not applicable, the method will not yield accurate results unless the baseline assumptions are adjusted to reflect the standards that actually apply. Further, the measure effectiveness is based on assumptions that certain other energy efficiency measures are also applied (such as third-party HVAC-commissioning); if those additional measures are not applied, the calculated reductions will not be accurate and will overestimate the reductions compared to what will actually be achieved.

There may be situations where you choose to apply a method even if the assumptions do not match the specific conditions of the project; while CAPCOA does not recommend this, if you do it, it is imperative that any deviations are clearly identified. While you may still be able to calculate a reduction for your measure, in many cases the error in your result will be so large that any conclusions you would draw from the analysis could be completely wrong.

Quantifying Measures for Different Purposes

There are several reasons that a person might implement measures to reduce GHG emissions. Some measures are implemented simply because it's a good thing to do. Knowing how many metric tons of GHG emissions were reduced might not be important in that case. There are other reasons for undertaking a project to reduce GHGs, however, and for some of these purposes quantification (and verification) become increasingly important, and sensitive. This chapter discusses the role of quantification, and to a lesser extent verification, in reductions undertaken for a range of reasons. These include: voluntary reductions, reductions undertaken specifically to mitigate current or future impacts, reductions for regulatory compliance, and reductions where some form of credit is being sought, including credits that may be traded on a credit exchange. The purpose for which reductions are quantified will determine the level of detail involved in the quantification, as well as the degree of verification needed to support the quantification. As stated previously, this discussion is provided for information purposes only; it should not be construed to advocate or endorse any particular policy position.

Voluntary Reductions

Voluntary reductions of GHG emissions are reductions that are not required for any reason, including a regulation, law, or other form of standard. Even when reductions are not mandatory, however, there may be reasons to quantify them. The project proponent may simply want to know how effective the project is. Examples of this would be when a project is undertaken in an educational setting, or to demonstrate the general feasibility of a concept, or promote an image of environmental responsibility. In such a case, the focus may be on implementing the project more than documenting exactly how many tons of CO_2e have been reduced, and a reasonable estimate might be sufficient. The project proponent may wish to track reductions to fulfill an organizational policy or commitment, or to establish a track record in GHG reductions. For these purposes, the quantification does not need to be precise, but it should still be based on sound principles and accepted methods.

When reductions are purely voluntary, they may be estimated using the methods contained in this document, even if all of the variables are not known, or if some of the assumptions are not fully supported by the specifics of the project. If the quantification is performed without the level of detail outlined in the method for a given measure (or specified for the baseline calculations), the results will be less accurate. The same is true if a method is used in a situation where the assumptions are not fully supported, or if the method is used outside the noted limitations. As one would expect, the greater the degree of variation from the conditions put forth in the fact sheets, the less accurate the quantification will be. Significant deviation can result in very large errors.

If there is any possibility that the project proponent may at some point wish to use the reductions to fulfill a future regulatory or mitigation requirement, or seek some form of credit for the reductions, the proponent should not deviate from the methods and should ensure that all necessary data are included, and all assumptions and limitations are appropriately addressed. Acceptance of the quantification methods in this Report to fulfill any requirement is solely at the discretion of the approving agency. Use of these methods does not guarantee that credit of any kind will be awarded for reductions made.

Reductions to Mitigate Current or Future Impacts

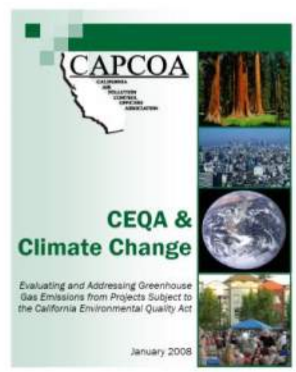
One of the most common reasons for quantifying emissions of GHG is to analyze and mitigate current or future impacts of specific actions or activities. This can include project-level impacts, such as those evaluated under the California Environmental Quality Act (CEQA), or plan-level impacts, such those resulting from the implementation of a General Plan or Climate Action Plan. Quantification of projects and mitigation under CEQA was the main focus in preparing this guidance document. Most of the measures quantified in the Report are project-level in nature. Many of these are also good examples of the kinds of policies and actions that would be included in a General Plan or a Climate Action Plan. The quantification methods provided here can be used to support conclusions about the effectiveness of different measures in a planning context; however, a full analysis of plan-level impacts will require consideration of additional factors, depending on the nature of the measure. Some of the measures have been specifically identified as General Plan measures, and a discussion is included about appropriate analysis of these measures, where study data exist to support such analysis.

Project-Level Mitigation: Existing environmental law and policy requires that environmental impacts of projects be evaluated and disclosed to the public, and where those impacts are potentially significant, that they be mitigated. At the federal level, the National Environmental Protection Act (NEPA) governs this evaluation. Many states have their own programs as well; in California, the California Environmental Quality Act, or CEQA, sets forth the requirements and the framework for the review.

The responsibility to evaluate impacts, to determine significance, and to define appropriate mitigation rests with the Lead Agency. This is typically a city or county with land-use decision-making authority, although other agencies can be Lead Agencies, depending on the nature of the project and the jurisdiction of the agency.

<u>Guidance on CEQA and Climate Change</u>: There are currently two resources for Lead Agencies on incorporating considerations of climate change into their CEQA processes. The first was prepared by CAPCOA, and the most recent is an amendment to the official CEQA Guidelines prepared by the California Natural Resources Agency (Resources Agency).

<u>CAPCOA Guidance</u>- In January of 2008, CAPCOA released a resource document, *"CEQA and Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act,"* that discussed different approaches to determining whether GHG emissions from projects are significant under CEQA. It reviewed the models and other tools available at that time for conducting GHG analyses, and the document also contained a list of mitigation measures. A copy of the report is available at *http://www.capcoa.org*.



<u>Resources Agency Guidance</u>- Since the release of that report, the California Natural Resources Agency (Resources Agency) finalized its guidance on GHG emissions and CEQA in December of 2009. Under Senate Bill 97 (Chapter 148, Statutes of 2007), the Governor's Office of Planning and Research (OPR) was required to prepare amendments to the state's CEQA Guidelines addressing analysis and mitigation of the potential effects of GHG emissions in CEQA documents. The legislation required the Resources Agency to adopt the amended Guidelines by 2010.

The CEQA Guidelines Amendments adopted by the Resources Agency made material changes to 14 sections of the Guidelines. The changes include dealing with the determination of significance (principally in Public Resource Code Section 15064) and cumulative impacts, as well as areas such as the consultation process for the draft EIR, the statement of overriding considerations, the environmental setting, mitigation measures, and tiering and streamlining. Overall, the discussion of determining significance in

these amendments is consistent with the earlier report released by CAPCOA.

In the Final Statement of Reasons (SOR) for the adoption of the amendments to the CEQA Guidelines, the Resources Agency makes two points that are important with regard to quantification of GHG emissions from projects. First, it states that the Guidelines "appropriately focus on a project's potential incremental contribution of GHGs" and that the amendments "expressly incorporate the fair argument standard." [1] This sets the parameters for the analysis to be performed. The Resources Agency further states that the analysis for GHGs must be consistent with existing CEQA principles, which includes standards for the substantial evidence needed to support findings.

Second, the Final SOR specifically states that the amendments "interpret and make specific statutory CEQA provisions and case law … determining the significance of GHG emissions that may result from proposed projects."[2] In this context, they cite specific case law as well as CEQA Guidelines Section 15144 that require a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance."[3]

Complete copies of the 2009 CEQA Guidelines Amendments and the Final Statement of Reasons may be downloaded at: *http://ceres.ca.gov/ceqa/docs/*.

<u>Quantification of Projects</u>: Project level quantification, especially as it pertains to CEQA, was CAPCOA's main focus in developing this Report. The baseline conditions and quantification methods were selected to be consistent with the implementation of AB 32, as well as the Scoping Plan developed by ARB. The list of mitigation measures selected for the Report reflects the types of strategies that local governments and project proponents have shown interest in, and sought direction on quantifying. For the most part, they entail clearly delineated boundary conditions, and have been designed to be applicable across a range of circumstances.

This Quantification Report does not provide any policy guidance on what amount of GHG emissions would be significant. The determination of significance, including any thresholds, is the exclusive purview of the Lead Agency and its policy board. CAPCOA's Quantification Report provides methods to quantify emissions from specific types of mitigation projects or measures. It is based on a careful review of existing studies and determinations to develop rigorous quantification methods that meet the substantial evidence requirements of CEQA.

A project proponent or reviewer who wishes to use these methods to quantify emissions for the purpose of complying with CEQA must adhere to the assumptions and limitations

[1] California Natural Resources Agency: "Final Statement of Reasons for Regulatory Action: Amendments to the State CEQA Guidelines Addressing and Analysis and Mitigation of Greenhouse Gas Emissions Pursuant to SB 97," December, 2009; p 12.
[2] Ibid: p. 18.
[3] Ibid: p. 18.

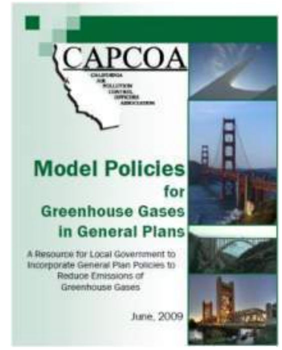
specified in the methods for each project type. If these assumptions and limitations are not followed, the quantification will not be valid. Ultimately, the Lead Agency will have the responsibility to review and decide whether to allow any requests for deviations from the method, and to determine whether those deviations have a substantive impact on the results. Lead Agencies may contact their local air district for assistance in making such a review, but CAPCOA will not be in a position to provide any case-by-case review of changes to the quantification methods in this report.

As stated previously, where good quality, project-specific data are available, they should be substituted for the more generalized data used in the baseline and mitigation emissions calculations. The quality of the data inputs can significantly affect the accuracy and reliability of the results. When quantification is performed for CEQA compliance, CAPCOA recommends that project-specific data be as robust as possible. We discourage the use of approximations or unsubstantiated numbers. In any case, CAPCOA strongly recommends that the source(s) and/or basis of all project-specific data supplied by the project proponent be clearly identified in the analysis, and the limitations of the data be discussed.

Plan-Level Mitigation: Cities and counties, as well as other entities, develop environmental planning documents. The most common are General Plans, which specify the blueprint for land-use, transportation, housing, growth, and resource management for cities, counties, and regions. These plans are periodically updated, and in recent updates, the California Attorney General has put jurisdictions on notice that their plans must consider climate change.

A stand-alone plan that considers climate change is a Climate Action Plan. Climate Action Plans can be developed for a school or company, for a city, county, region, or larger jurisdiction. A Climate Action Plan will typically identify a reduction target or commitment, and then set forth the complement of goals, policies, measures, and ordinances that will achieve the target. These policies and other strategies will typically include measures in transportation, land use, energy conservation, water conservation, and other elements.

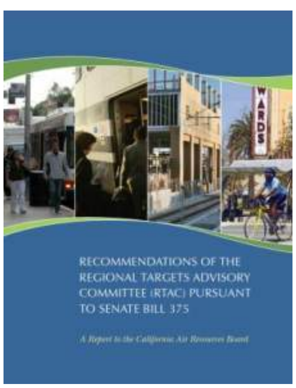
Guidance on Planning and Climate Change: CAPCOA prepared a guidance document on GHGs and General Plans for local governments. There are also several important processes under way that will have a significant impact on the planning process in the coming years. These include the early implementation of Senate Bill 375 (Steinberg, Statutes of 2008); the development of new General Plan Guidelines; and statewide planning for adaptation to the impacts of climate change. They are described below.



CAPCOA Guidance for General Plans- In June of 2009, CAPCOA released "*Model Policies for Greenhouse Gases in General Plans: A Resource for Local Government to Incorporate General Plan Policies to Reduce Emissions of Greenhouse Gases*." This document embodied a menu of GHG mitigation measures that could be included in a General Plan or a Climate Action Plan. It was structured around the elements of a General Plan, provided model language that could be taken and dropped into a plan, and also provided a worksheet for evaluating which measures to use. The CAPCOA Model Policies document focused on strategies to reduce GHG emissions; it did not address climate change adaptation, which is an important, but separate consideration.

Senate Bill 375- Senate Bill 375 is considered a landmark piece of legislation that aligns regional land use, transportation, housing, and greenhouse gas reduction planning efforts. The bill requires the ARB to set greenhouse gas emission reduction targets for light trucks and passenger vehicles for 2020 and 2035. The 18 Metropolitan Planning Organizations (MPOs) are responsible for preparing Sustainable Communities Strategies and, if needed, Alternative Planning Strategies (APS), that will include a region's respective strategy for meeting the established targets. An APS is an alternative strategy that must show how the region would, if implemented, meet the target if the SCS does not.

To develop the targets, SB 375 called for a Regional Targets Advisory Committee (RTAC), which included representatives from the MPOs, cities and counties, air districts, elected officials, the business community, nongovernmental organizations, and



experts in land use and transportation. The RTAC provided recommendations on the targets to ARB in a formal report in September, 2009. The report covers a range of important considerations in target setting and implementation. Target setting topics include: the use of empirical data and modeling; key underlying assumptions; best management practices; the base year, the metric, targets for 2020 and 2035; and both statewide and regional factors affecting transportation patterns. For implementation, the report considers housing and social equity issues; local government challenges in meeting the targets; funding and other support at the state and federal level; and a variety of other important considerations. A complete copy of the report may be downloaded at: *http://www.arb.ca.gov/cc/sb375/rtac/report/092909/finalreport.pdf*.

ARB staff released draft regional targets for 2020 for the four largest MPOs in June, 2010, along with placeholder targets for 2035. Placeholder targets were also issued for both 2020 and 2035 for MPOs in the San Joaquin Valley. An alternative approach to target setting was proposed for the remaining MPOs. As required by SB 375, ARB expects to formally adopt the final targets before the end of September, 2010. Additional information about the target setting process can be found at: *http://www.arb.ca.gov/cc/sb375/sb375.htm*.

For the four largest MPOs, the draft 2020 targets are expressed as a percent reduction in emissions based on the potential reductions from land use and transportation planning scenarios provided by the MPOs, with a proposed range for the targets between 5% and 10%[4]. This reduction excludes the expected emission reductions from Pavley GHG vehicle standards and low carbon fuel standard measures. Each of the four regions has its own placeholder targets for 2035, shown in Table 2-1, below.

Table 2-1: Draft Regional Targets for 2035

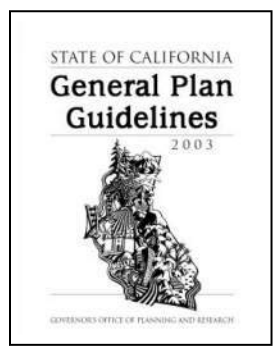
Regional MPO	Draft GHG Reduction Target
Metropolitan Planning Commission (MTC)	3-12%
Sacramento Area Council of Governments (SACOG)	13-17%
San Diego Association of Governments (SANDAG)	5-19%
Southern California Association of Governments (SCAG)	3-12%

Source: ARB: "Draft Regional Greenhouse Gas Emission Reduction Targets For Automobiles and Light Trucks Pursuant to Senate Bill 375" page 4.

The placeholder targets for the MPOs in the San Joaquin Valley range from 1-7% for both 2020 and 2035. Placeholder targets were provided in lieu of draft targets to allow the MPOs to provide additional information for ARB to consider before finalizing the targets. For the remaining six MPOs, ARB proposes to use the most current per-capita GHG emissions data, adjusted for the impacts of the recession, as the basis for setting individual regional targets in those areas.

In addition to serving on the RTAC, local districts will support the MPOs as they develop their strategies to meet their regional targets, and local cities and counties as they incorporate sustainable strategies into their own planning efforts. Two of the contractors who developed the quantification methods in this Quantification Report also served on the RTAC, and every effort has been made to ensure that work here will ultimately be compatible with, and useful in, the implementation of SB 375.

General Plan Guidelines- The Governor's Office of Planning and Research (OPR) provides technical assistance on land use planning and CEQA matters to local governments. In this effort, OPR is required to adopt and periodically revise advisory guidelines to assist local governments in the preparation of local general plans. Commonly referred to as the General Plan Guidelines, the most current edition was released in 2003.



In the 2003 edition, OPR included an overview of the General Plan statutory requirements, a review of CEQA's role in the general plan process, implementation techniques, and the General Plan's relationship to other statutory planning requirements. The 2003 Guidelines do not specifically address GHG emissions or climate change.

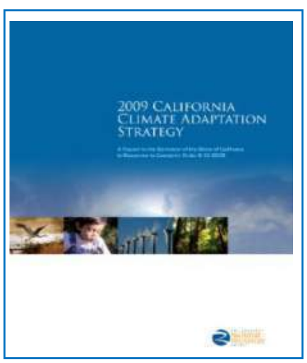
[4] ARB: "Draft Regional Greenhouse Gas Emission Reduction Targets For Automobiles and Light Trucks Pursuant to Senate Bill 375," June, 2010; page 4.

It is important to note that the General Plan Guidelines are advisory, not mandatory. Nevertheless, it is the state's only official document explaining California's legal requirements for general plans. The General Plan Guidelines are continually shaped to reflect current trends, changes in applicable laws, and incorporate additional statutory requirements. This includes anticipated effects from AB 32 and SB 375.

An update to the 2003 General Plan Guidelines has been in development and includes a Climate Change Supplement. This update is expected to be finalized by the end of 2010.

Adaptation- Adaptation has not received the same attention that has been given to steps that might prevent or mitigate the extent of climate change, however it is a topic that should not be ignored in General Plans. The overwhelming body of scientific studies point to a certain amount of change in our climate that is inevitable, even if we are aggressive and diligent in our efforts to prevent it. Many regions of the state (indeed, the nation) are projected to see substantial impacts on agriculture, climate dependant business (such as recreation and tourism), infrastructure, and habitat. Coastal areas will see a rise in sea level, currently projected to be between one and three meters by 2100. Wild fires are expected to increase in number, size, and severity. Stresses on the environment, combined with extreme weather events, are projected to increase the incidence and severity of a number of infectious diseases and other medical conditions. These and myriad other changes pose tremendous risks to people and our way of life.

For that reason, in December, 2009, a team of California state agencies released a report: "The 2009 Climate Adaptation Strategy." In it, the team states that 2.5 trillion dollars' worth of infrastructure in California is at risk from the various projected climate-related changes in our environment. The estimated cost of addressing the impacts on that infrastructure is about $3.9 billion, annually.[5] The report identifies a number of



steps to be taken in the near term to appropriately plan for and address this threat. Highlights of the actions include: the formation of a Climate Adaptation Advisory Panel; new approaches to water management; revised land-use planning to avoid construction in highly vulnerable areas; evaluation of all state infrastructure projects to avoid exacerbating threats to infrastructure; and, more specific planning by emergency response agencies, public health agencies, and others to fortify existing communities and resources, and prepare for future stressors. For more information, the full report may be downloaded at: *http://www.energy.ca.gov/2009publications/CNRA-1000-2009-027/CNRA-1000-2009-027-F.PDF*.

Quantification for Planning Purposes: Quantification of the impacts of measures for planning purposes is a different exercise than quantification for a specific project. By its

[5] California Natural Resources Agency: "2009 Climate Adaptation Strategy" Dec. 2009; p. 5.

very nature, planning involves a future set of conditions about which less is known, and indeed knowable. The art and science of planning depend upon the interpretation of present conditions and trends, and the application of that interpretation to create a picture of future conditions. This document does not address detailed planning analysis in a comprehensive manner.

The majority of the measures described and quantified here are project-level measures; only a few are plan-level measures by design. That said, many of the project level measures are good examples of the implementation of planning-level policies that were described in the CAPCOA Model Policies report. The quantification of these measures will provide important and useful information for the planner to use in the context of quantifying anticipated effects in broader planning efforts.

In a planning context, it is especially important to be mindful of the interactions of different measures. A more detailed explanation is provided in Chapter 6, but the main concern is that certain measures do interact with each other, and their effects are not independent. This means that some measures will have little effect on their own, but in combination with other measures may have significant effect. The classic example of this is the bus shelter. A clean, well-lit, and comfortable bus shelter can enhance ridership on the buses stopping at that shelter and therefore reduce vehicle trips; but without the underlying bus service, the shelter itself does not reduce vehicle trips.

There are also instances where a measure is less effective in combination with other measures than it might be by itself. There are several reasons why this can occur. In some cases this happens because of a diminishing return for consecutive efforts. For example, there may be six good methods to increase ridership on a public transit line, any one of which might increase transit ridership by 20%. But implementing all of them will not necessarily increase ridership by 120%. In fact, for each successive method applied, it is likely that a lesser effect will be observed. Another example is where the measures are in some sense competing, as in a campaign to increase ridership on a commuter rail line at the same time that a new public transit bus line is established with overlapping service areas. Although the ridership campaign might be expected to cause 5% of drivers to switch to rail, some of those potential new riders might use the new bus service instead, making the ridership campaign less effective. At the same time, the new bus line might also be expected to reduce vehicle trips by 5%, but the actual reduction may be lower in reality if some of the ridership comes from those who would have been rail passengers and not from driving. Together, the ridership campaign for the rail line and the new bus line may only reduce vehicle trips by 7%, not the 10% predicted from the estimates of their independent effectiveness.[6]

These effects become more pronounced when considered in a city-wide, county-wide, or regional context. The interplay of land use decisions and transportation infrastructure development will be better assessed with more integrated computer modeling efforts. The quantification of some of the strategies at the individual, project level will provide

[6] Please note that the effectiveness estimates provided here are only for the purposes of illustration and should not be taken as actual quantification of such measures.

insight into how useful and appropriate the strategies will be in the planning effort, however. More detailed discussion of how to quantify combinations of measures is provided in Chapter 6.

Reductions for Regulatory Compliance

There are three basic types of regulations for which emissions quantification is likely to be required: command-and-control regulations, permitting, and participation in a cap-and-trade program. A discussion of each is provided for information purposes, as is a discussion of quantification for mandatory emissions reporting regulations. The quantification methods in this document are intended primarily for use in project-level mitigation. Regulatory programs are likely to have specific requirements for monitoring, reporting, and quantification, which may or may not allow the use of the methods in this Report.

Command and Control Regulations: Some local air districts have command-and-control regulations for GHGs already on the books. These include limitations on the use of certain chemicals that are active in the atmosphere, performance requirements for landfill gas collection, and for systems that use GHGs with high Global Warming Potential, as well as efficiency standards for specific equipment or processes. Under the umbrella of the Scoping Plan, the ARB is also developing command-and-control regulations for a number of source categories. Regulations already adopted include standards for various GHGs that have a high global warming potential, such as sulfur hexafluoride (SF_6) used in the electricity sector, semiconductors, and other operations; perfluorocarbons in semiconductor manufacturing; certain refrigerants; and materials used in consumer products. There are also GHG emission limits on light-duty vehicles, rules for port drayage trucks and other heavy-duty vehicles, as well as landfill methane control requirements, and the Low Carbon Fuel Standard. Additional rulemaking is currently underway.

For these types of regulations, compliance may not rest upon quantification of emissions or emissions reductions. In many cases, installation of a specific technology, substitution of materials, or implementation of inspection and maintenance programs meets the requirements of the rule, and is presumed to have a certain effectiveness in reducing emissions from a baseline level. When a focused regulation does require quantification of emissions, it will generally specify a method for testing emissions, where appropriate, or for calculating emissions from other measured parameters.

A related, but more flexible type of regulation for emission reductions is an overall emissions cap for facilities or operations. Under this approach, sometimes referred to as a “bubble,” the regulation calls for an overall reduction in emissions from a specified baseline, but the operator has the discretion to decide how to achieve those reductions. This is different from a cap-and-trade program (see below), in that there is no trading between facilities, or purchasing of credits to offset obligations. Because energy efficiency and other conservation projects are a likely strategy to meet a facility-wide GHG emission reduction requirement, the quantification of measures in this Report may be useful for compliance with such a cap. Of course, the caveats about assumptions and data inputs are also important here. Further, demonstration of compliance with this kind of limit will also involve verification of the emissions reductions, and is likely to include ongoing compliance tracking.

The regional targets of SB 375 are a type of emissions cap. It is important to note that the quantification presented in this Report may ultimately be useful in demonstrating reductions towards those targets. Although much of the work of implementing SB 375 will involve extensive land use and transportation modeling, the project level quantification in this Report may allow cities and counties to track their contribution towards their region’s goal.

Permitting Programs: In addition to land-use permitting (discussed under “Project-level Mitigation” above), there may be requirements for operations to have permits to emit GHGs because GHGs are air pollutants. Federal air permitting requirements for stationary sources will become effective on January 1, 2011 (and will apply to applications that have not been acted upon prior to that date), under several federal permit programs, including Prevention of Significant Deterioration (PSD) and Title V. These programs are implemented by the local air districts. Applicability of these programs is based on annual potential to emit GHGs, with thresholds initially set between 75,000 and 100,000 tons per year, depending on the program, and decreasing over time, with final thresholds for smaller sources of GHG to be determined by a future federal rulemaking.

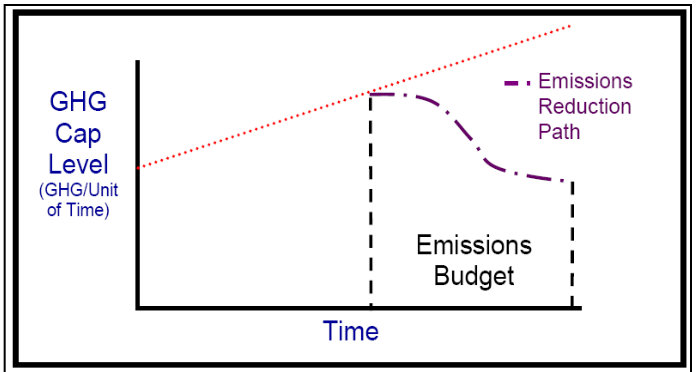
Because these permit programs are threshold-driven, quantification of emissions is an important element of compliance. At present, there is no specific federal guidance on quantifying GHG emissions pursuant to these programs, other than general guidelines for quantifying emissions of other regulated pollutants. This Quantification Report does not specifically address stationary source emissions, however some of the methods may be useful for certain elements of these programs, such as energy efficiency, water efficiency, and other associated measures of carbon use by a facility. The local air district with jurisdiction will be able to provide guidance on calculating emissions for a specific project, both for applicability and for compliance.

In addition, most permits require some form of verification, and ongoing demonstration on compliance. These obligations will be established as part of the permit.

Cap-and-Trade: A cap-and-trade program is a specific type of emissions trading program. Emissions trading in general is discussed in the next section. A brief explanation of cap-and-trade programs is provided below as background information for interested readers. It is not necessary to understand cap and trade programs, or emissions trading in general, in order to use the quantification methods in this report.

Further, these quantification methods were not developed specifically for the purposes of complying with cap and trade requirements, or for emissions trading more generally.

A cap-and-trade regulation establishes “allowances” for carbon emissions, expressed as CO_2 equivalents, usually in tons, or metric tons. An emitter of carbon must hold enough allowances to cover the amount of carbon it actually emits. Allowances are obtained on a carbon exchange, or market. In some cases they may be allocated by the government to emitters. There is a “cap” placed on the amount of allowances available in the market, and the cap declines over time. Carbon emitters must either reduce their emissions or purchase allowances from someone else; this is the “trade” part of the program. In this way, the program should cause carbon to be reduced wherever the reduction costs are lowest. The ARB is developing a cap-and-trade program which they currently expect will be considered for Board approval before the end of 2010. Information about the developing ARB program can be obtained from the conceptual drafts released by staff. Legislation is also pending at the federal level that would establish cap-and-trade on a national scale, but the ultimate scope and content of the program is still unknown. The most recent ARB draft proposal may be downloaded at: *http://www.arb.ca.gov/cc/capandtrade/capandtrade.htm*.



From ARB materials for AB 32 Program Design Technical Stakeholder Working Group Meeting, April 25, 2008, Figure 1, page 3

Although compliance with a cap-and-trade program is not likely to be a reason for quantifying GHG reductions today, it is likely to be one in the future. When that time comes, there will be several important considerations in deciding whether to use this Quantification Report in meeting those obligations.

Mandatory Reporting: The ARB currently has a Mandatory Reporting Rule for specified stationary sources with GHG emissions greater than 25,000 metric tons of CO_2e per year. This rule was established pursuant to the requirements of AB 32, and was intended to provide information to support the development of the Scoping Plan and its implementing regulations. At the time the Mandatory Reporting Rule was approved by the ARB Board, staff indicated that the Rule was not intended, nor did it include the level of detail necessary, to implement the cap-and-trade program (which, at that time, was not yet proposed). Applicable quantification protocols will be developed and approved by the ARB Board as part of its cap-and-trade regulation, as will a revised Mandatory Reporting Rule. More information about the ARB’s Mandatory Reporting Rule may be obtained at *http://www.arb.ca.gov/cc/reporting/ghg-rep/ghg-rep.htm*.

The U.S. EPA also has a Mandatory Reporting Rule. Under this rule, suppliers of fossil fuels or greenhouse gases that are used in industrial operations, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions are required to submit annual reports to EPA. The EPA rule does not currently specify quantification methods, and CAPCOA anticipates that any methods in this Report that would be applicable to affected reporters (e.g., building energy use) would be also be acceptable for use under the rule. Details on this rule can be found in 40 CFR Part 98, which was published in the Federal Register (*www.regulations.gov*) on October 30, 2009 under Docket ID No. EPA-HQ-OAR-2008-0508-2278.

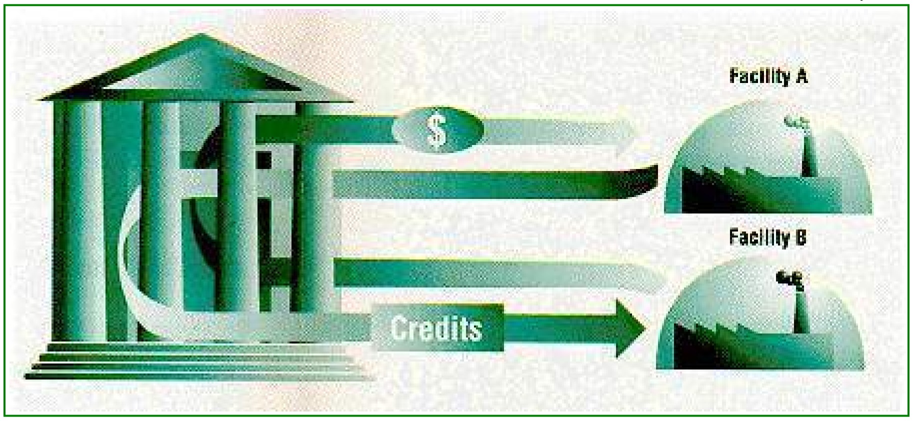
Reductions for Credit

There are several different ways to formally award credit for emission reductions. Emission reduction credits are used when the opportunity, desire, obligation, and the resources to implement reductions are not aligned. Sometimes an entity has the desire and opportunity to reduce emissions, but not the resources. Sometimes an entity is required to make reductions but has no viable project opportunities. Or funds may be available to implement project, but willing participants are needed. Systems are used to match up projects, proponents, funding, and, in some cases, compliance obligations, and the basis of the systems is emission reduction credits.

Concurrent Offsite Mitigation Projects: The simplest form of credit for emission reductions occurs when someone needs to reduce emissions to mitigate impacts (for example, under CEQA), but does not have a good opportunity within his or her own operation or project; but if a good opportunity is available at another operation the person who needs the reductions can fund that project in exchange for being able to take credit for the reduction. A variant of this can occur when a list of emission reduction projects that could be used for mitigation is maintained, and those projects are matched with people who need to implement mitigation. The key in this arrangement is that the project is directly funded by the person who needs mitigation, at whatever the cost the mitigation project ultimately has. The emission reductions occur, but are not traded as an independent commodity. The person who needs the mitigation remains obligated to ensure that the project is implemented and the emission reductions occur.

Mitigation Funds: Instead of matching the person needing mitigation with a project that is then directly funded by that person, it is also possible to collect the funding and then create the projects. In this case, funds are paid into a mitigation fund at a pre-established rate, and the operator of the fund is then obligated to find and implement emission reduction projects. The rate is typically set at a level (for example in dollars per ton needed) that is sufficient to implement an actual project to produce the emission reductions, based on data about actual project costs. As with concurrent offsite mitigation projects, the emission reductions here are not traded as an independent commodity, however a default rate is established. Under a mitigation fund, then, the person needing mitigation is considered to have provided it (that is, given “credit” for the reductions) at the point of paying into the mitigation fund. The obligation to ensure the emission reductions occur is transferred to the fund operator.

Emissions Trading: Emissions trading is a transaction that occurs between entities that make emission reductions which they don't need, and entities that desire emissions reductions but, for whatever reason, do not choose to make them. The emissions (or, more accurately, "credits" for the emission reductions) are treated as a commodity with independent value. The transaction occurs in some form of market, much as transactions occur between the grower of produce and the consumer in a local farmers market. The transaction, or trade, happens when a consumer believes that the product is worth the price being asked for it.



The obligation to ensure the emission reductions occur generally rests with the person selling the credits, and (to the extent an independent review has occurred) with whomever grants certification to the reduction project.

As explained above, a cap-and-trade program is a type of GHG trading market, but there are other types of emissions trading markets. An open GHG credit-based trading market does not have a cap, and participation is on a voluntary basis. In a credit-based market, credits are awarded for emission reductions, and may be purchased and sold as a commodity on an exchange. The credits are sometimes referred to as offsets, and they are generally tracked as tons, or metric tons, of pollutant reduced; in the case of GHGs, this is typically in the form of CO_2e. The important distinction between an open market and a cap-and-trade system is that the creation, buying, and selling of offsets is not restricted in an open market.

The following key terms and concepts are discussed to help the interested reader understand how credits are used in a trading market, It is not necessary to understand trading markets in order to use the quantification methods in this report, and the reader may proceed directly to Chapter 3.

<u>Regulators and Exchanges</u>: Some emissions trading markets are run by the government, while others are operated by independent, non-governmental entities. In government-run markets, such as the Regional Clean Air Incentives Market (RECLAIM) developed and administered by the South Coast Air Quality Management District, and U.S. EPA's Acid Rain program, a government agency establishes and implements the trading market. These markets are typically regulatory in nature, rather than voluntary, although some voluntary participation may be allowed. The Regional Greenhouse Gas Initiative (RGGI) implemented by ten Northeast and Mid-Atlantic states, and the

European Union Emission Trading Scheme (EU ETS) are other examples of regulatory markets.

Independent exchanges, such as the California Climate Action Registry (CCAR) and the Climate Registry (TCR), were established as independent, non-governmental operations. They offer a forum for entities to have emission reductions certified for credit, and for those credits to be bought and sold. These bodies develop their own structure and rules for participation. The nature of those rules determines the quality of the credits available on the exchange. Participation in the exchange is voluntary.

Standards for Credits: In order to be acceptable for credit under the AB 32 program, GHG emission reductions must be real, permanent, quantifiable, verifiable, enforceable, and additional. Historically, the federal Clean Air Act (CAA, or Act) has required emission reduction credits to be: real, permanent, quantifiable, enforceable, and surplus[7]. In this context, surplus means the reductions are not required by any law, regulation, permit condition, or other enforceable mechanism under the Act. California continued this concept in AB 32, requiring that any regulation adopted pursuant to AB 32 ensure that GHG reductions are "real, permanent, quantifiable, verifiable, and enforceable."[8]

The term "additional" comes from the Clean Development Mechanism in the Kyoto Protocol; it is essentially the same as "surplus" except that it is not restricted to any particular statute, and means that you cannot receive credit for any reductions that you were otherwise obligated to make. AB 32 requires its implementing regulations that include market-based compliance mechanisms to ensure that reductions are "in addition to any greenhouse gas emission reduction otherwise required by law or regulation, and any other greenhouse gas emission reduction that might otherwise occur."[9]

Protocols: Transactions to purchase emission reductions depend on the confidence the purchaser has in the value of reductions being purchased. Price is part of the concept of value that we can easily understand. The other, less tangible part of the concept of value is the quality of the emission reductions themselves. This is harder to understand because, unlike the produce at the farmer's market, we can't examine the product to determine its value. Not only are emission reductions invisible, they actually *didn't happen*. So to have confidence in their value, we need a reliable and accurate picture of what *would have happened*, as well as what *actually happened*.

Protocols are the formalized procedures for accounting for credits that ensure the credits are an accurate and reliable representation of emission reductions that actually occurred. Some protocols focus only on quantification of the reductions, while others also address documentation and verification. They can be developed and adopted by regulatory bodies, by the operators of exchanges, or by subject area experts. Some markets will require participants to use a specific protocol or set of protocols. Others

7 40 CFR Sections 51.493 and 51.852
8 California HS&C: Section 35862(d)(1)
9 Ibid, Section 35862(d)(2)

will allow participants to propose a protocol for developing and quantifying reductions. Failure to follow required protocols may prevent the project from receiving credit.

Holding and Using Credits: When credits are awarded for emission reduction projects, the owner of the credits is generally given a certificate of value. In this case, "value" means the corresponding emission reductions, not the price, which is determined by the market. The credits are registered with a bank where they are kept until the owner of the credits uses or sells them.

Credit Banks: Emission credit banks are similar to savings banks where money is deposited. The bank tracks credits, credit value, credit price, and transactions. It compiles data and issues reports. Banks are subject to accounting standards and requirements for transparency. It is important to note that not all credits can be banked. Credits or allowances that have a finite life do not retain their value beyond their life term.

Credit Life: Credits may have a specified life (for example, one year), or they may be permanent. The life of the credit may be dictated either by the nature of the reductions that generated it, or by the program in which it is being used. As discussed above, in California, AB 32 requires reductions for regulatory compliance to be permanent. In other markets, such as Kyoto's Clean Development Mechanism, there are both long term and short term credits.

Discounting Credit Value: Some regulatory structures require that credits be discounted, that is, the emission reduction value of the credit (not the price) is reduced to account for certain factors, or to enhance the liquidity of the market. In some cases, a portion of the credit value is surrendered or retired in the interest of environmental policy goals.

Offset Ratios: Offset ratios are a way to ensure an adequate margin of safety when credits are provided to offset impacts. A program may require that the amount of credits provided is greater than the anticipated emissions increases. If the program requires 10% extra credits, then the offset ratio is said to be "1.1 to 1."

The above discussion of emission reduction credits and trading is provided for information only, and should not be construed as endorsement of, or recommendation for, the use of credits or trading for the purposes of meeting GHG reduction obligations. CAPCOA does not make policy recommendations regarding credits or trading in this Report. Decisions about whether to allow the use of credits rests solely with the agency with jurisdiction over a project or program.

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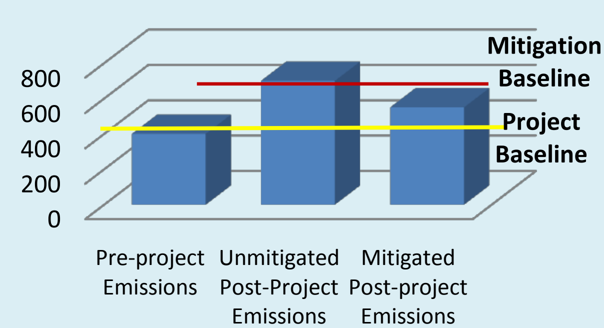
This chapter provides an overview of some key concepts that arise in considering quantification of GHG emission reduction projects. This discussion is provided so the reader understands the context in which these terms are used throughout this document. Here again, this discussion is not intended to endorse any policy position, nor does it provide any recommendations on thresholds of significance for GHG emissions. Policy decisions are left to individual agencies and their governing boards.

Baseline

An emissions baseline is the foundation of any estimate of the impacts of a project or of a mitigation measure. In its simplest form, it reflects the current level of emissions if those emissions do not vary. Usually, however, emissions do vary, typically because the activities or operations that cause the emissions change. Traffic patterns change with the time of day, ski areas are busiest in the winter, air conditioners run more in the summer, people drive less when fuel prices rise, and production of goods changes with the economy. To set a baseline, it is important to understand what factors affect the activity or operation in a way that will alter its emissions; then, the most appropriate scenario is selected and the emissions are adjusted to account for that scenario. Figure 3-1: Baseline illustrates the concept of baselines in project analysis.

Figure 3-1: Baseline



Regulatory programs that require calculation of emissions baselines generally specify the basis for the calculation. For example, a baseline scenario could be a three year average of actual emissions, or the worst case, or, as in CEQA, the program may call for an analysis to identify a representative set of conditions based on historical data.

In its proposed draft regulation for cap-and-trade, ARB defines baseline to mean "the scenario that reflects a conservative estimate of the business-as-usual performance or activities for the relevant type of activity or practice such that the baseline provides an adequate margin of safety to reasonably calculate the amount of GHG reductions in reference to such baseline."[1]

For this Quantification Report, CAPCOA selected a baseline period to correspond to the average GHG emissions from 2002 to 2004, inclusive. This is the emissions baseline period used by ARB in its Scoping Plan[2]. The baseline conditions used to quantify the

[1] ARB: "Preliminary Draft Regulation for a California Cap-and-Trade Program," Section 95802 (a)(2), Dec., 2009; page 5.
[2] ARB: "Climate Change Scoping Plan: a framework for change," Dec., 2008; page 11.

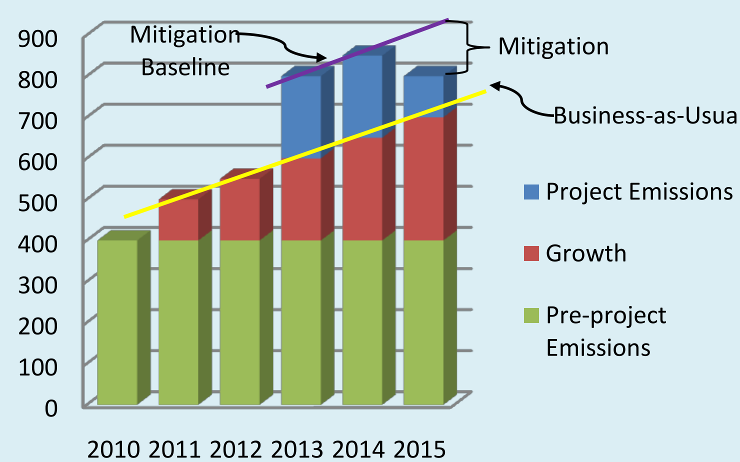
effectiveness of mitigation measures for this Quantification Report reflect the conditions that formed the basis for ARB's 2007 inventory of economic activity and GHG emissions. Those conditions and the associated quantification methods are explained in Appendix B to this Report. A copy of ARB's Scoping Plan may be downloaded at: *http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm*.

There may be circumstances in which a different set of baseline conditions is more appropriate. If a user wishes to adjust the baseline, CAPCOA recommends using the methods provided in the measure Fact Sheet, and in Appendix B, but substituting data inputs that better reflect the baseline conditions for the project under consideration. This ensures consistent methods are used so the comparison of baseline to project is an "apples-to-apples" comparison. So, for example, a user outside of California would substitute an emission factor for electricity generation that better represents the generation mix that is provided in the user's region. This alternative factor would be used in the baseline methods where electricity generation is part of the calculation, and would also be used in the quantification of emissions associated with the project.

It may also be appropriate to adjust the baseline conditions on a temporal basis if needed to account for changes over time. The ARB revises its emissions inventory information on a periodic basis. The most current inventory information was published in May of 2010, and covers the time period from 2000 to 2008. The information is available by category, with trends analysis, and with full documentation of data sources and methods. The updated emissions inventory information is available at: *http://www.arb.ca.gov/cc/inventory/data/data.htm*.

Business-as-Usual Scenario

Figure 3-2: Business-as-Usual



Not all baseline conditions occur in the present. In some cases, the baseline is a forecast of the conditions that are expected to exist at some time in the future, in the absence of interventions to change those future conditions. The forecasted baseline conditions are referred to as "business-as-usual" and are intended to reflect normal operation. For example, a town might currently have 20,000 residents, and be on a course to to add another 5,000 residents in low-density, planned development at the perimeter of its existing footprint over the next 10 years. The town could add an urban growth boundary that would change that anticipated development. In order to quantify the effect of adding the urban growth boundary, the business-as-usual growth scenario must first be calculated; that will form the baseline to compare to the growth scenario with the adopted boundary. Figure 3-2 illustrates the application of the “business-as-usual” concept to a project.

ARB defines business-as-usual to mean, “the normal course of business or activities for an entity or a project before the imposition of greenhouse gas emission reduction requirements or incentives.”[3]

Mitigation Types

There are four general ways to create emission reductions for mitigation projects: (1) the operation or activity can be avoided so that emissions are not created in the first place; (2) the operation or activity can be changed so that it creates fewer emissions; (3) emission control technology can be added to the activity or operation that prevents the release of emissions that are created; and (4) emissions that have been released can be sequestered in the environment. Each of these is discussed below.

Avoided Emissions: When someone chooses to walk to the grocery store in lieu of driving, or turn off the lights, energy isn’t needed to power the car or lights, and the emissions associated with that energy don’t occur. In the case of walking instead of driving, the avoided emissions include the CO_2 and other pollutants that would have come from the tailpipe of the car. These are “direct” emissions that are being avoided, and they can be readily quantified to show the benefit associated with walking. When electricity isn’t needed, it isn’t generated; the avoided emissions are the CO_2 and other pollutants that are not emitted by the power plant. Because the emissions are not directly emitted where the light is being used, this type of emissions are referred to as “indirect” emissions; even though they are indirect, they can still be quantified to show the benefit of turning off the lights. There can be other benefits associated with avoided emissions as well. When you consider the walking scenario in a lifecycle sense, the avoided emissions can also include the energy that would have been used to extract, refine, transport, and dispense the fuel. The same is true when you use a reusable cloth bag instead of a disposable plastic bag to carry your purchases; energy is needed to extract and refine the petroleum that goes into the bag, to make and transport the bag, and then to dispose of the bag after it is used. These kinds of avoided emissions are much more difficult to fully quantify, however, and will not be included in the quantification approaches in this document. Even if we aren’t quantifying the benefits, however, it is important to understand that avoided emissions can have positive effects both upstream and downstream, creating a ripple effect of further avoided emissions.

[3] ARB: “Preliminary Draft Regulation for a California Cap-and-Trade Program,” Section 95802 (a)(18), Dec., 2009; page 7.

Fewer Created Emissions: If the activity or operation can't be avoided, sometimes it can be accomplished in a way that creates fewer emissions. This is usually associated with increased efficiency. So, for example, if walking to the store isn't an option, someone could choose to drive there in a more efficient vehicle, like a gas-electric hybrid powered car. The engine in the hybrid is able to drive more miles with less fuel consumed. Less fuel consumed equates to fewer emissions at the tailpipe. In the lighting example, using a more efficient light bulb is one way to reduce the indirect emissions, but a more efficient power plant would also do this.

Controlled Emissions: Once emissions are created, they are either released to the environment, or they are controlled with technology that captures and stores or destroys them. In the car example, the addition of a catalytic converter allows the tailpipe emissions to be collected after they are created, and destroyed before they are released. Note that the efficiency of the engine (discussed above), and the control of emissions after they leave it, are two distinct ways to reduce emissions. There are also emissions control technologies for power plants.

Sequestration of Emissions: Carbon emissions are "sequestered" by embedding the carbon in structure that will hold the emissions and keep them out of the atmosphere. Sequestration happens through biological, chemical, or physical processes.

<u>Biological Sequestration</u>: Trees and other vegetation biologically absorb carbon from the atmosphere and incorporate it into their biomass; the carbon becomes the solid form of the growing tree or plant. Many sequestration projects involve the planting of trees or vegetation to improve the uptake of carbon from the atmosphere. Enhanced farming practices may also achieve some sequestration through the use of CO_2 absorbing cover crops, improved grazing practices, and restoration of depleted land. Increased peat production in peat bogs is also method to biologically sequester carbon.

<u>Chemical Sequestration</u>: Oceans absorb CO_2, and it causes the oceans to become more acidic (which is detrimental to coral reefs and other sea life). Other chemical processes include reacting CO_2 through a process called mineral carbonation to form stable carbonate minerals that are normally found in the earth's crust.

<u>Physical Sequestration</u>: CO_2 can also be physically contained in a way that prevents its release to the atmosphere. This can involve injecting it deep into the ground, for example into depleted oil and gas reservoirs. It can also be injected into oil wells to push up the oil. Another approach is to embed it in cement through a newly developed process that causes cement to absorb CO_2 from the atmosphere while it is curing.

Measure or Project Scope

Just as good quantification requires careful and transparent consideration of the baseline or business-as-usual scenario, it also requires a complete and detailed characterization of the measure or project being undertaken. This is important because considerations of what is included in, and what is excluded from, the analysis can have a significant impact on results of the quantification.

Determining the appropriate scope for the analysis of a project or measure is not always as simple as it might appear. Take for example the installation of solar panels in a remote desert region that receives a lot of sun. The panels generate electricity without releasing GHG emissions, which offset more traditional generation of electricity that does emit GHGs. But the desert region may be prone to dust or sand storms, which would quickly obscure the glass panels and decrease their effectiveness. This decrease could be minimized if the panels were cleaned regularly. But the cleaning will require vehicles to come to the site, which takes energy and releases GHGs, and the cleaning activity itself may do so as well. If the site is truly remote, the emissions from those vehicle trips could be large. But what if there is another installation nearby: can the trip-related emissions be considered only in addition to those for the other site? Do you have to know if the cleaning for both sites can be accomplished in one trip? And what about the energy and materials needed to make the solar panels?

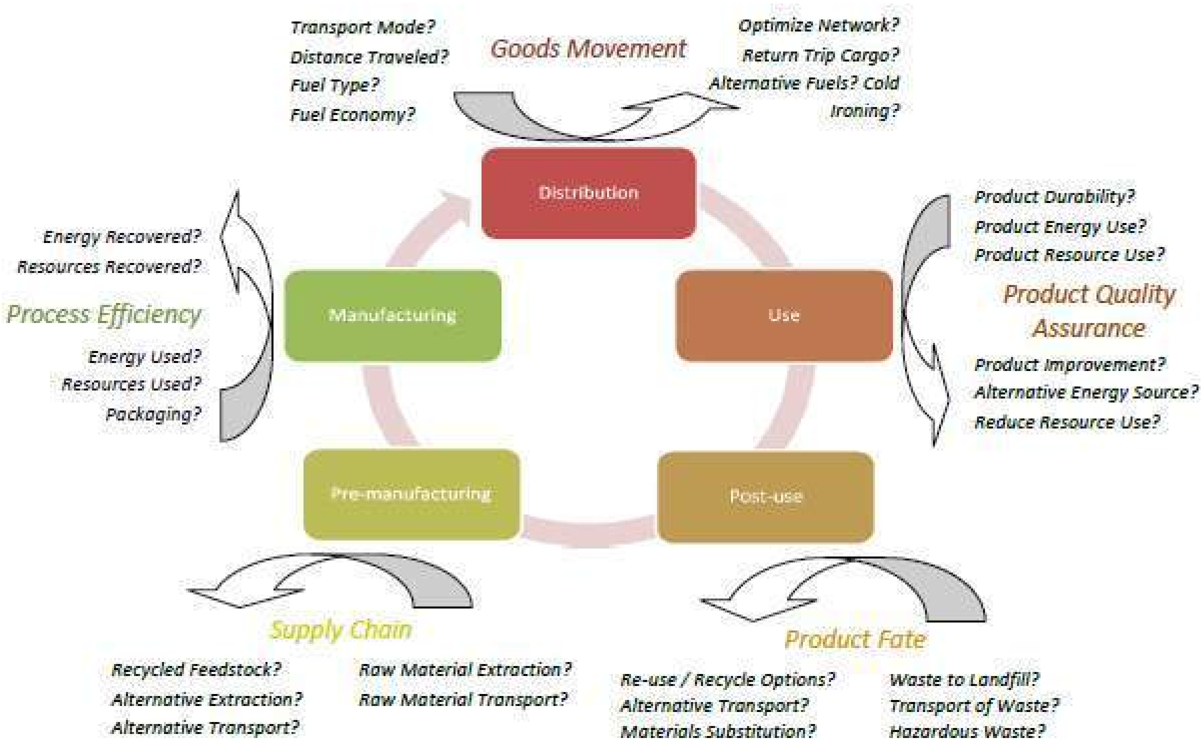
The methods in this Report generally include those reductions over which a project proponent can exercise direct control, as well as indirect emissions associated with electrical generation and the use of natural gas. CAPCOA does not include analysis of full lifecycle emissions in this Report, because of the complexity of the analysis involved and the lack of general standards for incorporating such considerations.

Lifecycle Analysis

Energy and materials are involved in the creation, processing, transport, and disposal of all of the products we use, from the tomatoes on our salads, to the computers we work with, the vehicles we drive (even if they are zero-emission vehicles), and the roadways we travel over. A lifecycle analysis attempts to identify and quantify the GHG emissions associated the energy and materials used at all stages of the product's life, from the gathering of raw materials, through the growing or fabrication, distribution, use, and the ultimate disposal at the end of the product's useful life.

This is a difficult and complicated undertaking; it is challenging to identify all of the inputs that are both necessary and meaningful for this sort of analysis. Even if the inputs can be identified, good data are not readily available to quantify emissions in most cases. Further, there is not yet agreement on methodological approaches to lifecycle analysis for most sectors (Figure 3-3: Lifecycle Analysis shows a basic schematic of some of these considerations.). For these reasons, as stated under the discussion of scope, above, CAPCOA does not include lifecycle analysis in this Report.

Figure 3-3: Lifecycle Analysis



Unfortunately, there are important mitigation projects or measures that cannot be quantified without a lifecycle analysis, and some of them are measures that are highly desirable or commonly encouraged. One example is the recycling and reuse of construction materials; it is intuitively obvious that recycling and reuse avoids both the embedded energy costs in the new material, as well as the energy and emissions associated with disposal. Another example is the push for reusable cloth grocery bags instead of disposable plastic ones, or reusable water bottles filled with tap water instead of disposable bottled water. For some of these measures, it is possible to do a limited lifecycle analysis, if the project scope is well defined and if the data are available. The Report provides a discussion of how to pursue an analysis in such cases, but otherwise identifies these kinds of measures as Best Management Practices.

It is important to note that Appendix F to the CEQA Guidelines Amendments approved in December of 2009 specifically state that a lead agency is not required to perform a project-level energy life-cycle analysis[4]. Because direct GHG emissions from electrical generation, and GHG emissions from electricity associated with water use (as well as other direct emissions associated with water treatment) are well defined and can be

[4] California Natural Resources Agency: Adopted Text of the CEQA Guidelines Amendments (Adopted December 30, 2009, Effective March 18, 2010), Appendix F.

accurately quantified, they are not considered to "lifecycle emissions" for the purposes of this Report, and they are included in these quantification methods.

Accuracy and Reliability

In an effort to standardize the creation of GHG inventories, and improve the quality of the information, the IPCC defines "good practice" for GHG emissions quantifications as those that "contain neither over- nor under-estimates so far as can be judged, and in which uncertainties are reduced as far as practicable."[5]

Part of the challenge in developing methods that meet this standard of good practice is assuring the accuracy of the methods. CAPCOA uses accuracy to mean the closeness of the agreement between the result of a measurement or calculation, and the true value, or a generally accepted reference value. When a method is accurate, it will, for a particular case, produce a quantification of emissions that is as close to the actual emissions as can practicably be done with information that is reasonably available.

To meet the good practice standard, the quantification methods must also be reliable, which is different from being accurate. A reliable method will yield accurate results across a range of different cases, not only in one particular case.

To some extent, the accuracy of the quantification is sacrificed to achieve reliability. This is because a method that can be applied across a range of scenarios must be generalized to some extent. So, for example, the transportation analyses do not, for the most part, differentiate between peak and off-peak vehicle trips, even though off-peak trips will have a lower emission impact because of the effects of congestion on travel time and engine performance. In order to fully address all of the factors that impact the emissions associated with vehicle trips in a specific project, a far more detailed and costly analysis would be needed, and it would not be readily applied to other situations. The methods contained in this Report have been developed to provide the best balance between accuracy and reliability, bearing in mind that ease of use is also important.

In order to ensure both the accuracy and the reliability of the quantification methods in this Report, each method is accompanied by a discussion of the assumptions and limitations of the method. Where either the assumptions are not met, or the limitations are exceeded, the method will not be accurate, and the error can be very large. Further, if the conditions of the project differ from the assumptions and limitations of the method, the quantification may no longer be applicable. It is possible to look at the underlying assumptions and calculation and make adjustments to the method so that it better reflects the conditions of a specific project. Doing this may preserve the accuracy to some extent, but the user is responsible for determining how best to accomplish this, and the reviewing agency will decide whether the results are still acceptable.

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[5] IPCC 2006, "2006 IPCC Guidelines for National Greenhouse Gas Inventories," Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds).Published: IGES, Japan. Page 1.6.

Additionality

In order for a project or measure that reduces emissions to count as mitigation of impacts, the reductions have to be "additional." Greenhouse gas emission reductions that are otherwise required by law or regulation would appropriately be considered part of the existing baseline. Thus, any resulting emission reduction cannot be construed as appropriate (or additional) for purposes of mitigation under CEQA. For example, in the draft regulation for cap-and-trade, ARB specifies that in order to be eligible for offset credit, "emission reductions must be in addition to any greenhouse gas reduction, avoidance or sequestration otherwise required by law or regulation, or any greenhouse gas reduction, avoidance or sequestration that would otherwise occur."[6] What this means in practice is that if there is a rule that requires, for example, increased energy efficiency in a new building, the project proponent cannot count that increased efficiency as a mitigation or credit unless the project goes beyond what the rule requires; and in that case, only the efficiency that is in excess of what is required can be counted. It also means that if there is a rule that requires a boiler to be replaced with one that releases fewer smog-forming pollutants, and the new boiler is more efficient and also releases less CO_2, the reduced CO_2 can't be counted as mitigation or credit, because the reductions were going to happen anyway. But if the boiler were replaced with a solar-powered water heater, the difference in emissions between a typical new boiler and the solar water heater could be counted.

From a practical standpoint, any reductions that are *not* additional have to be either included in the baseline or subtracted from the project, whichever is more appropriate. In preparing this Report, CAPCOA made determinations about requirements to include in or exclude from the baseline. A more complete discussion of those determinations is included in Appendix B.

Verification

Verification is the process by which we demonstrate that the emission reductions we have quantified for a project actually occurred. While not important for purely voluntary projects, verification in some form is a necessary step in most other circumstances. Verification is an important component in establishing the value of reductions that are made. It allows others to have confidence in the quality of the reductions. If the reductions are being made to satisfy an obligation to mitigate impacts, the agency with jurisdiction should be consulted to determine what standard of verification is needed. In some cases, independent, third-party verification is required. Not all regulatory programs specify third-party verification, however. For example, the U.S. EPA's Mandatory Reporting Rule relies instead on routine compliance verification through a permit system.

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[6] ARB: "Preliminary Draft Regulation for a California Cap-and-Trade Program," Section 95802 (a)(4), Dec., 2009; page 6.

This chapter of the Report provides an explanation of how the quantification methods were developed, and the limitations of the sources used. There is also an overview of the presentation of the quantification methods in the Report. Finally this section discusses the limitations of the methods themselves, and how these limitations should be considered when applying the methods to actual mitigation projects.

General Emission Quantification Approach

The emission quantification methods in this Report are designed to provide GHG estimates using readily available, user-specified information for a source or activity. In general, GHG emissions associated with a given source or activity are estimated using data for a physical quantity or metric, on the underlying assumption that CO_2 emissions are directly proportional to that metric. For example, emissions related to vehicles are estimated using vehicle trips and mileage data. For sources of indirect emissions such as buildings, swimming pools, municipal lighting and water distribution, the metric is energy use as electricity or natural gas[1]. When site-specific energy use data are not available, energy use can be estimated using a physical metric such as the volume of water supplied, the size of building, and the number of lamps.

For each source metric there are emission factors that quantify the amount of emissions released as a result of the source or activity. These emission factors have been developed by various governmental agencies, public utilities and other entities though data analysis and numerical models. The factors are based on certain assumptions that define the typical or "baseline" emissions scenario. For example, emission factors for vehicles assume a particular type of fuel and driving speed, and emission factors for electricity use assume a certain mix of electricity generating methods. .

Individual GHGs are converted to carbon dioxide equivalent units by multiplying values by their global warming potential (GWP). The GWP values used in this report are based on the IPCC Second Assessment Report (SAR, 1996), even though more recent (and slightly different) GWP values were developed in the IPCC's Third Assessment Report (TAR, 2001) and Fourth Assessment Report (FAR, 2007). The values in the SAR were used in this Report because they are still used by international convention.

The general equation for emissions quantification is shown below for each GHG:

$$\text{GHG Emissions} = [\text{source metric}] \times [\text{emission factor}] \times [\text{GWP}]$$

Then, all GHGs are summed from an individual source.

$$\text{GHG Emissions}_{total} = \sum_{n=1}^{i} [\text{GHG Emissions}]_n$$

[1] Note that emissions from natural gas use are not always indirect in nature. For more discussion of direct and indirect emissions and types of mitigation, please see Chapter 3.

Where "source metric" and "emission factor" are defined as follows:

Source Metric: The "source metric" is the unit of measure of the source of the emissions. For example, for transportation sources, the metric is vehicle miles traveled; for building energy use, it is "energy intensity", that is, the energy demand per square foot of building space. Mitigation measures that involve source reduction are measures that reduce the source metric. This can include for example, reducing the miles traveled by a vehicle because the reduction in miles traveled will reduce the emissions generated from vehicle travel. Similarly, a reduction in dwelling unit electricity use by installing energy efficient appliances and lighting will reduce the emissions associated with total electricity assigned to dwelling units.

Emissions associated with source reduction measures are generally avoided emissions. As discussed in Chapter 3, there are often additional benefits to these kinds of reductions. Source reduction promotes efficient use and management of resources and utilities, in addition to avoiding emissions. Thus, source reduction can also result in a decreased need for downstream emissions control. From a quantification standpoint, for this type of measure, it is the "source metric" in the basic emissions equation (above) that changes.

Emission Factor: The "emission factor" is the rate at which emissions are generated per unit of source metric (see above). Reductions in the emission factor happen when fewer emissions are generated per unit of source metric, for example, a decrease in the amount emissions that are released per kilowatt hour, per gallon of water, etc. Such a decrease may apply if a carbon-neutral electricity source (e.g. from photovoltaics) is used in place of grid electricity, which has higher associated emissions; or if electricity is used instead of combustion fuel, such as with electric cars. Reductions can also occur if a fuel with lower GHG emissions is used in the place of one with higher GHG emissions. From a quantification standpoint, for this type of measure, it is the "emission factor" in the equation that changes.

For both kinds of measures, mitigated emissions are calculated using the same general equation, but the emissions will change based on whether the values change for the source metric or the emission factor. Several mitigation measures may apply to the same source, changing both the source metric and the emission factor, and the estimation of the overall impact of simultaneous measures must be carefully evaluated. In some cases the reductions are additive, but in others they must be evaluated sequentially. Other sets of mitigation measures may require additional analysis to avoid double-counting. Furthermore, not all types of mitigation measures will be feasible in all situations. Chapter 6 provides a detailed discussion of considerations in quantifying the combination of mitigation measures, as well as a set of rules to guard against over-estimation of reductions.

Quantification of Baseline Emissions

In order to ensure that similar assumptions and methodologies are being used to quantify both the baseline and project emissions, a consistent set of methodologies for determining the GHG emission baseline emissions was defined. This was the first step in establishing quantitative methods for assessing GHG mitigation reductions. The results of this effort are contained in Appendix B and should be utilized or considered when establishing baseline emission levels. This same set of methodologies was used to develop the quantification methods for each mitigation measure.

Quantification of Emission Reductions for Mitigation Measures

There is a wide array of mitigation measures that could reduce direct or indirect GHG emissions for a project; however, not all of them can be readily quantified with the information and tools currently available. Other measures may be individually quantifiable, but the quantification cannot be reliably extrapolated to other similar projects. The goal in developing this Quantification Report was to provide accurate and reliable methods that can be easily applied across a range of projects and settings. This section explains how the list of measures included in this guidance was developed, and how the measures are presented.

Screening of Mitigation Measures: An initial list of candidate measures was developed with about 75 types of greenhouse gas mitigation measures related to site design, land use, building components, parking measures, energy, solid waste management, etc. These were identified because they were commonly seen in land use permit applications or were measures that air districts have been frequently asked for guidance on. A literature review was done to identify potential additional measures.

Measures from this compiled list were screened based on the following criteria:

- Relevance to project-level CEQA analysis;
- Availability of empirical evidence or reliable research to credibly establish baselines and level of effectiveness; and
- Non-negligible level of effectiveness determined by credible research.

Measures or grouped measures that did not meet all three of these criteria were evaluated for the possibility of grouping measures with synergistic effects or describing as a Best Management Practice (BMP). Where measures were determined to be BMPs, the Report describes the relevant literature and, where applicable, provides methods that could be used if substantial evidence is available to support the reduction effectiveness. In addition some measures had substantial evidence of reductions when implemented at a general Plan (GP) level rather than a project level. These measures were retained as applicable for General Plans, only. Local Agencies may decide to provide incentives or allocate the General Plan level reductions to specific projects by weighting the overall effect by the number of projects to which the General Plan reduction would apply.

Information Sources and Their Limitations: The quantified effect that different mitigation measures have on source quantities or emission intensities must be based on substantial evidence and should be enforceable (to ensure that the commitments are adhered to) and verifiable (to confirm that the mitigation measures were implemented).

Examples of credible sources for supporting evidence include government agency-sponsored studies, peer-reviewed scientific literature, case studies, government-approved modeling software and widely adopted protocols. In order for the supporting evidence or data for a given mitigation measure to be deemed applicable, it must be based on similar or scalable assumptions and conditions in terms of period of study, physical scale, site-specific parameters, operating conditions, technology, population type, etc.

There are uncertainties associated with any type of estimation method. Some of these methods attempt to predict future behavior with respect to water and energy use using historical data and trends, which may not accurately reflect changes in behavior due to increasing awareness of resource conservation. Despite these uncertainties, the methods presented in Chapter 7 provide the best available estimations of GHG emissions and are therefore suitable for the project-level inventories.

Enforceable Reductions: As discussed in Chapter 2, emission reductions (whether as mitigation under CEQA, for regulatory purposes, or for trading) have to be enforceable. For that reason, in this Report the quantity of reductions or applicability of mitigation measures is limited to elements which the project proponent can control. Additional reductions in GHG emissions may be feasible in the broader sense and may occur; however, because the project proponent does not have control over these elements, those other reductions are not considered in the quantification methods here.

For instance, in the context of a building project, source reductions that rely on individual occupant behavior are generally not enforceable by the builder. A residential dwelling, when occupied, will contain a variety of electrical appliances. An individual occupant may decide to purchase energy efficient appliances and would therefore reduce energy use. This reduction in energy use is not enforceable, however, because the project proponent can’t dictate individual occupants’ purchases; these types of reductions are not counted in the methods in this Report. There may be some instances, however, where the project proponent is the occupant and would have the ability to enforce behavior. In these instances additional emission reductions not quantified in this document may be feasible and enforceable.

Some reductions in emissions are not enforceable when voluntary, but become enforceable when implemented as part of a regulatory scheme. Once regulations that result in emissions reductions are enacted, the project should be reviewed to determine how the requirements affect the baseline, and the reductions that can be quantified for mitigation credit.

When the emission reductions from a project are not enforceable, and therefore not quantified under these protocols, they may still have value for mitigation purposes and a qualitative analysis should be considered. Decisions about whether such reductions will be considered, and what sort of qualitative analysis is appropriate, are the responsibility of the agency reviewing the project.

Creation of Mitigation Measure Fact Sheets: Once the list of mitigation measures was determined, detailed Fact Sheets were developed for each mitigation measure. Each fact sheet presents a summary of the measure's applicability; the required calculation inputs from the actual project; the baseline emissions method; the mitigation calculation method and associated assumptions; a discussion of the calculation and an example calculation; and finally a summary of the preferred and alternative literature sources for measure efficacy. The fact sheets begin with a measure description. This description includes two critical components: (1) specific language regarding the measure implementation (which should be consistent with the implementation method for the actual project), and (2) a discussion of key support strategies that are assumed to also be in place for the reported range of effectiveness. Chapter 6 provides a discussion of the Fact Sheets and a brief description of their intended use. The Fact Sheets themselves are included in Chapter 7.

Quantification Methods

In this Report, emissions reductions are presented in terms of percentage reductions. For mitigation measures where the source metric is reduced, reductions were generally assessed based on a ratio comparison of a common "denominator" source metric for each source category in order to assist in the quantification of strategy impacts:

- Building Energy Use will utilize natural gas and electricity use.
- Water will utilize outdoor and indoor water use.
- Solid waste will utilize waste disposed.
- Mobile sources will utilize changes in vehicle miles travelled (VMT).

For mitigation measures involving emission factor reductions, a ratio comparing the mitigated and baseline emissions factor is utilized to quantify the emission reductions.

Because a ratio comparison is utilized, in most cases the reductions quantified for GHGs will also be the same reduction assessed for criteria pollutants and toxic air contaminants provided the reduction in emission factors also occurs for the other types of pollutants. This is not always the case and in some cases a reduction for one pollutant may result in an increase for another pollutant.

There is one exception to the quantitative approach described above, for off-road and on-road vehicles that affects the quantification of the emissions of ROGs. The underlying data and methods available to quantify these emissions were limited to running emissions (that is, emissions from the tailpipe while the engine is running). There are also evaporative emissions, however, which occur when pollutants evaporate from the fuel in the fuel tank and escape to the atmosphere. The evaporative emissions of most pollutants are very small when compared to the running emissions, but evaporative emissions of ROGs are not small compared to the running emissions. Because the underlying data and methods available did not address evaporative emissions, they are not part of the emission factor ratio and must be accounted for separately. Accordingly, an estimate of the ratio of running to evaporative emissions for ROGs was determined and used to adjust the reductions for ROGs from vehicles.

Limitations to Quantification of Emission Reductions for Mitigation Measures

In order to properly apply the quantification methods in this Report, it is important to understand the limitations of the methods. The following discusses the limitations of the underlying data and methods used to develop the quantification in this Report. A discussion of the limits on applying the methods in the Report is contained in Chapter 6. Further, the Fact Sheet for each individual measure identifies specific limitations and considerations that affect the application of that particular measure.

Prediction of Future Behavior: In order to assess the emissions associated with a project that does not yet exist, it is necessary to make assumptions regarding anticipated amounts of energy use, VMT, water use, etc, that will characterize the project once it occurs. These values may be based on estimates of source metrics from surveys of current values for those metrics, or from recent historical values. When such data are used, they are typically assumed to remain constant when applied to the project unless a there is a specific action (such as the application of a mitigation measure) that would alter the value(s). Although this is a commonly accepted practice, in reality, current behavior is not likely to remain constant over time in the way it is assumed. For instance, the occupant of a building determines the set point of thermostats, the duration of showers, and the usage of air conditioning, among other things. The project proponent will have little, if any, influence over these choices made by the future occupants.

Understanding the limits of these predictions, they are still the best basis for estimating future behavior. For this Report, quantification was based on current median behavior attributes. The limitations of the predictions can be minimized, however. Information about what influences behavior in specific circumstances is often available. Where data are available to show the relationship between external factors and the source metrics used to quantify a particular measure (such as fuel prices and VMT, for example), and more specific information is available about those external factors to predict future trends, that information could be used to further refine the quantification presented here. Again, the quality of the data used will substantially affect the accuracy and reliability of the results. It is also important to be aware of, and to minimize if possible, the error that can result from combining data from different sources (see below).

Combination of Data Sources: The quantification of some of the measures in this Report required the use of multiple sources of data. Any time data are derived from different sources there may be slight discrepancies the underlying in methodologies and data set characteristics; when the information between two data sets is combined, the discrepancies may affect the ultimate quantification of emissions, either over- or underestimating them. For example, some energy efficient appliances were not directly called out in the study of primary energy use based on end use. To obtain information on specific end uses, a secondary source was consulted that quantified energy use by end uses, and the values from this study were used to provide the detail where the end use data were lacking in the first study. It is not possible to determine the precise magnitude of the error that combining these two data sets induced in the final quantification, however every effort was made to minimize potential errors through thorough review of available data and exclusion of incompatible data sets.

There may be data sets available when considering a specific project that address the particulars of the project but are not generally applicable. Such case-specific data could be substituted for the more general data used to develop the quantifications in this Report. If such a substitution is considered, it is important to understand that it can result in an error in the quantification of the mitigation measure reductions because the methods used to derive the case-specific data may contain different assumptions that are not considered in, or are not consistent with the mitigation measure as characterized in the Fact Sheet. Anyone proposing the use of alternative underlying data for source metrics or emission factors must have a good understanding of the assumptions used in estimating the metrics/factors used in the baseline methodology and measure quantification for this Report. The discussion of sources and methods in the measure Fact Sheets as well as the baseline methodology in Appendix B should provide sufficient information to make this assessment.

Understanding these caveats, use of source-specific data is generally an improvement over that of generalized data, and where good quality source-specific data are available, they should be used. CAPCOA will not be able to review case-specific changes to the methods in this Report; however, the local air district may be able to provide assistance or recommendations. The decision to allow alterations to methods, including substitution of underlying data sets, rests with the agency reviewing the project.

Projects That Involve More Than One Mitigation Measure: Each mitigation measure was quantified using a specific set of underlying data and assumptions, and will provide the most accurate and reliable results when the project precisely matches the description of the measure, with all of its assumptions and limitations. In reality, projects may differ from the described measures, or may involve the application of more than one measure. In order to ensure that the resulting quantification is appropriate and accurate, specific procedures are provided in Chapter 6 for combining mitigation measures.

Lack of Detailed Information: The quantification methods provided in this report have been developed to allow them to be applied to a range of project conditions and still yield accurate and reliable results. In order to do this, the methods require data inputs that reflect the specific conditions of the project. Because the project has not yet been completed, however, certain information about the project will not be known and must be either estimated or assumed based on standard procedures. For example, at the time of the CEQA process a project proponent might know the number of residential dwelling units that will be in the project, but not know the actual square footage individual units will have. Similarly, while the project proponent may know a general type of non-residential land uses planned, these are often generalized categories such as retail and do not reflect the true diversity and range of source category parameters that would occur between the specific types of retail that the project eventually has. Nor can a project proponent predict specific appliances that will be in buildings or frequency of use. Further, most projects rely on generalized trip rate and trip lengths information that are not specific to the project; these estimates may over or underestimate the actual trip rates and trip lengths generated by the project. In each of these cases, estimates of future conditions are made based on accepted procedures and available data. This Report does not provide, or in any way alter, guidance on the level of detail required for the review or approval of any project. For the purposes of CEQA documents, the current CEQA guidelines address the information that is needed.[2]

The lack of precise and accurate data inputs limits the quality of the quantified project baseline and mitigated emissions, however. This limitation can be minimized to the extent the project proponent is able to provide better predictive data, or establish incentives, agreements, covenants, deeds, or other means of defining and restricting future uses to allow more precise estimates of the emissions associated with them. Some of these means of refining the data may also be creditable as mitigation of the project. The approval of any such enhancements of the data, or credit as mitigation, is at the discretion of the agency reviewing the project.

Use of Case Studies: One method of enhancing the data available for a project is the use of case studies. Case studies generally have detailed information regarding a particular effect. However, there are limitations of using this information to quantify emissions in other situations since adequate controls may not have been studied to separate out combined effects. There may be features or characteristics in the case-study that do not translate to the project and therefore may over or underestimate the GHG emission reductions. For the most part, case studies were not used as the primary source in the development of the quantification methods in this report. Where case studies were used to enhance underlying data, the studies were carefully reviewed to ensure that appropriate controls were used and the data meet the quality requirements of this Report.

[2] See: California Natural Resources Agency: 2007 CEQA Guidelines – Title 14 California Code of Regulations, Sections 15125, 15126.2, 15144, and 15146.

Extent Reductions Are Demonstrated in Practice: Some of the GHG mitigation measures in this Report are open-ended with regards to the amount of reductions that are theoretically possible. There are, however, practical limitations to the amount of reductions that can actually be achieved. These limitations can include the cost to implement the measure, physical constraints (e.g., roof space for photovoltaic panels), mainstream availability of technology, regulatory constraints, and other practical considerations. In applying the quantification methods for these types of measures, it is important to evaluate the reasonableness and practicability of the assumptions regarding these parameters.

Over time, some of these limitations may change. Implementation costs decrease as advanced technology is reaches mass production scale, for example, technological innovation can address physical constraints, and regulations change. The determination of feasibility for project assumptions should therefore be reconsidered for future applications based on the best available information at the time.

Biogenic CO_2 Emissions: This document did not address biogenic CO_2 emissions. Biogenic CO_2 emissions result from materials that are derived from living cells, as opposed to CO_2 emissions derived from fossil fuels, limestone, and other materials that have been transformed by geological processes. Biogenic CO_2 contains carbon that is present in organic materials that include, but are not limited to, wood, paper, vegetable oils, animal fat, and waste from food, animals, and vegetation (such as yard or forest waste). Biogenic CO_2 emissions are excluded from these GHG emissions quantification methods because they are the result of materials in the biological/physical carbon cycle, rather than the geological carbon cycle.

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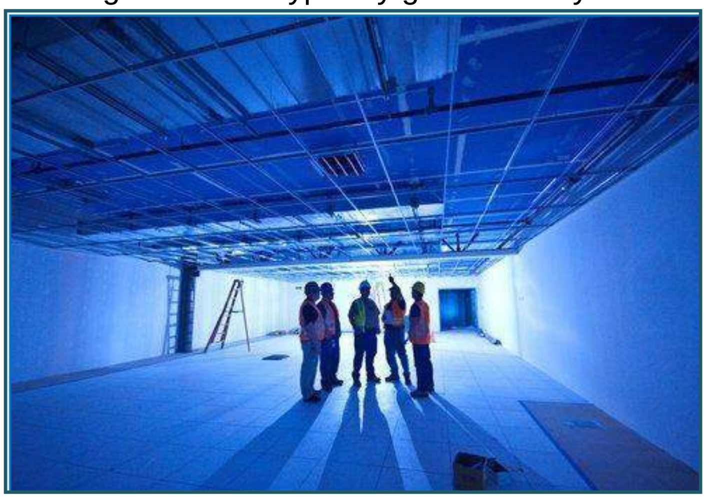
Introduction

The mitigation measures quantified for this Report fall into general categories within which the quantification methods follow a common approach. The following sections summarize the select categories and subcategories of measures and discuss the quantification methods used for each one. In general, emission reductions are quantified (1) as a percentage of the baseline emissions; or (2) by calculating mitigated emissions and determining the change in emissions relative to the baseline case. More detailed explanation of the parameters and equations used to calculate the emission reductions for each individual measure are provided in the Fact Sheets in Chapter 7.

Building Energy Use

The emissions associated with building energy use come from power generation that provides the energy used to operate the building. Power is typically generated by a remote, central electricity generating plant, or onsite generation by fuel combustion. These emissions can be reduced by lowering the amount of electricity and natural gas required for building operations. This can be achieved by designing a more energy-efficient building structure and/or installing energy-efficient appliances. Replacing high-emitting energy generation with clean energy will also reduce emissions, and that type of mitigation is discussed in "On-site Energy Generation" below.



NREL.gov

As discussed in Chapter 3, this Report does not include a lifecycle analysis for GHG emissions. However, if a project proposes mitigation in the form of improved building energy use, a limited analysis of indirect emissions will be needed to quantify the associated reductions in GHG emissions. Emissions associated with energy use to light and heat buildings are, as stated previously, well-defined and not considered to be "lifecycle emissions" for the purposes of this Report. The quantification methods in this Report that deal with building energy use provide a specific method for conducting that analysis.

Emission reductions in this category are quantified as percentage reductions in specific baseline energy end uses, such as Title 24-regulated energy or household appliance energy use. The baseline values are determined using California-specific energy end use databases such as California Commercial End-Use Survey (CEUS) and Residential Appliance Saturation Study (RASS). The percentage reduction in Title-24 regulated energy is a project-specific input, whereas the percentage reductions in energy use for energy-efficient models of various household appliances can be obtained from literature sources (for example, through the Energy Star program).

Outdoor Water Use

Energy use associated with pumping, treating and conveying water generates indirect GHG emissions. The amount of energy required depends on both the volume of water and energy intensity associated with the water source. For example, it generally takes less energy to pump and convey water from a local source than to transport water across long distances. As a result, the GHG emission factor associated with locally-sourced water will also be lower. Indirect GHG emissions associated with water use can be decreased by reducing the water demand and/or by using a less energy-intensive water source. As discussed in Chapter 3, these emissions are well-defined and are not considered to be "lifecycle emissions" for the purposes of this report.

Outdoor water use at mixed-use developments is associated with irrigation for landscaping. The volume of water required for landscaping will depend on the areal extent of landscaping; the specific watering needs for the type of vegetation; and the water efficiency of the irrigation system. A reduction in outdoor water demand can be achieved by designing water-efficient landscapes that include plants with relatively low watering needs; minimizing areas of water-intensive turf; and installing smart irrigation systems to avoid excessive water use. Emission reductions associated with water-efficient design are quantified as the difference between mitigated and baseline values, which in turn are estimated using established models from government agencies or scientific literature. Emission reductions associated with smart irrigation systems and turf minimization are quantified as percentage reductions from the baseline. The implementation of gray water systems, where allowed, and the use of recycled water can also reduce emissions; however, it is important to consider the energy used to operate the gray water or water recycling system. These percentages are either taken from literature or estimated using site-specific data. The quantification methods in this Report include estimates of electricity use for recycled water systems, but not for gray water systems, because those emissions are generally more site specific.

As described previously, the energy use intensity for water supply will depend on the water source and its associated treatment and conveyance requirements. The typical or baseline scenario water source for Southern California is the State Water Project; however, other less-energy intensive supplies such as locally-treated recycled wastewater may instead be used to satisfy some of the project's non-potable water demand. Energy intensity values for different water sources can be obtained from California Energy Commission reports on water-related energy use, and are provided in Appendix E (Table E-2). Emissions associated with water use are estimated by multiplying the volume of water by the energy intensity value for the water source. The associated emission reduction is quantified by calculating emissions associated with water supplied by the lower impact water source (which can include the gray water or recycled water systems mentioned above), and subtracting it from the emissions associated with the same volume of water using the typical or baseline scenario water source.

Indoor Water Use

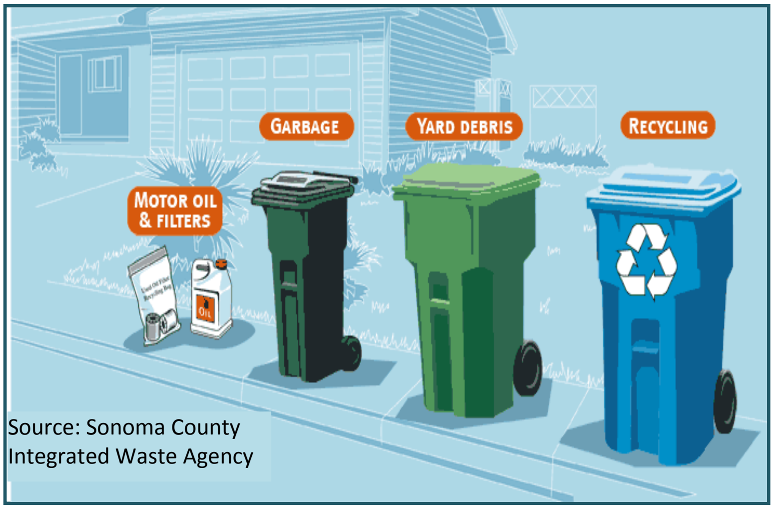
Similar to outdoor water use, indirect GHG emissions from indoor water use can be reduced by decreasing water demand or using a less energy-intensive water source. A project can reduce its indoor water demand relative to the baseline scenario by installing low-flow and high-efficiency water fixtures and appliances such as toilets, showerheads, faucets, clothes washers, and dishwashers.

Emission reductions associated with reduced water demand will be directly proportional to the decrease in demand. The total percentage reduction can be estimated by summing the reductions associated with each type of water-saving feature, which can be obtained from such sources as the California Green Building Standards Code or Energy Star standards. This total percentage would then be multiplied by the project's baseline demand, which should be available from the project's water assessment report. If the water assessment also has an estimate of mitigated water demand, which incorporates the reductions associated with water-saving features, then the reduction can be directly calculated as the difference between baseline and mitigated values.

Emission reductions associated with lower-impact water sources can be quantified as described above for outdoor water use.

Municipal Solid Waste

Solid waste generated at a site can directly produce GHG emissions via decomposition or incineration; it also generates vehicle-based emissions from trucks required to transport waste from its source to the waste handling facility. A reduction in the mass of municipal solid waste sent to landfills would lower emissions associated with its transport and treatment. This can be achieved by reducing the rate at which waste is generated, or by diverting material away from the landfill via on-site composting, reuse, or recycling operations (although direct and transport-related emissions associated with the alternate fates must be accounted for too).



Source: Sonoma County Integrated Waste Agency

Most methods to quantify municipal solid waste involve life-cycle assessments. The fact sheets describe the inventory emissions and the available tools that should be used if the Local Agency or project Applicant would like to quantify the benefits of a solid waste measure with respect to a reduction in life-cycle emissions.

Public Area and Traffic Signal Lighting

Energy use for lighting generates indirect GHG emissions. The amount of energy required for lighting depends in part on the number and energy needs of the lamps. Indirect emissions from lighting energy use can be reduced by installing energy-efficient lamps that maintain the same efficacy beyond what is required to meet any government standards. The replacement of existing, incandescent traffic signal lamps with light-emitting diode (LED) versions will reduce traffic light energy use relative to the baseline. New public lighting fixtures outfitted with energy-efficiency lamps will also use less electricity than the existing baseline energy use. However, because regulations require all new traffic lights to be LED-based, the methods in this Report do not quantify a reduction associated with LED traffic lights for new traffic intersections. Emissions reductions for lighting-based mitigation measures are quantified as percentages of the baseline emissions. The percentage reductions for energy-efficiency lighting are based on a survey of literature data.

Vegetation (including Trees)

As discussed in Chapter 3, vegetation incorporates carbon into its structure during its growth phase, and thereby can remove a finite amount of carbon from the atmosphere. The sequestration capacity of on-site vegetation is determined by the area available for vegetation, and the types of vegetation installed. A project can increase the area available for vegetation by converting previously developed land into vegetated open space. Conversions from one type of vegetated land to another may increase or decrease carbon sequestration, depending on the relative sequestration capacities of the land types. A third way to increase sequestration is by planting new trees on either developed or undeveloped land.

The increase in carbon sequestration capacity is determined by calculating the total sequestration capacity of converted land, new vegetated land and trees; and then subtracting the combined capacity of vegetated land or trees that are removed. Carbon sequestration capacities for different land types (e.g. cropland, forest land) and for different tree species classes are available from IPCC guidelines, and summarized in Table E-2, in Appendix E.

Construction Equipment

Construction equipment typically uses diesel fuel and releases emissions based on the amount of fuel combusted and emission factor of the equipment. Emissions can be reduced by using equipment that emits fewer pollutants for the same amount of work.

This is typically equipment powered through grid electricity or hybrid technology. The exclusive use of grid electricity eliminates the diesel emissions at the site but would increase indirect electricity emissions. However, grid-based emissions are typically small compared to the emissions from the diesel-fueled equipment (depending on the source of grid power). Hybrid-powered equipment would decrease but not completely eliminate fuel use. The electricity for hybrid equipment is self-generated unless the equipment has plug-in capability, so it would not increase grid-based electrical generation and the associated emissions there.

The emissions reductions in this category are determined by finding the difference between the estimated mitigation emissions and the baseline emissions for construction equipment. Emissions for the mitigated scenario may consist of direct emissions from combustion fuel use, and/or indirect emissions from grid electricity. These would be calculated using resources described previously, such as the OFFROAD database and literature-based methodologies and values.

Transportation

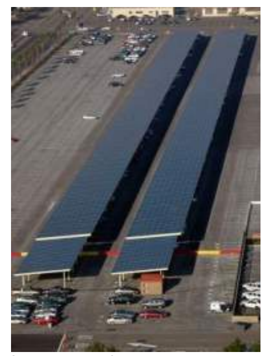
Transportation emissions can be reduced by improving the emissions profile of the vehicle fleet that travels the roads, or by reducing the vehicle miles traveled by the fleet. The majority of the measures quantified for this report focus on the reduction of VMT. This can be accomplished by optimizing the location and types of land uses in the project and its immediate vicinity, and by site enhancements to roads, and to bike and pedestrian networks to encourage the use of alternative modes of transportation. Mode shifts are also encouraged by implementing parking policies, transit system improvements, and trip reduction coordination or incentive programs.

The emission reductions in this category are determined by evaluating the elasticity of a measure relative to the amount of vehicle miles traveled that may be reduced as a result of the mitigation measure.

A few transportation measures in this Report are aimed at improving the emissions profile of the vehicle fleet. These measures promote alternative fuel, hybrid or electrical vehicles. The emission reductions in these measures are based on the improved emission factors and on changes to the assumed vehicle fleet mix.

On-Site Energy Generation

Different modes of energy generation have different GHG emission intensities. Fossil fuel-based generation emits GHG gases from combustion of the fuel, with the amount of emissions depending on the quantity and type of fuel used. Renewable energy generation, on the other hand, typically has significantly fewer emissions, and some types do not have any associated GHG emissions, such as photovoltaic systems and solar hot water heaters (excluding lifecycle emissions, as previously described in Chapter 3).



Solar Array at Coronado Naval Base

The emission reductions associated with using renewable non-emitting energy generated on-site are quantified as the emissions avoided because an equivalent amount of grid energy is not used. To calculate this, the energy generated by the on-site system(s) must be quantified, and then multiplied by the utility-specific emission factor for the type of energy (e.g. electricity, natural gas) being replaced. Energy generated on site is usually used for building operations; hence, it is generally considered a mitigation measure for building energy use.

Miscellaneous

The following miscellaneous mitigation measures are also discussed:

<u>Loading Docks</u>: A project applicant may elect to limit idling of engines beyond what is required by regulation at loading docks, or provide electrified loading docks. Electrified loading docks reduce the need for diesel auxiliary engines to run in order to keep refrigerated transportation units temperature controlled. The emission reduction is a comparison of the GHG emissions associated with the electricity compared to the diesel fuel combustion.

<u>Off-site Mitigation</u>: At the discretion of the reviewing agency, emission reductions may be created with offsite mitigation projects, as described in Chapter 2. If an off-site

mitigation project is approved, the amount of emission reductions generated depends on the type of project implemented.

The numerical emission reductions would be quantified using the methods described for the different project categories above, with baseline values derived for the off-site location (instead of the project's baseline scenario). Once the numerical reductions have been estimated, they can be compared to the project's baseline emissions in order to determine the relative percentage reductions. Certain types of off-site projects may result in one-time emissions and others may result in a continuing stream of emissions reductions.

Carbon Sequestration: Emission reductions may be generated by implementing a carbon sequestration project. Carbon sequestration may be biological, chemical, or physical in nature, as described in Chapter 3. This Report does not address chemical or physical sequestration projects.

For biological sequestration, emission reductions are calculated as for vegetation projects (see above). The amount of the sequestration equals the amount of carbon removed by the vegetation.

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This chapter of the Report explains how the quantification of individual strategies is presented in Fact Sheets, how those fact sheets are designed and organized, and how to use them. This chapter also explains how and why mitigation measures have been grouped, and provides detailed discussion of how to apply the quantification methods when more than one strategy is being applied to the same project. A summary of the range of effectiveness for different measures is also provided for general information purposes, in table form, however it is very important that those generalized ranges NOT be used in place of the more specific quantification methods for the measure as detailed in the measure Fact Sheet. Finally, at the end of the Chapter there are step-by-step instructions on using the Fact Sheets, including an example.

Mitigation Strategies and Fact Sheets:

Accurate and reliable quantification depends on properly identifying the important variables that affect the emissions from an activity or source, and from changes to that activity or source. In order to provide a clear summary of those variables and usable instructions on how to find and apply the data needed, we have designed a Fact Sheet format to present each strategy or measure.

Types of Mitigation Strategies: There are three different types of mitigation strategies described in Chapter 7: Quantified measures, Best Management Practices, and General Plan strategies.

<u>Quantified Measures</u>: Quantified measures are fully quantified, project-level mitigation strategies. They are presented in categories where the nature of the underlying emissions sources are the same; the categories are discussed under “Organization of Fact Sheets” below. In addition, the measures may either stand alone, or be considered in connection with one or more other measures (that is, “grouped”). Groups of measures are always within a category; more detailed explanation is provided in “Grouping of Strategies” below. The majority of the strategies in this Report are fully Quantified Measures, and a strategy may be assumed to be of this type unless the Fact Sheet notes otherwise.

<u>Best Management Practices</u>: Several strategies are denoted as Best Management Practice (BMP). These measures are of two types. The first type of BMPs are quantifiable and describe methods that can be used to quantify the GHG mitigation reductions provided the project Applicant can provide substantial evidence supporting the values needed to quantify the reduction. These are listed as BMPs since there is not adequate literature at this time to generalize the mitigation measure reductions. However, the project Applicant may be able to provide the site specific information necessary to quantify a reduction. The second type of BMPs do not have methods for quantifying GHG mitigation reductions. These measures have preliminary evidence suggesting they will reduce GHG emissions if implemented, however, at this time adequate literature and methodologies are not available to quantify these reductions or

they involve life-cycle GHG emission benefits. The measures are encouraged to be implemented nonetheless. Local Agencies may decide to provide incentives to encourage implementation of these measures.

General Plan Strategies: The measures listed under the General Plan category are measures that will have the most benefit when implemented at a General Plan level, but are not quantifiable or applicable at the project specific level. While on a project basis some of these measures may not be quantifiable, at the General Plan level they may be quantified under the assumption that this will be implemented on a widespread basis. Local Agencies may decide to provide incentives or allocate the General Plan level reductions to specific projects by weighting the overall effect by the number of projects the General Plan reduction would apply to.

Introduction to the Fact Sheets: This Report presents the quantification of each mitigation measure in a Fact Sheet format. Each Fact Sheet includes: a detailed summary of each measure's applicability; the calculation inputs for the specific project; the baseline emissions method; the mitigation calculation method and associated assumptions; a discussion of the calculation and an example calculation; and finally a summary of the preferred and alternative literature sources for measure efficacy. The Fact Sheets are found in Chapter 7.

Layout of the Fact Sheets: Each Fact Sheet describes one mitigation measure. The mitigation measure has a unique number and is provided at the bottom of each page in that measure's Fact Sheet. This will assist the end user in determining where a mitigation measure fact sheet begins and ends while still preserving consecutive page numbers in the overall Report.

At the top of each Fact Sheet, the name of the measure category appears on the left, and the subcategory on the right. Cross-references to prior CAPCOA documents appear at the top left, below the category name. Specifically, measures labeled CEQA #: are from the *CAPCOA 2008 CEQA & Climate Change*[1] and measures labeled MP#: are from the *CAPCOA 2009 Model Policies for Greenhouse Gases in General Plans*[2]. This cross-referencing is also included in the list of measures at the beginning of Chapter 7, and is intended to allow the user to move easily between the documents. The measure number is at the bottom of the page, on the right-hand side.

The fact sheets begin with a measure description. This description includes two critical components:

(1) Specific language regarding the measure implementation – which should be consistent with the implementation method suggested by the project Applicant; and

[1] Available online at http://www.capcoa.org/wp-content/uploads/downloads/2010/05/CAPCOA-White-Paper.pdf
[2] Available online at http://www.capcoa.org/wp-content/uploads/downloads/2010/05/CAPCOA-ModelPolicies-6-12-09-915am.pdf

(2) A discussion of key support strategies that are required for the reported range of effectiveness.

Appendices with additional calculations and assumptions for some of the fact sheets are provided at the end of this document. Default assumptions should be carefully reviewed for project applicability. Appendix B details the methodologies that should be used to calculate baseline GHG emissions for a project.

Organization of the Fact Sheets – Categories and Subcategories: The Fact Sheets are organized by general emission category types as follows:

- Energy
- Transportation
- Water
- Landscape Equipment
- Solid Waste
- Vegetation
- Construction
- Miscellaneous Categories
- General Plans

Several of these main categories are split into subcategories, for ease of understanding how to properly address the effects of combining the measures. Strategies are organized into categories and subcategories where they affect similar types of emissions sources. As an example, the category of "Energy" includes measures that reduce emissions associated with energy generation and use. Within that category, there are subcategories of measures that address "Building Energy Use," "Alternative Energy," and "Lighting," each with one or more measures in it. The measures in the subcategory are closely related to each other.

Categories and subcategories for the measures are illustrated in Charts 6-1 and 6-2, below. Chart 6-1 shows all of the measure categories EXCEPT the Transportation category, including their subcategories; note that not all categories have subcategories. Measures in the Transportation category are shown in Chart 6-2. There are a number of subcategories associated with the Transportation category. As shown in Chart 6-2, the primary measures in each subcategory are indicated in bold type, and the measures shown in normal type are either support measures, or they are explicitly "grouped" measures.

It is important to note that subcategories are NOT the same as "grouped" measures / strategies. The grouping of strategies connotes a specific relationship, and is explained in the next section, below.

Chart 6-1: Non-Transportation Strategies Organization

Energy			Water		Area Landscaping	Solid Waste	Vegetation	Construction	Miscellaneous	General Plans
BE	AE	LE	WSW	WUW	A	SW	V	C	Misc	GP
Building Energy	**Alternative Energy**	**Lighting**	**Water Supply**	**Water Use**	**Landscaping Equipment**	**Solid Waste**	**Vegetation**	**Construction**	**Miscellaneous**	**General Plans**
Exceed Title 24	**Onsite Renewable Energy**	**Install High Efficacy Lighting**	**Adopt a Water Conservation Strategy**		**Prohibit gas Powered Landscape Equipment**	Institute or Extend Recycling & Composting Services	**Plant Urban Trees**	**Use Alternative Fuels for Construction Equipment**	**Establish Carbon Sequestration**	Fund Incentives for Energy Efficiency
			OR							
Install Energy Efficient Appliances	**Utilize Combined Heat & Power**	**Limit Outdoor Lighting**	**Use Reclaimed Water**	**Install Low-Flow Fixtures**	Implement Lawnmower Exchange Program Reduction: Grouped	Recycle Demolished Construction Material	**New Vegetated Open Space**	**Use Electric or Hybrid Construction Equipment**	**Establish Off-site Mitigation**	Establish a Local Farmer's Market
Install Programmable Thermostats Reduction: Grouped	**Establish Methane Recovery**	Replace Traffic Lights with LED Reduction: Additional	**Use Graywater**	**Design Water-Efficient Landscapes**	Electric Yard Equipment Compatibility Reduction Grouped			Limit Construction Equipment Idling	**Implement an Innovative Strategy**	Establish Community Gardens
Obtain 3rd Party Commissioning Reduction: Grouped			**Use Locally Sourced Water**	**Use Water-Efficient Irrigation**				Institute a Heavy-Duty Off-Road Vehicle Plan	Use Local and Sustainable Building Materials	Plant Urban Shade Trees
				Reduce Turf				Implement a Construction Vehicle Inventory Tracking System	Require BMP in Agriculture and Animal Operations	Implement Strategies to Reduce Urban Heat-Island Effect
				Plant Native or Drought-Resistant Vegetation					Require Environmentally Responsible Purchasing	

Note: Strategies in bold text are primary strategies with reported VMT reductions; non-bolded strategies are support or grouped strategies.

Chart 6-2: Transportation Strategies Organization

Transportation Measures (Five Subcategories) Global Maximum Reduction (all VMT): urban = 75%; compact infill = 40%; suburban center or suburban with NEV = 20%; suburban = 15%					Global Cap for Road Pricing needs further study	
Transportation Measures (Four Categories) Cross-Category Max Reduction (all VMT): urban = 70%; compact infill = 35%; suburban center or suburban with NEV = 15%; suburban = 10%				Max Reduction = 15% overall; work VMT = 25%; school VMT = 65%;	Max Reduction = 25% (all VMT)	
Land Use / Location Max Reduction: urban = 65%; compact infill = 30%; suburban center = 10%; suburban = 5%	**Neighborhood / Site Enhancement** Max Reduction: without NEV = 5%; with NEV = 15%	**Parking Policy / Pricing** Max Reduction = 20%	**Transit System Improvements** Max Reduction = 10%	**Commute Trip Reduction** (assumes mixed use) Max Reduction = 25% (work VMT)	**Road Pricing Management** Max Reduction = 25%	**Vehicles**
Density (30%)	Pedestrian Network (2%)	Parking Supply Limits (12.5%)	Network Expansion (8.2%)	CTR Program Required = 21% work VMT Voluntary = 6.2% work VMT	Cordon Pricing (22%)	Electrify Loading Docks
Design (21.3%)	Traffic Calming (1%)	Unbundled Parking Costs (13%)	Service Frequency / Speed (2.5%)	Transit Fare Subsidy (20% work VMT)	Traffic Flow Improvements (45% CO2)	Utilize Alternative Fueled Vehicles
Location Efficiency (65%)	NEV Network (14.4) <NEV Parking>	On-Street Market Pricing (5.5%)	Bus Rapid Transit (3.2%)	Employee Parking Cash-out (7.7% work VMT)	Required Contributions by Project	Utilize Electric or Hybrid Vehicles
Diversity (30%)	Car Share Program (0.7%)	Residential Area Parking Permits	Access Improvements	Workplace Parking Pricing (19.7% work VMT)		
Destination Accessibility (20%)	Bicycle Network <Lanes> <Parking> <Land Dedication for Trails>		Station Bike Parking	Alternative Work Schedules & Telecommute (5.5% work VMT)		
Transit Accessibility (25%)	Urban Non-Motorized Zones		Local Shuttles	CTR Marketing (5.5% work VMT)		
BMR Housing (1.2%)			Park & Ride Lots*	Employer-Sponsored Vanpool/Shuttle (13.4% work VMT)		
Orientation Toward Non-Auto Corridor				Ride Share Program (15% work VMT)		
Proximity to Bike Path				Bike Share Program		
				End of Trip Facilities		
				Preferential Parking Permit		
				School Pool (15.8% school VMT)		
				School Bus (6.3% school VMT)		

Note: Strategies in bold text are primary strategies with reported VMT reductions; non-bolded strategies are support or grouped strategies.

Grouping of Strategies

Strategies noted as “grouped” are separately documented in individual Fact Sheets but must be paired with other strategies within the category. When these “grouped” strategies are implemented together, the combination will result in either an enhancement to the primary strategy by improving its effectiveness or a non-negligible reduction in effectiveness that would not occur without the combination.

Rules for Combining Strategies or Measures

Mitigation measures or strategies are frequently implemented together with other measures. Often, combining measures can lead to better emission reductions than implementing a single measure by itself. Unfortunately, the effects of combining the measures are not always as straightforward as they might at first appear. When more and more measures are implemented to mitigate a particular source of emissions, the benefit of each additional measure diminishes. If it didn’t, some odd results would occur. For example, if there were a series of measures that each, independently, was predicted to reduce emissions from a source by 10%, and if the effect of each measure was independent of the others, then implementing ten measures would reduce all of the emissions; and what would happen with the eleventh measure? Would the combination reduce 110% of the emissions? No. In fact, each successive measure is slightly less effective than predicted when implemented on its own.

On the other hand, some measures enhance the performance of a primary measure when they are combined. This Report includes a set of rules that govern different ways of combining measures. The rules depend on whether the measures are in the *same* category, or different categories. Remember, the categories include: Energy, Transportation, Water, Landscape Equipment, Solid Waste, Vegetation, Construction, Miscellaneous Categories, and General Plans.

Combinations Between Categories: The following procedures must be followed when combining mitigation measures that fall in separate categories. In order to determine the overall reduction in GHG emissions compared to the baseline emissions, the relative magnitude of emissions between the source categories needs to be considered. To do this, the user should determine the percent contribution made by each individual category to the overall baseline GHG emissions. This percent contribution by a category should be multiplied by the reduction percentages from mitigation measures in that category to determine the scaled GHG emission reductions from the measures in that category. This is done for each category to be combined. The scaled GHG emissions for each category can then be added together to give a total GHG reduction for the combined measures in all of the categories.

For example, consider a project whose total GHG emissions come from the following categories: transportation (50%), building energy use (40%), water (6%), and other (4%). This project implements a transportation mitigation measure that results in a 10% reduction in VMT. The project also implements mitigation measures that result in a 30% reduction in water usage. The overall reduction in GHG emissions is as follows:

Reduction from Transportation: 0.50 x 0.10 = 0.5 or 5%
Reduction from Water: 0.06 x 0.30 = 0.018 or 1.8%

Total Reduction: 5% + 1.8% = 6.8%

This example illustrates the importance of the magnitude of a source category and its influence on the overall GHG emission reductions.

The percent contributions from source categories will vary from project to project. In a commercial-only project it may not be unusual for transportation emissions to represent greater than 75% of all GHG emissions whereas for a residential or mixed use project, transportation emissions would be below 50%.

Combinations <u>Within</u> Categories: The following procedures must be followed when combining mitigation measures that fall within the same category.

<u>Non-Transportation Combinations</u>: When combining non-transportation subcategories, the total amount of reductions for that category should not exceed 100% except for categories that would result in additional excess capacity that can be used by others, but which the project wants to take credit for (subject to approval of the reviewing agency). This may include alternative energy generation systems tied into the grid, vegetation measures, and excess graywater or recycled water generated by the project and used by others. These excess emission reductions may be used to offset other categories of emissions, with approval of the agency reviewing the project. In these cases of excess capacity, the quantified amounts of excess emissions must be carefully verified to ensure that any credit allowed for these additional reductions is truly surplus.

Category Maximum- Each <u>category</u> has a maximum allowable reduction for the combination of measures in that category. It is intended to ensure that emissions are not double counted when measures within the category are combined. Effectiveness levels for multiple strategies within a <u>subcategory</u> (as denoted by a column in the appropriate chart, above) may be multiplied to determine a combined effectiveness level up to a maximum level. This should be done first to mitigation measures that are a source reduction followed by those that are a reduction to emission factors. Since the combination of mitigation measures and independence of mitigation measures are both complicated, this Report recommends that mitigation measure reductions within a category be multiplied unless a project applicant can provide substantial evidence indicating that emission reductions are independent of one another. This will take the following form:

GHG emission reduction for category = 1-[(1-A) x (1-B) x (1-C)]

Where:

A, B and C = Individual mitigation measure reduction percentages for the strategies to be combined in a given category.

Global Maximum- A separate maximum, referred to as a global maximum level, is also provided for a combination across subcategories. Effectiveness levels for multiple strategies across categories may also be multiplied to determine a combined effectiveness level up to global maximum level.

For example, consider a project that is combining 3 mitigation strategies from the water category. This project will install low-flow fixtures (measure WUW-1), use water-efficient irrigation (measure WUW-4, and reduce turf (measure WUW-5). Reductions from these measures will be:

- low-flow fixtures 20% or 0.20 (A)
- water efficient irrigation 10% or 0.10 (B)
- turf reductions 20% or 0.20 (C)

To combine measures within a category, the reductions would be
= 1-[(1-A) x (1-B) x (1-C)]
= 1-[(1-.20) x (1-.10) x (1-.20)]
= 1-[(0.8) x (0.9) x (.8)]
= 1-0.576 = 0.424
= 42.4%

Transportation Combinations: The interactions between the various categories of transportation-related mitigation measures is complex and sometimes counter-intuitive. Combining these measures can have a substantive impact on the quantification of the associated emission reductions. In order to safeguard the accuracy and reliability of the methods, while maintaining their ease of use, the following rules have been developed and should be followed when combining transportation-related mitigation measures. The rules are presented by sub-category, and reference Chart 6-2 Transportation Strategies Organization. The maximum reduction values also reflect the highest reduction levels justified by the literature. The chart indicates maximum reductions for individual mitigation measures just below the measure name.

Cross-Category Maximum- A cross-category maximum is provided for any combination of land use, neighborhood enhancements, parking, and transit strategies (columns A-D in Chart 6-1, with the maximum shown in the top row). The total project VMT reduction across these categories should be capped at these levels based on empirical evidence.[3] Caps are provided for the location/development type of the project. VMT reductions may be multiplied across the four categories up to this maximum. These include:

- Urban: 70% VMT
- Compact Infill: 35%
- Suburban Center (or Suburban with NEV): 15%
- Suburban: 10% (note that projects with this level of reduction must include a diverse land use mix, workforce housing, and project-specific transit; limited empirical evidence is available)

(See blue box, pp. 58-59.)

[3] As reported by Holtzclaw, et al for the State of California.

As used in this Report, location settings are defined as follows:

Urban: A project located within the central city and may be characterized by multi-family housing, located near office and retail. Downtown Oakland and the Nob Hill neighborhood in San Francisco are examples of the typical urban area represented in this category. The urban maximum reduction is derived from the average of the percentage difference in per capita VMT versus the California statewide average (assumed analogous to an ITE baseline) for the following locations:

Location	Percent Reduction from Statewide VMT/Capita
Central Berkeley	-48%
San Francisco	-49%
Pacific Heights (SF)	-79%
North Beach (SF)	-82%
Mission District (SF)	-75%
Nob Hill (SF)	-63%
Downtown Oakland	-61%

The average reflects a range of 48% less VMT/capita (Central Berkeley) to 82% less VMT/capita (North Beach, San Francisco) compared to the statewide average. The urban locations listed above have the following characteristics:

- Location relative to the regional core: these locations are within the CBD or less than five miles from the CBD (downtown Oakland and downtown San Francisco).
- Ratio or relationship between jobs and housing: jobs-rich (jobs/housing ratio greater than 1.5)
- Density character
  - typical building heights in stories: six stories or (much) higher
  - typical street pattern: grid
  - typical setbacks: minimal
  - parking supply: constrained on and off street
  - parking prices: high to the highest in the region
- Transit availability: high quality rail service and/or comprehensive bus service at 10 minute headways or less in peak hours

Compact infill: A project located on an existing site within the central city or inner-ring suburb with high-frequency transit service. Examples may be community redevelopment areas, reusing abandoned sites, intensification of land use at established transit stations, or converting underutilized or older industrial buildings. Albany and the Fairfax area of Los Angeles are examples of typical compact infill area as used here. The compact infill maximum reduction is derived from the average of the percentage difference in per capita VMT versus the California statewide average for the following locations:

Location	Percent Reduction from Statewide VMT/Capita
Franklin Park, Hollywood	-22%
Albany	-25%
Fairfax Area, Los Angeles	-29%
Hayward	-42%

The average reflects a range of 22% less VMT/capita (Franklin Park, Hollywood) to 42% less VMT/capita (Hayward) compared to the statewide average. The compact infill locations listed above have the following characteristics:

- Location relative to the regional core: these locations are typically 5 to 15 miles outside a regional CBD
- Ratio or relationship between jobs and housing: balanced (jobs/housing ratio ranging from 0.9 to 1.2)
- Density character
  - typical building heights in stories: two to four stories
  - typical street pattern: grid
  - typical setbacks: 0 to 20 feet
  - parking supply: constrained
  - parking prices: low to moderate
- Transit availability: rail service within two miles, or bus service at 15 minute peak headways or less

As used in this Report, additional location settings are defined as follows:

Suburban Center: A project typically involving a cluster of multi-use development within dispersed, low-density, automobile dependent land use patterns (a suburb). The center may be an historic downtown of a smaller community that has become surrounded by its region's suburban growth pattern in the latter half of the 20th Century. The suburban center serves the population of the suburb with office, retail and housing which is denser than the surrounding suburb. The suburban center maximum reduction is derived from the average of the percentage difference in per capita VMT versus the California statewide average for the following locations:

Location	Percent Reduction from Statewide VMT/Capita
Sebastopol	0%
San Rafael (Downtown)	-10%
San Mateo	-17%

The average reflects a range of 0% less VMT/capita (Sebastopol) to 17% less VMT/capita (San Mateo) compared to the statewide average. The suburban center locations listed above have the following characteristics:

- Location relative to the regional core: these locations are typically 20 miles or more from a regional CBD
- Ratio or relationship between jobs and housing: balanced
- Density character
  - typical building heights in stories: two stories
  - typical street pattern: grid
  - typical setbacks: 0 to 20 feet
  - parking supply: somewhat constrained on street; typically ample off-street
  - parking prices: low (if priced at all)
- Transit availability: bus service at 20-30 minute headways and/or a commuter rail station

While all three locations in this category reflect a suburban "downtown," San Mateo is served by regional rail (Caltrain) and the other locations are served by bus transit only. Sebastopol is located more than 50 miles from downtown San Francisco, the nearest urban center. San Rafael and San Mateo are located 20 miles from downtown San Francisco.

Suburban: A project characterized by dispersed, low-density, single-use, automobile dependent land use patterns, usually outside of the central city (a suburb). Suburbs typically have the following characteristics:

- Location relative to the regional core: these locations are typically 20 miles or more from a regional CBD
- Ratio or relationship between jobs and housing: jobs poor
- Density character
  - typical building heights in stories: one to two stories
  - typical street pattern: curvilinear (cul-de-sac based)
  - typical setbacks: parking is generally placed between the street and office or retail buildings; large-lot residential is common
  - parking supply: ample, largely surface lot-based
  - parking prices: none
- Transit availability: limited bus service, with peak headways 30 minutes or more

The maximum reduction provided for this category assumes that regardless of the measures implemented, the project's distance from transit, density, design, and lack of mixed use destinations will keep the effect of any strategies to a minimum.

Global Maximum- A global maximum is provided for any combination of land use, neighborhood enhancements, parking, transit, and commute trip reduction strategies (the first five columns in the organization chart). This excludes reductions from road-pricing measurements which are discussed separately below. The total project VMT reduction across these categories, which can be combined through multiplication, should be capped at these levels based on empirical evidence.[4] Maximums are provided for the location/development type of the project. The Global Maximum values can be found in the top row of Chart 6-2.

These include:

- Urban: 75% VMT
- Compact Infill: 40% VMT
- Suburban Center (or Suburban with NEV): 20%
- Suburban: 15% (limited empirical evidence available)

Specific Rules for Subcategories within Transportation- Because of the unique interactions of measures within the Transportation Category, each subcategory has additional rules or criteria for combining measures.

❖ Land Use/Location Strategies – Maximum Reduction Factors: Land use measures apply to a project area with a radius of ½ mile. If the project area under review is greater than this, the study area should be divided into subareas of radii of ½ mile, with subarea boundaries determined by natural "clusters" of integrated land uses within a common walkshed. If the project study area is smaller than ½ mile in radius, other land uses within a ½ mile radius of the key destination point in the study area (i.e. train station or employment center) should be included in design, density, and diversity calculations. Land use measures are capped based on empirical evidence for location setting types as follows:[5]

- Urban: 65% VMT
- Compact Infill: 30% VMT
- Suburban Center: 10% VMT
- Suburban: 5% VMT

❖ Neighborhood/Site Enhancements Strategies – Maximum Reduction Factors: The neighborhood/site enhancements category is capped at 12.7% VMT reduction (with Neighborhood Electric Vehicles (NEVs)) and 5% without NEVs based on empirical evidence (for NEVs) and the multiplied combination of the non-NEV measures.

❖ Parking Strategies – Maximum Reduction Factors: Parking strategies should be implemented in one of two combinations:

- Limited (reduced) off-street supply ratios plus residential permit parking and priced on-street parking (to limit spillover), or
- Unbundled parking plus residential permit parking and priced on-street parking (to limit spillover).

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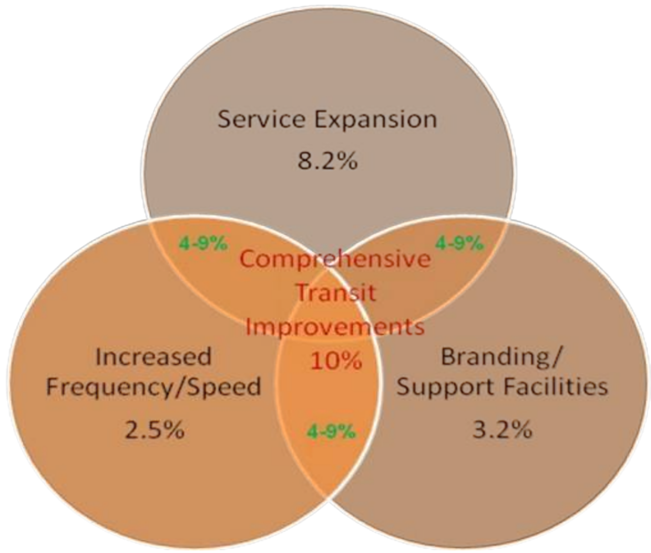
[4] As reported by Holtzclaw, et al for the State of California. Note that CTR strategies must be converted to overall VMT reductions (from work-trip VMT reductions) before being combined with strategies in other categories.

[5] As reported for California locations in Holtzclaw, et al. "Location Efficiency: Neighborhood and Socioeconomic Characteristics Determine Auto Ownership and Use – Studies in Chicago, Los Angeles, and San Francisco." *Transportation Planning and Technol*ogy, 2002, Vol. 25, pp. 1–27.

Note: The reduction maximum of 20% VMT reflects the combined (multiplied) effect of unbundled parking and priced on-street parking.

- Transit System Strategies – Maximum Reduction Factors: The 10% VMT reduction maximum for transit system improvements reflects the combined (multiplied) effect of network expansion and service frequency/speed enhancements. A comprehensive transit improvement would receive this type of reduction, as shown in the center overlap in the Venn diagram, below.



- Commuter Trip Reductions (CTR) Strategies – Maximum Reduction Factors: The most effective commute trip reduction measures combine incentives, disincentives, and mandatory monitoring, often through a transportation demand management (TDM) ordinance. Incentives encourage a particular action, for example parking cash-out, where the employee receives a monetary incentive for not driving to work, but is not punished for maintaining status quo. Disincentives establish a penalty for a status quo action. An example is workplace parking pricing, where the employee is now monetarily penalized for driving to work. The 25% maximum for work-related VMT applies to comprehensive CTR programs. TDM strategies that include only incentives, only disincentives, and/or no mandatory monitoring, should have a lower total VMT reduction than those with a comprehensive approach. Support strategies to strengthen CTR programs include guaranteed-ride-home, taxi vouchers, and message boards/marketing materials. A 25% reduction in work-related VMT is assumed equivalent to a 15% reduction in overall project VMT for the purpose of the global maximum; this can be adjusted for project-specific land use mixes.

  Two school-related VMT reduction measures are also provided in this category. The maximum reduction for these measures should be 65% of school-related VMT based on the literature.

- Road Pricing/Management Strategies – Maximum Reduction Factors: Cordon pricing is the only strategy in this category with an expected VMT reduction potential. Other forms of road pricing would be applied at a corridor or region-wide level rather than as mitigation applied to an individual development project. No domestic case studies are available for cordon pricing, but international studies suggest a VMT reduction maximum of 25%. A separate, detailed, and project-specific study should be conducted for any project where road pricing is proposed as a VMT reduction measure.

Additional Rules for Transportation Measures- There are also restrictions on the application of measures in rural applications, and application to baseline, as follows:

- Rural Application: Few empirical studies are available to suggest appropriate VMT reduction caps for strategies implemented in rural areas. Strategies likely to have the largest VMT reduction in rural areas include vanpools, telecommute or alternative work schedules, and master planned communities (with design and land use diversity to encourage intra-community travel). NEV networks may also be appropriate for larger scale developments. Because of the limited empirical data in the rural context, project-specific VMT reduction estimates should be calculated.

- Baseline Application: As discussed in previous sections of this report, VMT reductions should be applied to a baseline VMT expected for the project, based on the Institute of Transportation Engineers' 8^{th} Edition *Trip Generation Manual* and associated typical trip distance for each land use type. Where trip generation rates and project VMT provided by the project Applicant are derived from another source, the VMT reductions must be adjusted to reflect any "discounts" already applied.

Range of Effectiveness of Mitigation Measures

The following charts provide the range of effectiveness for the quantified mitigation measures. Each chart shows one category of measures, with subcategories identified. The charts also show the basis for the quantification, and indicate applicable groupings. IMPORTANT: these ranges are approximate and should NOT be used in lieu of the specific quantification method provided in the fact sheet for each measure. Restrictions on combining measures must be observed.

CAPCOA

Table 6-1: Energy Category

Energy						
Category	Measure Number	Strategy	BMP	Grouped With #	Range of Effectiveness	
					Percent Reduction in GHG Emissions	Basis
Building Energy Use	BE-1	Buildings exceed Title 24 Building Envelope Energy Efficiency Standards by X% (X is equal to the percentage improvement selected for the project			For a 10% improvement over 2008 Title 24: Non-Residential electricity use: 0.2-5.5%; natural gas use: 0.7-10% Residential electricity use: 0.3-2.6%; natural gas use: 7.5-9.1%	
	BE-2	Install Programmable Thermostat Timers	x		BMP	
	BE-3	Obtain Third-party HVAC Commissioning and Verification of Energy Savings	x	BE-1	BMP	
	BE-4	Install Energy Efficient Appliances			Residential building: 2-4% Grocery Stores: 17-22%	Appliance Electricity Use
	BE-5	Install Energy Efficient Boilers			1.2-18.4%	Fuel Use
Alternative Energy Generation	AE-1	Establish Onsite Renewable Energy Systems-Generic			0-100%	
	AE-2	Establish Onsite Renewable Energy Systems-Solar Power			0-100%	
	AE-3	Establish Onsite Renewable Energy Systems-Wind Power			0-100%	
	AE-4	Utilize a Combined Heat and Power System			0-46%	
	AE-5	Establish Methane Recovery in Landfills			73-77%	
	AE-6	Establish Methane Recovery in Wastewater Treatment Plants			95-97%	
Lighting	LE-1	Install Higher Efficacy Public Street and Area Lighting			16-40%	Outdoor Lighting Electricity Use
	LE-2	Limit Outdoor Lighting Requirements	x		BMP	
	LE-3	Replace Traffic Lights with LED Traffic Lights			90%	Traffic Light Electricity Use

Table 6-2: Transportation Category

Transportation						
Category	Measure Number	Strategy	BMP	Grouped With #	Range of Effectiveness	
					Percent Reduction in GHG Emissions	Basis
Land Use / Location	LUT-1	Increase Density			1.5-30.0%	VMT
	LUT-2	Increase Location Efficiency			10-65%	VMT
	LUT-3	Increase Diversity of Urban and Suburban Developments (Mixed Use)			9-30%	VMT
	LUT-4	Incr. Destination Accessibility			6.7-20%	VMT
	LUT-5	Increase Transit Accessibility			0.5-24.6%	VMT
	LUT-6	Integrate Affordable and Below Market Rate Housing			0.04-1.20%	VMT
	LUT-7	Orient Project Toward Non-Auto Corridor			NA	
	LUT-8	Locate Project near Bike Path/Bike Lane			NA	
	LUT-9	Improve Design of Development			3.0-21.3%	VMT
Neighborhood / Site Design	SDT-1	Provide Pedestrian Network Improvements			0-2%	VMT
	SDT-2	Traffic Calming Measures			0.25-1.00%	VMT
	SDT-3	Implement a Neighborhood Electric Vehicle (NEV) Network			0.5-12.7%	VMT
	SDT-4	Urban Non-Motorized Zones		SDT-1	NA	
	SDT-5	Incorporate Bike Lane Street Design (on-site)		LUT-9	NA	
	SDT-6	Provide Bike Parking in Non-Residential Projects		LUT-9	NA	
	SDT-7	Provide Bike Parking in Multi-Unit Residential Projects		LUT-9	NA	
	SDT-8	Provide EV Parking		SDT-3	NA	
	SDT-9	Dedicate Land for Bike Trails		LUT-9	NA	
Parking Policy / Pricing	PDT-1	Limit Parking Supply			5-12.5%	
	PDT-2	Unbundle Parking Costs from Property Cost			2.6-13%	
	PDT-3	Implement Market Price Public Parking (On-Street)			2.8-5.5%	
	PDT-4	Require Residential Area Parking Permits		PDT-1, 2 & 3	NA	

Transportation - continued						
Category	Measure Number	Strategy	BMP	Grouped With #	Range of Effectiveness	
					Percent Reduction in GHG Emissions	Basis
Trip Reduction Programs	TRT-1	Implement Voluntary CTR Programs			1.0-6.2%	Commute VMT
	TRT-2	Implement Mandatory CTR Programs – Required Implementation/Monitoring			4.2-21.0%	Commute VMT
	TRT-3	Provide Ride-Sharing Programs			1-15%	Commute VMT
	TRT-4	Implement Subsidized or Discounted Transit Prog.			0.3-20.0%	Commute VMT
	TRT-5	Provide End of Trip Facilities		TRT-1, 2 & 3	NA	
	TRT-6	Telecommuting and Alternative Work Schedules			0.07-5.50%	Commute VMT
	TRT-7	Implement Commute Trip Reduction Marketing			0.8-4.0%	Commute VMT
	TRT-8	Implement Preferential Parking Permit Program		TRT-1, 2 & 3	NA	
	TRT-9	Implement Car-Sharing Program			0.4-0.7%	VMT
	TRT-10	Implement School Pool Program			7.2-15.8%	School VMT
	TRT-11	Provide Employer-Sponsored Vanpool/Shuttle			0.3-13.4%	Commute VMT
	TRT-12	Implement Bike-Sharing Program		SDT-5, LUT-9	NA	
	TRT-13	Implement School Bus Program			38-63%	School VMT
	TRT-14	Price Workplace Parking			0.1-19.7%	Commute VMT
	TRT-15	Implement Employee Parking “Cash-Out”			0.6-7.7%	Commute VMT

Transportation - continued						
Category	Measure Number	Strategy	BMP	Grouped With #	Range of Effectiveness	
					Percent Reduction in GHG Emissions	Basis
Transit System Improvements	TST-1	Provide a Bus Rapid Transit System			0.02-3.2%	VMT
	TST-2	Implement Transit Access Improvements		TST-3, TST-4	NA	
	TST-3	Expand Transit Network			0.1-8.2%	VMT
	TST-4	Increase Transit Service Frequency/Speed			0.02-2.5%	VMT
	TST-5	Provide Bike Parking Near Transit		TST-3, TST-4	NA	
	TST-6	Provide Local Shuttles		TST-3, TST-4	NA	
Road Pricing / Management	RPT-1	Implement Area or Cordon Pricing			7.9-22.0%	VMT
	RPT-2	Improve Traffic Flow			0-45%	VMT
	RPT-3	Require Project Contributions to Transportation Infrastructure Improvement Projects		RPT-2, TST-1 to 6	NA	
	RPT-4	Install Park-and-Ride Lots		RPT-1, TRT-11, TRT-3, TST-1 to 6	NA	
Vehicles	VT-1	Electrify Loading Docks and/or Require Idling-Reduction Systems			26-71%	Truck Idling Time
	VT-2	Utilize Alternative Fueled Vehicles			Varies	
	VT-3	Utilize Electric or Hybrid Vehicles			0.4-20.3%	Fuel Use

Table 6-3: Water Category

Water						
Category	Measure Number	Strategy	BMP	Grouped With #	Range of Effectiveness	
					Percent Reduction in GHG Emissions	Basis
Water Supply	WSW-1	Use Reclaimed Water			up to 40% for Northern Californiaup to 81% for Southern California	Outdoor Water Use
	WSW-2	Use Gray Water			0-100%	Outdoor Water Use
	WSW-3	Use Locally-Sourced Water Supply			0-60% for Northern and Central California; 11-75% for Southern California	Indoor and Outdoor Water Use
Water Use	WUW-1	Install Low-Flow Water Fixtures.			Residential: 20% Non-Residential: 17-31%	Indoor Water Use
	WUW-2	Adopt a Water Conservation Strategy.			varies	
	WUW-3	Design Water-Efficient Landscapes			0-70%	Outdoor Water Use
	WUW-4	Use Water-Efficient Landscape Irrigation Systems			6.1%	Outdoor Water Use
	WUW-5	Reduce Turf in Landscapes and Lawns			varies	
	WUW-6	Plant Native or Drought-Resistant Trees and Vegetation			BMP	

Table 6-4: Area Landscaping

Area Landscaping						
Category	Measure Number	Strategy	BMP	Grouped With #	Range of Effectiveness	
					Percent Reduction in GHG Emissions	Basis
Area Landscaping	A-1	Prohibit Gas Powered Landscape Equipment.			LADWP: 2.5-46.5% PG&E: 64.1-80.3% SCE: 49.5-72.0% SDGE: 38.5-66.3% SMUD: 56.3-76.0%	Fuel Use
	A-2	Implement Lawnmower Exchange Program			BMP	
	A-3	Electric Yard Equipment Compatibility		A-1 or A-2	BMP	

Table 6-5: Solid Waste Category

Solid Waste						
Category	Measure Number	Strategy	BMP	Grouped With #	Range of Effectiveness	
					Percent Reduction in GHG Emissions	Basis
Solid Waste	SW-1	Institute or Extend Recycling and Composting Services			BMP	
	SW-2	Recycle Demolished Construction Material			BMP	

Table 6-6: Vegetation Category

Vegetation						
Category	Measure Number	Strategy	BMP	Grouped With #	Range of Effectiveness	
					Percent Reduction in GHG Emissions	Basis
Vegetation	V-1	Urban Tree Planting		GP-4	varies	
	V-2	Create new vegetated open space.			varies	

Table 6-7: Construction Category

Construction						
Category	Measure Number	Strategy	BMP	Grouped With #	Range of Effectiveness	
					Percent Reduction in GHG Emissions	Basis
Construction	C-1	Use Alternative Fuels for Construction Equipment			0-22%	Fuel Use
	C-2	Use Electric and Hybrid Construction Equipment			2.5-80%	Fuel Use
	C-3	Limit Construction Equipment Idling beyond Regulation Requirements			varies	
	C-4	Institute a Heavy-Duty Off-Road Vehicle Plan		Any C	BMP	
	C-5	Implement a Vehicle Inventory Tracking System		Any C	BMP	

Table 6-8: Miscellaneous Category

Miscellaneous						
Category	Measure Number	Strategy	BMP	Grouped With #	Range of Effectiveness	
					Percent Reduction in GHG Emissions	Basis
Miscellaneous	Misc-1	Establish a Carbon Sequestration Project			varies	
	Misc-2	Establish Off-Site Mitigation			varies	
	Misc-3	Use Local and Sustainable Building Materials	x		BMP	
	Misc-4	Require Best Management Practices in Agriculture and Animal Operations	x		BMP	
	Misc-5	Require Environmentally Responsible Purchasing	x		BMP	
	Misc-6	Implement an Innovative Strategy for GHG Mitigation	x		BMP	

Table 6-9: General Plans

General Plan Strategies						
Category	Measure Number	Strategy	BMP	Grouped With #	Range of Effectiveness	
					Percent Reduction in GHG Emissions	Basis
General Plans	GP-1	Fund Incentives for Energy Efficiency	x		BMP	
	GP-2	Establish a Local Farmer's Market	x		BMP	
	GP-3	Establish Community Gardens	x		BMP	
	GP-4	Plant Urban Shade Trees	x	V-1	BMP	
	GP-5	Implement Strategies to Reduce Urban Heat-Island Effect	x		BMP	

Applicability of Quantification Fact Sheets Outside of California
In order to apply the quantification methods in this Report to projects located outside of California, the assumptions and methods in the baseline methodology and in the Fact Sheets should be reviewed prior to applying them. First, evaluate the basis for use metrics and emission factors for applicability outside of California. The Report references various sources for use metrics and emission factors; if these are California-specific, the method should be evaluated to determine if these same use metrics and emission factors are applicable to the project area. If they are not applicable, factors appropriate for the project area should be substituted in the baseline and project methods. Key factors to consider are climate zone[6], precipitation, building standards, end-user behavior, and transportation environment (land use and transportation characteristics). Use metrics likely to vary outside of California include:

- Building Energy Use
- Water Use
- Vehicle Trip Lengths and Vehicle Miles Traveled
- Building Standards
- Waste Disposal Rates
- Landscape Equipment Annual Usage

Emission factors relate the use metric to carbon intensity to estimate GHG emissions. Depending on the type of emission factor, these values may or may not change based on location. For instance, the emission factor for combustion of a specific amount of fuel does not typically change; however the engine mix may change by location, and fuel use by those engines may be different. Other emission factors are regionally dependent and alternative sources should be investigated. Emission factors likely to vary outside of California include:

- Electricity associated with water and wastewater supply and treatment
- Carbon intensity of electricity supplied
- Fleet and model year distribution of vehicles which influences emission factors

The user should be able to adjust the methodologies to: (1) calculate the baseline for a given mitigation measure; and then (2) incorporate the appropriate data and assumptions into the calculations for the emission mitigation associated with the measure.

There is at least one mitigation measure that will not be applicable outside of California unless adjustments are made by substituting location-specific factors in the baseline methodology: the improvement beyond Title 24 (BE-1) is not applicable outside of California since buildings outside California would be subject to different building codes. The project Applicant may be able to estimate a baseline energy use for building envelope systems under other building standards and estimate the change in energy use for improvements to building envelope systems using building energy software or literature surveys.

[6] Climate zones are specific geographic areas of similar climatic characteristics, including temperature, weather, and other factors which affect building energy use. The California Energy Commission identified 16 Forecasting Climate Zones (FCZs) within California.

How to Use a Fact Sheet to Quantify a Project

This section provides step-by-step instructions and an example regarding how a fact sheet can be used. After choosing the appropriate fact sheet(s), follow these general steps. Steps may need to be adjusted for different types of fact sheets.

Step 1: Does this fact sheet apply?
Carefully read the measure's description and applicability to ensure that you are using the correct fact sheet.

Step 2: Is the measure "grouped"?
Check Tables 6-1 to 6-9 to see if the measure is "grouped" with other measures. If it is, then all measures in the group must be implemented together.

Step 3: Review defaults
Review the default assumptions in the fact sheet.

Step 4: Data inputs
Determine the type of data and data sources necessary. Refer to Appendix B and other suggested documents.

Step 5: Calculate baseline emissions
Calculate baseline emissions using formulas provided in the fact sheet.

Step 6: Percent reductions
If applicable, calculate the percent reduction for the specific action in the measure.

Step 7: Quantify reductions
Quantify emission reductions for a particular mitigation measure using the provided formula.

Step 8: Grouped measures
If you are using a mitigation measure that is grouped with another measure, refer to Tables 6-1 to 6-9 and complete the calculations for all measures that are grouped together for a particular mitigation strategy.

Step 9: Multiple measures
See Chapter 6 for how to combine reductions from multiple measures.

IMPORTANT: Clearly document information such as data sources, data used, and calculations.

Example:

The following is an example calculation for a building project that will use Fact Sheet 2.1.1 - *Exceed Title 24 Building Envelope Energy Efficiency Standards by X%*. In this example, a large office building is being built, and it will be designed to do 10% more than Title 24 standards for both electricity and natural gas.

- **Step 1 – Does this fact sheet apply?**
  The project and fact sheet have been reviewed, and YES, this fact sheet is appropriate to use to estimate reductions from the project.

- **Step 2 - Is the measure "grouped"?**
  NO, this is a measure that does not have to be done with other measures.

- **Step 3 – Review defaults**
  Default assumptions and emission factors have been reviewed and used, as appropriate.

- **Steps 4 – Data inputs**
  The table below shows the data needed for the example, the sample data input, and the source of the sample data. Make sure the data use the units specified in the equation. *

Data for Fact Sheet 2.1.1 Example

Data Needed	Input	Source of Data
Project type	Commercial land use = Large Office	User Input
Size	100,000 sq. ft	User Input
Climate Zone	1	From Figure BE 1.1
Electricity $Intensity_{baseline}$	8.32 kWh/SF/yr	From Fact Sheet 2.1.1
Utility Provider	PG&E	User Input
Emission $Factor_{Electricity}$	2.08E-4 MT CO_2e/kWh	Fact Sheet 2.1.1
Natural Gas $Intensity_{baseline}$	18.16 kBTU/SF/yr	From Fact Sheet 2.1.1
Emission $Factor_{NaturalGas}$	5.32E-5 MT CO_2e/therm	From Fact Sheet 2.1.1
% Reduction Commitment	10% over 2008 Title 24 Standards	User Input

- **Step 5 – Calculate baseline emissions**
  Once all necessary information has been obtained, use the equation provided to determine the baseline emissions. Round results to the nearest MT.

⇨ GHG Emissions $Baseline_{Electicity}$ = Electricity $Intensity_{Baseline}$ x Size x Emission $Factor_{Electricity}$

= 8.32 kWh/SF/yr x 100,000 SF x (2.08E-4 MT CO_2e/kWh)
= **173 MT CO_2e/yr [Baseline GHG Emissions for Electricity]**

⇨ GHG Emissions $Baseline_{Natural\ Gas}$ = Natural Gas $Intensity_{Baseline}$ x Size x Emission $Factor_{NaturalGas}$

= 18.16 kBTU/SF/yr x 100,000 SF x (5.32E-5 MT CO_2e/kBTU)
= **97 MT CO_2e/yr [Baseline GHG Emissions for Natural Gas]**

⇨ GHG $Emissions_{Baseline}$ = GHG Emissions $Baseline_{Electricity}$ + GHG Emissions $Baseline_{Natural\ Gas}$

= 173 MT CO_2e/yr + 97 MT CO_2e/yr
= 270 MT CO_2e/yr

- **Step 6 – Percent reductions**

Now calculate the percent GHG emission reduction based on the stated improvement goal. In this example the goal is a 10% reduction over Title 24 Energy Efficiency Standards. See Table BE-1.1 for data used for this step.

- $\text{Reduction}_{\text{Electricity}}$ from 1% over 2008 Title 24 Standards = 0.20%
  $\text{Reduction}_{\text{NaturalGas}}$ from 1% over 2008 Title 24 Standards = 1.00%

From Table BE-1.1

- Multiply the Percent Factor from Table BE-1.1 by the Percent Reduction Commitment (10% for this example)

Reduction in GHG emissions from electricity generation:

= 0.20% x 10
= 2%

Reduction Percentage X 10% goal

Reduction in GHG emissions from natural gas combustion:

= 1% x 10
= 10%

Reduction Percentage X 10% goal

- **Step 7 – Quantify reductions**
  Using the percent reductions, the emission reductions can be calculated, as shown below.

- Total Building GHG emissions = GHG Emissions $\text{Baseline}_{\text{Electricity.}}$ x ($\text{Reduction}_{\text{Electricity}}$)
  + GHG Emissions $\text{Baseline}_{\text{NaturalGas}}$ x ($\text{Reduction}_{\text{NaturalGas}}$)

= 173 MT CO_2e/yr x $(\frac{100\%-2\%}{100})$ + 97 MT CO_2e/yr x $(\frac{100\%-10\%}{100})$
= **257 MT CO_2e/yr**

Net reductions are the difference between the baseline emissions and the emissions calculated above for what will occur with this strategy implemented.

- Net reductions = Baseline – Total Building GHG Emissions

= 270 MT CO_2e/yr - 257 MT CO_2e/yr
= **13 MT CO_2e/yr**

This shows that a 10% improvement in energy consumption over 2008 Title 24 Standards from electricity and natural gas will result in a GHG reduction of 13 MT CO_2e/yr.

- **Step 8 – Grouped measures**
  In this example, the measure is not grouped. For grouped measures, refer to Tables 6-1 to 6-9 in Chapter 6 for how to combine reductions.

- **Step 9 – Multiple measures**
  See “Rules for Combining Strategies or Measures” section in Chapter 6 for how to add reductions from multiple measures

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1.0 Introduction

Chapter 7 is made up of a series of Fact Sheets. Each sheet summarizes the quantification methodology for a specific mitigation measure. As described in Chapter 6, the measures are grouped into Categories, and, in some cases, into subcategories. For information about the development of the Fact Sheets, please see Chapter 4. For a discussion of specific quantification issues in select measure categories or subcategories, please refer to Chapter 5. Chapter 6 provides a detailed explanation of the organization and layout of the Fact Sheets, including rules that govern the quantification of measures that have been, or will be, implemented in combination.

In order to facilitate navigation through, and the use of, the Fact Sheets, they have been color coded to reflect the Category the measure is in, and if applicable, the subcategory. The color scheme is shown in Charts 6-1 and 6-2, and also in Table 7-1 (below).

The colored bar at the top of each Fact Sheet corresponds to the Category color as shown in Charts 6-1 and 6-2, and in Table 7-1; the Category name is shown in the colored bar at the left hand margin. The second colored bar, immediately below the first one, shows the name of the subcategory, if any, and corresponds to subcategory color in those charts and tables. The subcategory name appears at the right hand margin.

At the left hand margin, below the Category name, is a cross-reference to the corresponding measure in the previous two CAPCOA reports (*CEQA and GHG*; and *Model Polices for GHG in General Plans*). The term “MP#” refers to a measure in the Model Policies document. The term CEQA# refers to a measure in the CEQA and GHG report.

At the bottom of the page is a colored bar that corresponds to the Category, and, where applicable, there is a colored box at the right hand margin, contiguous with the colored bar. This color of the box corresponds to the subcategory, where applicable. The box contains the measure number.

The layout of information in each Fact Sheet is covered in detail in Chapter 6.

Table 7-1, below, provides an index and cross-reference for the measure Fact Sheets. It is color-coded, as explained above, and may be used as a key to more quickly and easily navigate through the Fact Sheets

Table 7-1: Measure Index & Cross Reference

Section	Category	Page #	Measure #	BMP	MP #	CEQA #
3.4	Commute Trip Reduction Programs	218				
3.4.1	Implement Commute Trip Reduction Program - Voluntary	218	TRT-1		-	-
3.4.2	Implement Commute Trip Reduction Program – Required Implementation/Monitoring	223	TRT-2		MO-3.1	T-19
3.4.3	Provide Ride-Sharing Programs	227	TRT-3		MO-3.1	-
3.4.4	Implement Subsidized or Discounted Transit Program	230	TRT-4		MO-3.1	-
3.4.5	Provide End of Trip Facilities	234	TRT-5		MO-3.2	TRT-1, TRT-2, TRT-3
3.4.6	Encourage Telecommuting and Alternative Work Schedules	236	TRT-6		TR-3.5	-
3.4.7	Implement Commute Trip Reduction Marketing	240	TRT-7		-	-
3.4.8	Implement Preferential Parking Permit Program	244	TRT-8		TR-3.1	TRT-1, TRT-2, TRT-3
3.4.9	Implement Car-Sharing Program	245	TRT-9		-	-
3.4.10	Implement a School Pool Program	250	TRT-10		-	-
3.4.11	Provide Employer-Sponsored Vanpool/Shuttle	253	TRT-11		MO-3.1	-
3.4.12	Implement Bike-Sharing Programs	256	TRT-12		-	SDT-5, LUT-9
3.4.13	Implement School Bus Program	258	TRT-13		TR-3.4	-
3.4.14	Price Workplace Parking	261	TRT-14		-	-
3.4.15	Implement Employee Parking “Cash-Out”	266	TRT-15		TR-5.3	MM T-9
3.5	Transit System Improvements	270				
3.5.1	Provide a Bus Rapid Transit System	270	TST-1		-	MS-G3
3.5.2	Implement Transit Access Improvements	275	TST-2		LU-3.4.3	TST-3, TST-4
3.5.3	Expand Transit Network	276	TST-3		-	MS-G3
3.5.4	Increase Transit Service Frequency/Speed	280	TST-4		-	MS-G3
3.5.5	Provide Bike Parking Near Transit	285	TST-5		TR-4.1.4	TST-3, TST-4
3.5.6	Provide Local Shuttles	286	TST-6			TST-3, TST-4
3.6	Road Pricing/Management	287				
3.6.1	Implement Area or Cordon Pricing	287	RPT-1		TR-3.6	-
3.6.2	Improve Traffic Flow	291	RPT-2		TR-2.1, TR-2.2	-
3.6.3	Required Project Contributions to Transportation Infrastructure Improvement Projects	297	RPT-3		-	RPT-2, TST-1 to 6
3.6.4	Install Park-and-Ride Lots	298	RPT-4		TR-1	RPT-1, TRT-11, TRT-3, TST-1 to 6
3.7	Vehicles	300				
3.7.1	Electrify Loading Docks and/or Require Idling-Reduction Systems	300	VT-1		TR-6	-
3.7.2	Utilize Alternative Fueled Vehicles	304	VT-2		-	MM T-21
3.7.3	Utilize Electric or Hybrid Vehicles	309	VT-3		-	MM T-20
4.0	**Water**	**332**				
4.1	Water Supply	332				
4.1.1	Use Reclaimed Water	332	WSW-1		COS-1.3	MS-G-8
4.1.2	Use Gray Water	336	WSW-2		COS-2.3	-
4.1.3	Use Locally Sourced Water Supply	341	WSW-3		-	-
4.2	Water Use	347				
4.2.1	Install Low-Flow Water Fixtures	347	WUW-1		EE-2.1.6; COS 2.2	MM-E23
4.2.2	Adopt a Water Conservation Strategy	362	WUW-2		COS-1.	MS-G-8
4.2.3	Design Water-Efficient Landscapes	365	WUW-3		COS-2.1	-
4.2.4	Use Water-Efficient Landscape Irrigation Systems	372	WUW-4		COS-3.1	MS-G-8
4.2.5	Reduce Turf in Landscapes and Lawns	376	WUW-5		-	-
4.2.6	Plant Native or Drought-Resistant Trees and Vegetation	381	WUW-6	x	COS-3.1	MM D-16

Section		Category	Page #	Measure #	BMP	MP #	CEQA #
5.0		**Area Landscaping**	**384**				
5.1		Landscaping Equipment	384				
	5.1.1	Prohibit Gas Powered Landscape Equipment.	384	A-1		-	-
	5.1.2	Implement Lawnmower Exchange Program	389	A-2	x	EE-4.2	MM D-13
	5.1.3	Electric Yard Equipment Compatibility	391	A-3	x	MO-2.4	A-1 or A-2; MM D-14
6.0		**Solid Waste**	**392**				
6.1		Solid Waste	392				
	6.1.1	Institute or Extend Recycling and Composting Services	401	SW-1	x	WRD-2	MM D-14
	6.1.2	Recycle Demolished Construction Material	402	SW-2	x	WRD-2.3	MM C-4
7.0		**Vegetation**	**402**				
7.1		Vegetation	402				
	7.1.1	Urban Tree Planting	402	V-1		COS-3.3, COS 3.2	GP-4, MM T-14
	7.1.2	Create New Vegetated Open Space	406	V-2		COS-4.1	-
8.0		**Construction**	**410**				
8.1		Construction	410				
	8.1.1	Use Alternative Fuels for Construction Equipment	410	C-1		TR-6, EE-1	MM C-2
	8.1.2	Use Electric and Hybrid Construction Equipment	420	C-2		TR-6, EE-1	-
	8.1.3	Limit Construction Equipment Idling beyond Regulation Requirements	428	C-3		TR-6.2	-
	8.1.4	Institute a Heavy-Duty Off-Road Vehicle Plan	431	C-4	x	TR-6.2, EE-1	Any C
	8.1.5	Implement a Construction Vehicle Inventory Tracking System	432	C-5	x	-	-
9.0		**Miscellaneous**	**433**				
9.1		Miscellaneous	433				
	9.1.1	Establish a Carbon Sequestration Project	433	Misc-1		LU-5	-
	9.1.2	Establish Off-Site Mitigation	435	Misc-2		-	-
	9.1.3	Use Local and Sustainable Building Materials	437	Misc-3	x	EE-1	MM C-3, E-17
	9.1.4	Require Best Management Practices in Agriculture and Animal Operations	439	Misc-4	x	-	-
	9.1.5	Require Environmentally Responsible Purchasing	440	Misc-5	x	MO-6.1	-
	9.1.6	Implement an Innovative Strategy for GHG Mitigation	442	Misc-6	x	-	-
10.0		**General Plans**	**444**				
10.1		General Plans	444				
	10.1.1	Fund Incentives for Energy Efficiency	444	GP-1	x	-	-
	10.1.2	Establish a Local Farmer's Market	446	GP-2	x	LU-2.1.4	MM D-18
	10.1.3	Establish Community Gardens	448	GP-3	x	LU-2.1.4	MM D-19
	10.1.4	Plant Urban Shade Trees	450	GP-4	x	COS-3.2	V-1, MM T-14
	10.1.5	Implement Strategies to Reduce Urban Heat-Island Effect	455	GP-5	x	LU-6.1	MM E-8, E-12

2.0 Energy

2.1 Building Energy Use

To determine overall reductions, the ratio of building energy associated GHG emissions to the other project categories needs to be determined. This percent contribution to the total is multiplied by the percentage reduction.

2.1.1 Buildings Exceed Title 24 Building Envelope Energy Efficiency Standards By X%[1]

(X is equal to the percentage improvement selected by Applicant such as 5%, 10%, or 20%)

Range of Effectiveness:

For a 10% improvement beyond Title 24 the range of effectiveness is:

	Electricity	Natural Gas
Non-residential	0.2 – 5.5%	0.7 – 10%
Residential	0.3 – 2.6%	7.5 – 9.1%

This is dependent on building type and climate zones.

Measure Description:

Greenhouse gases (GHGs) are emitted as a result of activities in residential and commercial buildings when electricity and natural gas are used as energy sources. New California buildings must be designed to meet the building energy efficiency standards of Title 24, also known as the California Building Standards Code. Title 24 Part 6 regulates energy uses including space heating and cooling, hot water heating, and ventilation[2]. By committing to a percent improvement over Title 24, a development reduces its energy use and resulting GHG emissions.

[1] Compliance with Title 24 is determined from the total daily valuation (TDV) of energy use in the built-environment (on a per square foot per year basis). TDV energy use is a parameter that reflects the burden that a building imposes on an electricity supply system. In general, there is a larger electricity demand and, hence, stress on the supply system during the day (peak times) than at night (off peak). Since a TDV analysis requires significant knowledge about the actual building which is not typically available during the CEQA process, the estimate of the energy and GHG savings from an improvement over Title 24 energy use from a TDV basis is proportional to the actual energy use.

[2] Hardwired lighting is part of Title 24 part 6. However, it is not part of the building envelope energy use and therefore not considered as part of this mitigation measure.

The energy use of a building is dependent on the building type, size and climate zone it is located in.

The *California Commercial Energy Use Survey* (CEUS) and *Residential Appliance Saturation Survey* (RASS) datasets can be used for these calculations since the data is scalable size and available for several land use categories in different climate zones in California.

The Title 24 standards have been updated twice (in 2005 and 2008) since some of these data were compiled. The California Energy Commission (CEC) has published reports estimating the percentage deductions in energy use resulting from these new standards. Based on CEC's discussion on average savings for Title 24 improvements, these CEC savings percentages by end user can be used to account for reductions in electricity and natural gas use due to updates to Title 24. Since energy use for each different system type (i.e., heating, cooling, water heating, and ventilation) as well as appliances is defined, this method will also easily allow for application of mitigation measures aimed at reducing the energy use of these devices in a prescriptive manner.

Measure Applicability:

- Electricity and natural gas use in residential and commercial buildings subject to California's Title 24 building requirements.
- This measure is part of a grouped measure. To ensure the measure effectiveness, this measure also requires third-party HVAC commissioning and verification of energy savings such as including the results from an alternative compliance model indicating the energy savings.

Inputs:

The following information needs to be provided by the Project Applicant:

- Square footage of non-residential buildings
- Number of dwelling units
- Building/Housing Type
- Climate Zone[3]
- Total electricity demand (KWh) per dwelling unit or per square feet
- % reduction commitment (over 2008 Title 24 standards)

Baseline Method:

The baseline GHG emissions from electricity and natural gas usage (reflecting 2008 Title 24 standards with no energy-efficient appliances) are calculated as follows:

---

[3] See Figure BE-1.1.

$$\text{GHG Emissions Baseline}_{Electricity} = \text{Electricity Intensity}_{baseline} \times \text{Size} \times \text{Emission Factor}_{Electricity}$$

$$\text{GHG Emissions Baseline}_{NaturalGas} = \text{Natural Gas Intensity}_{baseline} \times \text{Size} \times \text{Emission Factor}_{NaturalGas}$$

Where:

Electricity Intensity$_{baseline}$ = Total electricity demand (kWh) per dwelling unit or per square foot; provided by applicant and adjusted for 2008 Title 24 standards (calculated based on CEUS and RASS)[4]

Natural Gas Intensity$_{baseline}$ = Total natural gas demand (kBTU or therms) per dwelling unit or per square foot; provided by applicant and adjusted for 2008 Title 24 standards (calculated based on CEUS and RASS)[5]

Emission Factor$_{Electricity}$ = Carbon intensity of local utility (CO_2e/kWh)[6]

Emission Factor$_{NaturalGas}$ = Carbon intensity of natural gas use (CO_2e/kBTU or CO_2e/therm)[7]

Size = Number of dwelling units or square footage of commercial land uses

Mitigation Method:

$$\text{GHG reduction \%}_{Mitigated\_Electricity} = \text{Reduction}_{Electricity} \times \text{Reduction Commitment}$$

$$\text{GHG reduction \%}_{Mitigated\_NaturalGas} = \text{Reduction}_{NaturalGas} \times \text{Reduction Commitment}$$

Where:

Reduction = Applicable reduction based on climate zone, building type, and energy type from Tables BE-1.1 and BE-1.2

Reduction Commitment = Project’s reduction commitment beyond 2008 Title 24 standards (expressed as a whole number)

This should be done for each individual building type. If the project involves multiple building types or only a percentage of buildings will have reductions the total for all buildings needs to be determined. This percentage should be applied as follows and summed over all buildings types:

---

4 See Appendix B for baseline inventory calculation methodologies to assist in determining these values.
5 See Appendix B for baseline inventory calculation methodologies to assist in determining these values.
6 Ibid.
7 Ibid.

$$\sum_i (Reduction \times Commitment)\left(\frac{buildingGHG_i}{TotalGHG_i}\right)(\%BuildingType)$$

$buildingGHG_i$	=	GHG emissions for specific building type for either electricity or natural gas
$TotalGHG_i$	=	Total GHG emissions for all buildings for either electricity or natural gas
i	=	electricity or natural gas
$\%BuildingType$	=	portion of building(s) of this type

Tables BE-1.1 and BE-1.2 tabulate the percent reductions from building energy use for each land use type in the various climate zones in California. There is one table for residential land uses and another for non-residential land uses. There is a column for electricity reductions and another for natural gas reductions.

Assumptions:

See Figure BE-1.1 below for a map showing the 16 Climate Zones. Data for some Climate Zones is not presented in the CEUS and RASS studies. However, data from similar Climate Zones is representative and can be used as follows:

For non-residential building types:

Climate Zone 9 should be used for Climate Zone 11.
Climate Zone 9 should be used for Climate Zone 12.
Climate Zone 1 should be used for Climate Zone 14.
Climate Zone 10 should be used for Climate Zone 15.

For residential building types:

Climate Zone 2 should be used for Climate Zone 6.
Climate Zone 1 should be used for Climate Zone 14.
Climate Zone 10 should be used for Climate Zone 15.

Data based upon the following references:

- CEC. 2009. Residential Compliance Manual for California's 2008 Energy Efficiency Standards. Available online at: http://www.energy.ca.gov/title24/2008standards/residential_manual.html
- CEC. 2009. Nonresidential Compliance Manual for California's 2008 Energy Efficiency Standards. Available online at: http://www.energy.ca.gov/title24/2008standards/nonresidential_manual.html
- CEC. 2004. Residential Appliance Saturation Survey. Available online at: http://www.energy.ca.gov/appliances/rass/

- CEC. 2006. Commercial End-Use Survey. Available online at: http://www.energy.ca.gov/ceus/

Emission Reduction Ranges and Variables:

[Refer to Attached Tables BE-1.1 and BE-1.2 for climate zone and land use specific percentages]

This information uses 2008 Title 24 information. To adjust to 2005 Title 24, see Table BE-1.3.

Pollutant	Category Emissions Reductions
CO_2e	See Tables BE-1.1 and BE-1.2 for percentage reductions for every 1% improvement over 2008 Title 24.
PM	See Tables BE-1.1 and BE-1.2 for percentage reduction from natural gas. There is no reduction for electricity.
CO	See Tables BE-1.1 and BE-1.2 for percentage reduction from natural gas. There is no reduction for electricity.
SO_2	See Tables BE-1.1 and BE-1.2 for percentage reduction from natural gas. There is no reduction for electricity.
NOx	See Tables BE-1.1 and BE-1.2 for percentage reduction from natural gas. There is no reduction for electricity.

Discussion:

If the applicant selects to commit beyond requirements for 2008 Title 24 standards, the applicant would reduce the amount of GHG emissions associated with electricity generation and natural gas combustion.

Example:

Commercial land use = Large Office

Square footage = 100,000 sq. ft.

Climate Zone = 1

Utility Provider = PG&E

% Reduction Commitment = 10% over 2008 Title 24 Standards

$\text{Electricity Intensity}_{\text{baseline}}$ = 8.32 kWh/SF/yr (adjusted to reflect 2008 Title 24 standards)

$\text{Emission Factor}_{\text{Electricity}}$ = 2.08E-4 MT CO_2e/kWh

Electricity $Emissions_{baseline}$ = 8.32 kWh/SF/yr x 100,000 SF x (2.08E-4 MT CO_2e/kWh)
= 173 MT CO_2e/yr

Natural Gas $Intensity_{baseline}$ = 18.16 kBTU/SF/yr (adjusted to reflect 2008 Title 24 standards)

Emission $Factor_{NaturalGas}$ = 5.32E-5 MT CO_2e/therm

Natural Gas $Emissions_{baseline}$= 18.16 kBTU/SF/yr x 100,000 SF x (5.32E-5 MT CO_2e/kBTU)
= 97 MT CO_2e/yr

GHG $emissions_{baseline}$ = 173 MT CO_2e/yr + 97 MT CO_2e/yr
= 270 MT CO_2e/yr

From Table BE-1.1:

$Reduction_{Electricity}$ from 1% over 2008 Title 24 Standards = 0.20%
$Reduction_{NaturalGas}$ from 1% over 2008 Title 24 Standards = 1.00%

Reduction in GHG emissions from electricity generation: 0.20% x 10 = 2%
Reduction in GHG emissions from natural gas combustion: 1% x 10 = 10%
Mitigated Building GHG emissions = 173 MT CO_2e/yr x (100% - 2%) + 97 MT CO_2e/yr x (100% - 10%) = 257 CO_2e/yr

Preferred Literature:

GHG reductions from a percent improvement over Title 24 can be quantified by calculating baseline energy usage using methodologies based on the California Energy Commission (CEC)'s Residential Appliance Saturation Survey (RASS) and Commercial End-Use Survey (CEUS), or an applicable Alternative Calculation Method (ACM). RASS and CEUS data are based on CEC Forecasting Climate Zones (FCZs); therefore, differences in project energy usage due to different climates are accounted for. The percent improvement is applied to Title 24 built environment energy uses, and overall GHG emissions are calculated using local utility emission factors. This methodology allows the Project Applicant flexibility in choosing which specific measures it will pursue to achieve the percent reductions (for example, installing higher quality building insulation, or installing a more efficient water heating system), while still making the mitigation commitment at the time of California Environmental Quality Act (CEQA) analysis.

Alternative Literature:

Alternatively, a Project Applicant could use the "prescriptive package" approach to demonstrate compliance with Title 24. Using this approach, the Project Applicant would commit to specific design elements above Title 24 prescriptive package requirements at the time of CEQA analysis, such as using solar water heating or improved insulation. Rather than calculating an overall percent reduction in GHG emissions based on an overall baseline value as presented above, the prescriptive approach requires the Project Applicant to break down building energy use by end-use. The Project Applicant would need to provide substantial evidence supporting the GHG reductions attributable to mitigation measures for each end-use. There are several references for quantifying GHG reductions from prescriptive measures. One example of a prescriptive measure is installing tankless or on-demand water heaters. These systems use a gas burner or electric element to heat water as needed and therefore do not use energy to store heated water. According to the U.S. Department of Energy (USDOE), typical tankless water heaters can be 24-34% more energy efficient than conventional storage tank water heaters [1]. Another example of a prescriptive measure is installing geothermal (ground-source or water-source) heat pumps. This measure takes advantage of the fact that the temperature beneath the ground surface is relatively constant. Fluid circulating through underground pipe loops is either heated or cooled and the heat is either upgraded or reduced in the heat pump depending on whether the building requires heating or cooling [2]. United States Environmental Protection Agency (USEPA) reports that ENERGY STAR - qualified geothermal heat pump systems are 30-45% more efficient than conventional heat pumps [3].

Alternative Literature References:

[1] USDOE. Energy Savers: Demand (Tankless or Instantaneous) Water Heaters. Accessed February 2010. Available online at: http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=12820

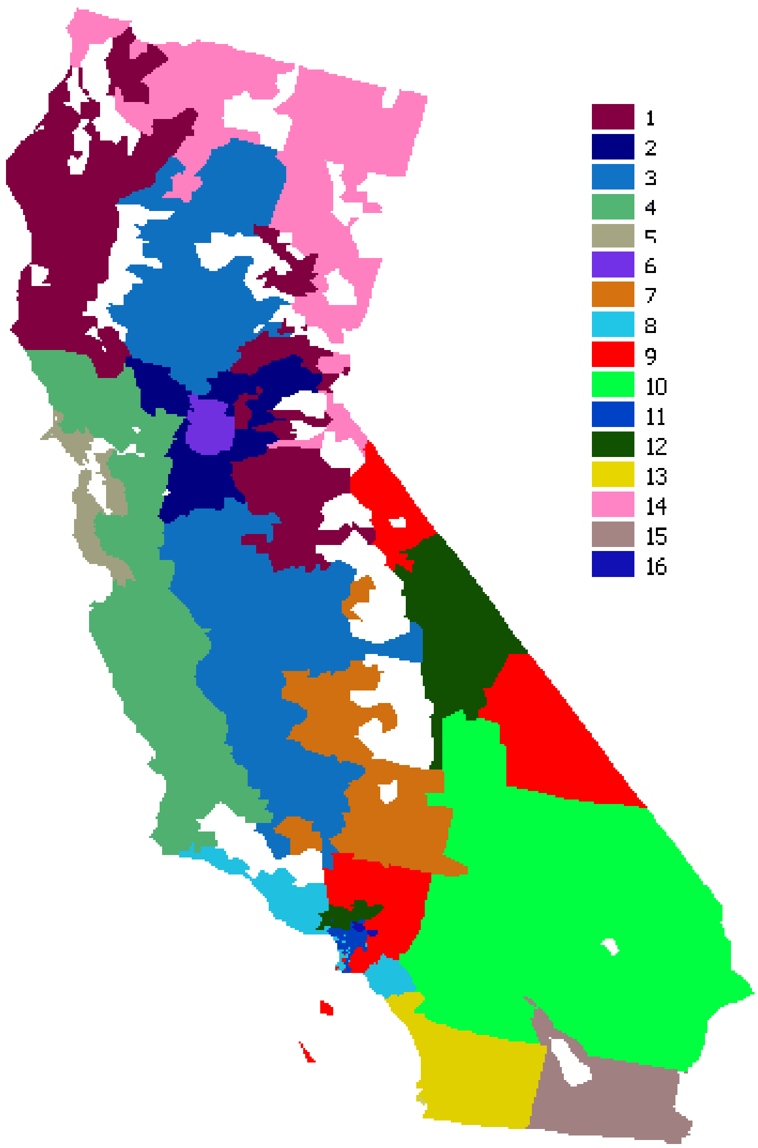
[2] CEC. Consumer Energy Center: Geothermal or Ground Source Heat Pumps. Accessed February 2010. Available online at: http://www.consumerenergycenter.org/home/heating_cooling/geothermal.html

[3] USEPA. ENERGY STAR: Heat Pumps, Geothermal. Accessed February 2010. Available online at: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=HP

Other Literature Reviewed:

None

Figure BE-1.1
CEC Forecast Climate Zones[8,9]



[8] Adapted from Figure 2 of CEC. 2004. Residential Appliance Saturation Survey. Available online at: http://www.energy.ca.gov/appliances/rass/
[9] White spaces represent national parks and forests.

Table BE-1.1
Non-Residential
Reduction for 1% Improvement over 2008 Title 24

Climate Zone	Building Types	Reduction	
		Electricity	Natural Gas
1	All Commercial	0.22%	0.76%
	All Office	0.36%	1.00%
	All Warehouses	0.02%	0.00%
	College	0.28%	1.00%
	Grocery	0.08%	0.96%
	Health	0.33%	1.00%
	Large Office	0.20%	1.00%
	Lodging	0.30%	1.00%
	Miscellaneous	0.16%	0.91%
	Refrigerated Warehouse	0.02%	0.00%
	Restaurant	0.19%	0.25%
	Retail	0.40%	1.00%
	School	0.26%	0.94%
	Small Office	0.37%	1.00%
	Unrefrigerated Warehouse	0.00%	0.00%
2	All Commercial	0.24%	0.86%
	All Office	0.35%	0.97%
	All Warehouses	0.07%	1.00%
	College	0.45%	1.00%
	Grocery	0.17%	1.00%
	Health	0.35%	0.72%
	Large Office	0.31%	1.00%
	Lodging	0.30%	0.99%
	Miscellaneous	0.22%	1.00%
	Refrigerated Warehouse	0.02%	1.00%
	Restaurant	0.22%	0.38%
	Retail	0.36%	0.97%
	School	0.36%	0.96%
	Small Office	0.38%	0.96%
	Unrefrigerated Warehouse	0.12%	1.00%
3	All Commercial	0.26%	0.66%
	All Office	0.32%	0.98%
	All Warehouses	0.03%	0.95%
	College	0.28%	0.94%
	Grocery	0.14%	0.53%
	Health	0.43%	0.82%
	Large Office	0.34%	0.97%
	Lodging	0.55%	0.73%

Climate Zone	Building Types	Reduction	
		Electricity	Natural Gas
	Miscellaneous	0.25%	0.82%
	Refrigerated Warehouse	0.02%	1.00%
	Restaurant	0.26%	0.18%
	Retail	0.29%	0.81%
	School	0.33%	0.93%
	Small Office	0.30%	1.00%
	Unrefrigerated Warehouse	0.13%	0.94%
4	All Commercial	0.27%	0.71%
	All Office	0.38%	1.00%
	All Warehouses	0.06%	0.77%
	College	0.37%	0.87%
	Grocery	0.12%	0.75%
	Health	0.45%	0.85%
	Large Office	0.41%	1.00%
	Lodging	0.30%	0.90%
	Miscellaneous	0.20%	0.76%
	Refrigerated Warehouse	0.02%	0.20%
	Restaurant	0.18%	0.30%
	Retail	0.29%	1.00%
	School	0.32%	0.95%
	Small Office	0.30%	1.00%
	Unrefrigerated Warehouse	0.10%	0.98%
5	All Commercial	0.26%	0.72%
	All Office	0.36%	0.95%
	All Warehouses	0.06%	0.46%
	College	0.44%	0.98%
	Grocery	0.09%	0.67%
	Health	0.40%	0.84%
	Large Office	0.37%	0.94%
	Lodging	0.29%	0.81%
	Miscellaneous	0.18%	0.73%
	Refrigerated Warehouse	0.04%	0.29%
	Restaurant	0.11%	0.25%
	Retail	0.24%	0.85%
	School	0.16%	0.91%
	Small Office	0.29%	1.00%
	Unrefrigerated Warehouse	0.07%	0.85%
6	All Commercial	0.31%	0.73%
	All Office	0.38%	0.95%
	All Warehouses	0.07%	0.86%
	College	0.43%	0.99%

Climate Zone	Building Types	Reduction	
		Electricity	Natural Gas
	Grocery	0.16%	0.64%
	Health	0.46%	0.86%
	Large Office	0.39%	0.94%
	Lodging	0.40%	0.86%
	Miscellaneous	0.25%	0.66%
	Refrigerated Warehouse	0.03%	0.58%
	Restaurant	0.24%	0.35%
	Retail	0.31%	0.83%
	School	0.31%	0.96%
	Small Office	0.34%	1.00%
	Unrefrigerated Warehouse	0.09%	1.00%
7	All Commercial	0.25%	0.88%
	All Office	0.32%	0.94%
	All Warehouses	0.02%	0.64%
	College	0.25%	0.99%
	Grocery	0.12%	0.90%
	Health	0.32%	0.93%
	Large Office	0.34%	1.00%
	Lodging	0.41%	0.94%
	Miscellaneous	0.18%	0.99%
	Refrigerated Warehouse	0.02%	0.64%
	Restaurant	0.27%	0.19%
	Retail	0.34%	0.99%
	School	0.29%	0.96%
	Small Office	0.31%	0.91%
	Unrefrigerated Warehouse	0.00%	0.00%
8	All Commercial	0.30%	0.62%
	All Office	0.37%	0.94%
	All Warehouses	0.12%	0.99%
	College	0.43%	0.67%
	Grocery	0.14%	0.50%
	Health	0.45%	0.85%
	Large Office	0.38%	0.94%
	Lodging	0.34%	0.86%
	Miscellaneous	0.22%	0.68%
	Refrigerated Warehouse	0.02%	0.93%
	Restaurant	0.27%	0.31%
	Retail	0.28%	0.49%
	School	0.33%	0.92%
	Small Office	0.33%	0.96%
	Unrefrigerated Warehouse	0.16%	0.99%

Climate Zone	Building Types	Reduction	
		Electricity	Natural Gas
9	All Commercial	0.28%	0.60%
	All Office	0.39%	0.96%
	All Warehouses	0.13%	0.95%
	College	0.33%	0.98%
	Grocery	0.14%	0.46%
	Health	0.44%	0.85%
	Large Office	0.43%	0.98%
	Lodging	0.37%	0.84%
	Miscellaneous	0.23%	0.76%
	Refrigerated Warehouse	0.03%	0.91%
	Restaurant	0.21%	0.19%
	Retail	0.32%	0.71%
	School	0.32%	0.90%
	Small Office	0.31%	0.94%
	Unrefrigerated Warehouse	0.18%	0.96%
10	All Commercial	0.30%	0.61%
	All Office	0.35%	1.00%
	All Warehouses	0.11%	0.58%
	College	0.27%	1.00%
	Grocery	0.19%	0.67%
	Health	0.46%	0.92%
	Large Office	0.34%	1.00%
	Lodging	0.39%	0.92%
	Miscellaneous	0.24%	0.49%
	Refrigerated Warehouse	0.03%	0.07%
	Restaurant	0.29%	0.29%
	Retail	0.36%	0.87%
	School	0.37%	0.80%
	Small Office	0.36%	1.00%
	Unrefrigerated Warehouse	0.15%	0.98%
13	All Commercial	0.29%	0.66%
	All Office	0.38%	0.80%
	All Warehouses	0.19%	0.95%
	College	0.33%	0.86%
	Grocery	0.11%	0.40%
	Health	0.39%	0.88%
	Large Office	0.41%	0.80%
	Lodging	0.40%	0.82%
	Miscellaneous	0.17%	0.39%

Climate Zone	Building Types	Reduction	
		Electricity	**Natural Gas**
	Refrigerated Warehouse	0.07%	1.00%
	Restaurant	0.24%	0.21%
	Retail	0.28%	0.53%
	School	0.31%	0.92%
	Small Office	0.32%	0.76%
	Unrefrigerated Warehouse	0.26%	0.93%

Table BE-1.2
Residential
Reduction for 1% Improvement over 2008 Title 24

Climate Zone	Housing	Reduction	
		Electricity	**Natural Gas**
1	Multi	0.24%	0.86%
	Single	0.17%	0.87%
	Townhome	0.22%	0.87%
2	Multi	0.15%	0.89%
	Single	0.14%	0.91%
	Townhome	0.11%	0.89%
3	Multi	0.23%	0.90%
	Single	0.18%	0.91%
	Townhome	0.16%	0.90%
4	Multi	0.12%	0.88%
	Single	0.09%	0.91%
	Townhome	0.09%	0.90%
5	Multi	0.09%	0.88%
	Single	0.04%	0.91%
	Townhome	0.05%	0.90%
7	Multi	0.25%	0.87%
	Single	0.16%	0.88%
	Townhome	0.18%	0.85%
8	Multi	0.09%	0.77%
	Single	0.07%	0.82%
	Townhome	0.07%	0.80%
9	Multi	0.08%	0.77%
	Single	0.11%	0.82%
	Townhome	0.09%	0.80%
10	Multi	0.26%	0.80%
	Single	0.18%	0.83%
	Townhome	0.22%	0.81%

11	Multi	0.05%	0.77%
	Single	0.05%	0.83%
	Townhome	0.03%	0.81%
12	Multi	0.15%	0.75%
	Single	0.15%	0.83%
	Townhome	0.13%	0.80%
13	Multi	0.09%	0.79%
	Single	0.06%	0.83%
	Townhome	0.05%	0.81%

2.1.2 Install Programmable Thermostat Timers

Range of Effectiveness:

Best Management Practice influences building energy use for heating and cooling.

Measure Description:

Programmable thermostat timers allow users to easily control when the HVAC system will heat or cool a certain space, thereby saving energy. Because most commercial buildings already have timed HVAC systems, this mitigation measure focuses on residential programmable thermostats.

The DOE reports [1] that residents can save around 10% on heating and cooling bills per year by lowering the thermostat by 10-15 degrees for eight hours[10]. This can be accomplished using an automatic timer or programmable thermostat, such that the heat is reduced while the residents are at work or otherwise out of the house. The energy savings from a programmable thermostat, however, depend on the user. Some users preset the thermostat to heat the house before they come home, thereby increasing energy usage, while others use it to avoid heating the house when they are not home or asleep. Because of the large variability in individual occupant behavior and because it is unclear whether programmable thermostats systematically reduce energy use, this measure cannot be reasonably quantified. This mitigation measure should be incorporated as a Best Management Practice to allow for educated occupants to have the most efficient means at controlling their heating and cooling energy use. In order to take quantitative credit for this mitigation measure, the Project Applicant would need to provide detailed and substantial evidence supporting a reduction in energy use and associated GHG emissions.

Measure Applicability:

- Electricity use in residential dwellings.
- Best Management Practice only.

Assumptions:

Data based upon the following references:

[1] USDOE. Energy Savers: Thermostats and Control Systems. Available online at: http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12720

[10] Such a large drop in thermostat temperatures may not be applicable in parts of California; more applicable may be the raising of the thermostat for airconditioned spaces.

Emission Reduction Ranges and Variables:

This is a best management practice and therefore at this time there is no quantifiable reduction. Check with local agencies for guidance on any allowed reductions associated with implementation of best management practices.

If substantial evidence was provided, the GHG reductions would equal the percent savings in total electricity or natural gas. The total reduction would be:

GHG reduction = (% thermostat reduce heat/cool energy use) x
(% end use heat/cool of total energy use)

Preferred Literature:

The DOE reports [1] that residents can save approximately 10% on heating and cooling bills per year by lowering the thermostat by 10-15 degrees for eight hours. This can be accomplished using an automatic timer or programmable thermostat, such that the heat is reduced while the residents are at work or otherwise out of the house. The energy savings from a programmable thermostat, however, depend on the user. Some users preset the thermostat to heat the house before they come home, thereby increasing energy usage, while others use it to avoid heating the house when they are not home or asleep.

Alternative Literature:

None

Other Literature Reviewed:

Pacific Northwest National Laboratory. 2007. GridWise Demonstration Project Fast Facts. Available online at: http://gridwise.pnl.gov/docs/pnnl_gridwiseoverview.pdf.

2.1.3 Obtain Third-party HVAC Commissioning and Verification of Energy Savings

Range of Effectiveness:

Not applicable on its own. This measure enhances effectiveness of BE-1.

Measure Description:

Ensuring the proper installation and construction of energy reduction features is essential to achieving high thermal efficiency in a house. In practice, HVAC systems commonly do not operate at the designed efficiency due to errors in installation or adjustments. A Project Applicant can obtain HVAC commissioning and third-party verification of energy savings in thermal efficiency components including HVAC systems, insulation, windows, and water heating.

This measure is required to be grouped with measure "Exceed Title 24 Energy Efficiency Standards by X% (BE-1).

Measure Applicability:

- This measure is part of a grouped measure. This measure also requires third-party HVAC commissioning and verification of energy savings.
- Buildings subject to California's Title 24 building requirements.

Preferred Literature:

While Title 24 requires that a home's ducts be tested for leaks whenever the central air conditioner or furnace is installed or replaced, a third-party verifier such as the California Home Energy Efficiency Rating Service (CHEERS) and ENERGY STAR Home Energy Rating Service (HERS) can ensure that ducts were properly sealed [1-3]. These certified raters can also verify other energy efficiency measures, such as HVAC controls, insulation performance, and the air-tightness of the building envelope. Furthermore, these raters can analyze a home and make climate-specific recommendations for further improving the home's energy efficiency. Since this mitigation measure ensures that the building envelope systems are properly installed and sealed, there is no quantifiable reduction for this measure. It is recommended as a Best Management Practice grouped with the Title 24 improvement mitigation measure.

Alternative Literature:

None

Literature References:

[1] California Home Energy Efficiency Rating Services. What is CHEERS? Available online at: http://www.cheers.org/Home/Overview/tabid/124/Default.aspx. Accessed March 2010.

[2] USEPA. ENERGY STAR: Features of ENERGY STAR Qualified New Homes. Available online at: http://www.energystar.gov/index.cfm?c=new_homes.nh_features. Accessed March 2010.

[3] USEPA. ENERGY STAR: Independent Inspection and Testing. Available online at: http://www.energystar.gov/ia/new_homes/features/HERSrater_062906.pdf. Accessed March 2010.

2.1.4 Install Energy Efficient Appliances

Range of Effectiveness:

Residential 2-4% GHG emissions from electricity use. Grocery Stores: 17-22% of GHG emissions from electricity use.

Measure Description:

Using energy-efficient appliances reduces a building's energy consumption as well as the associated GHG emissions from natural gas combustion and electricity production. To take credit for this mitigation measure, the Project Applicant (or contracted builder) would need to ensure that energy efficient appliances are installed. For residential dwellings, typical builder-supplied appliances include refrigerators and dishwashers. Clothes washers and ceiling fans would be applicable if the builder supplied them. For commercial land uses, energy-efficient refrigerators have been evaluated for grocery stores. See Mitigation Method section on how project applicant may quantify additional building types and appliances.

The energy use of a building is dependent on the building type, size and climate zone it is located in. The *California Commercial Energy Use Survey* (CEUS) and *Residential Appliance Saturation Survey* (RASS) datasets for this calculation since the data is scalable by size and available for several land use categories in different climate zones in California. Typical reductions for energy-efficient appliances can be found in the *Energy Star and Other Climate Protection Partnerships 2008 Annual Report* or subsequent Annual Reports. ENERGY STAR refrigerators, clothes washers, dishwashers, and ceiling fans use 15%, 25%, 40%, and 50% less electricity than standard appliances, respectively.

RASS does not specify a ceiling fan end-use; rather, electricity use from ceiling fans is accounted for in the Miscellaneous category which includes interior lighting, attic fans, and other miscellaneous plug-in loads. Since the electricity usage of ceiling fans alone is not specified, a value from the National Renewable Energy Laboratory (NREL) Building American Research Benchmark Definition (BARBD) is used. BARBD reports that the average energy use per ceiling fan is 84.1 kWh per year. In this mitigation measure, it is assumed that each multi-family, single-family, and townhome residence has one ceiling fan. The electricity savings shown here is based on installing an ENERGY STAR ceiling fan and does not account for an occupant's decreased use of cooling devices such as air conditioners. For ceiling fans, the 50% reduction was applied to 84.1 kWh of the electricity attributed to the Miscellaneous RASS category.

Measure Applicability:

- Electricity use in residential dwellings and commercial grocery stores.
- This mitigation measure applies only when appliance installation can be specified as part of the Project.

Inputs:

The following information needs to be provided by the Project Applicant:

- Number of dwelling units and/or size of grocery store
- Climate Zone
- Housing Type (if residential)
- Utility provider
- Total natural gas demand (kBTU or therms) per dwelling unit or per square foot
- Types of energy efficient appliances to be installed (refrigerator, dishwasher, or clothes washer for residential land uses and refrigerators for grocery stores)

Baseline Method:

$$\text{GHG emissions} = \text{Electricity Intensity}_{baseline} \times \text{Size} \times \text{Emission Factor}_{Electricity} + \text{Natural Gas Intensity}_{baseline} \times \text{Size} \times \text{Emission Factor}_{NaturalGas}$$

Where:

GHG emissions = MT CO_2e (reflecting 2008 Title 24 standards with no energy-efficient appliances)

Electricity Intensity$_{baseline}$ = Total electricity demand (kWh) per dwelling unit or per square foot; provided by applicant and adjusted for 2008 Title 24 standards[11]

Natural Gas Intensity$_{baseline}$ = Total natural gas demand (kBTU or therms) per dwelling unit or per square foot; provided by applicant and adjusted for 2008 Title 24 standards[12]

Emission Factor$_{Electricity}$ = Carbon intensity of local utility (CO2e/kWh)[13]

Emission Factor$_{NaturalGas}$ = Carbon intensity of natural gas use (CO_2e/kBTU or CO_2e/therm)[14]

Size = Number of dwelling units or square footage of commercial land uses

Mitigation Method:

$$\text{GHG emissions}_{mitigated} = \text{Electricity Emissions}_{baseline} \times (1\text{-(Sum of Reductions)}) +$$

[11] See Appendix B for baseline inventory calculation methodologies to assist in determining these values.
[12] Ibid
[13] Ibid.
[14] Ibid.

Natural Gas Emissions$_{baseline}$

Where:

Electricity Emissions$_{baseline}$	=	Emissions due to electricity generation, adjusted for 2008 Title 24 Standards (calculated based on CEUS and RASS)
Sum of Reductions	=	Applicable reduction based on energy efficient appliances installed (expressed as a decimal)
Natural Gas Emissions$_{baseline}$	=	Emissions due to natural gas combustion, adjusted for 2008 Title 24 Standards (calculated based on CEUS and RASS)
Building GHG reduction Percentage	=	[GHG emissions mitigated/GHG emissions baseline]

Tables BE-4.1 and BE-4.2 tabulate the percent reductions from installing specific ENERGY STAR appliances for each land use type in the various climate zones in California. There is one table for residential land uses and another for non-residential land uses. This will only result in reductions associated with electricity use and does not apply to natural gas since there are no major Energy Star appliances that use natural gas. The energy efficient heating, cooling, and water heating systems that may use natural gas are included in improvements over Title 24 (see measure BE-1).

For other building types and energy efficient appliances, the reductions similar to those in the tables can be quantified as follows:

Reduction = (Appliance End Use %) x (1 – efficiency)

Where:

Appliance End Use %	=	portion of energy for this appliance compared to total electricity use
Efficiency	=	percent reduction in energy use for efficient appliance compared to standard.

Assumptions:

Data for some Climate Zones is not presented in the CEUS and RASS studies. However, data from similar Climate Zones is representative and can be used as follows:

For non-residential building types:
Climate Zone 9 should be used for Climate Zone 11.
Climate Zone 9 should be used for Climate Zone 12.

Climate Zone 1 should be used for Climate Zone 14.
Climate Zone 10 should be used for Climate Zone 15.
For residential building types:
Climate Zone 2 should be used for Climate Zone 6.
Climate Zone 1 should be used for Climate Zone 14.
Climate Zone 10 should be used for Climate Zone 15.

Data based upon the following references:

[1] USEPA. 2008. ENERGY STAR 2008 Annual Report. Available online at: http://www.epa.gov/cpd/annualreports/annualreports.htm

[2] CEC. 2004. Residential Appliance Saturation Survey. Available online at: http://www.energy.ca.gov/appliances/rass/

[3] CEC. 2006. Commercial End-Use Survey. Available online at: http://www.energy.ca.gov/ceus/

[4] NREL. 2010. Building America Research Benchmark Definition. Available online at: http://www.nrel.gov/docs/fy10osti/47246.pdf

Emission Reduction Ranges and Variables:

[Refer to Attached Tables BE-4.1 and BE-4.2 for climate zone and land use specific percentages]

If more than one type of appliance is considered the percentage for each appliance should be added together.

Pollutant	Category Emissions Reductions
CO_2e	See Tables BE-4.1 and BE-4.2 for percentage reductions.
PM	Not Quantified[15]
CO	Not Quantified
SO_2	Not Quantified
NOx	Not Quantified

Discussion:

If the applicant commits to installing energy efficient appliances, the applicant would reduce the amount of GHG emissions associated with electricity generation because

[15] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

more energy efficient appliances will require less electricity to run. This reduces GHG emissions from power plants.

Example:

Housing Type = Single Family Home

Number of Dwelling Units = 100

Climate Zone = 1

Utility Provider = PG&E

Energy efficient appliances to be installed = refrigerator and dishwasher

Electricity $Intensity_{baseline}$	=	7,196 kWh/DU/yr (adjusted to reflect 2008 Title 24 standards)
Emission $Factor_{Electricity}$	=	2.08E-4 MT /kWh
Electricity $Emissions_{baseline}$	=	7,196 kWh/DU/yr x 100 DU x (2.08E-4 MT CO_2e/kWh)
	=	150 MT CO_2e/yr
Natural Gas $Intensity_{baseline}$	=	365 therms/DU/yr (adjusted to reflect 2008 Title 24 standards)
Emission $Factor_{NaturalGas}$	=	5.32E-3 MT CO_2e/kBTU
Natural Gas $Emissions_{baseline}$	=	365 therm/DU/yr x 100 DU x (5.32E-3 MT CO_2e/therm)
	=	194 MT CO_2e/yr
GHG $emissions_{baseline}$	=	150 MT CO_2e/yr + 194 MT CO_2e/yr
	=	344 MT CO_2e/yr

Sum of Reductions associated with electricity generation from Table BE-4.2 = 2.05%
Reductions associated with natural gas combustion = 0%

GHG $emissions_{mitigated}$ = 150*(1-.0205) + 194

= 341

Building GHG reduction = 1 - 341 / 344 = 0.9%

Preferred Literature:

The USEPA ENERGY STAR Program has identified energy efficient residential and consumer appliances including air conditioners, refrigerators, freezers, clothes washers, dishwashers, fryers, steamers, and vending machines. The ENERGY STAR Annual Report presents the average percent energy savings from using an ENERGY STAR-qualified appliance instead of a standard appliance. GHG emissions reductions are calculated based on local utility emission factors and the baseline appliance energy use derived from the CEC RASS and CEUS methodologies. RASS and CEUS data are climate-specific; therefore, differences in project energy usage due to different climates are accounted for.

Alternative Literature:

None

Other Literature Reviewed:

None

Table BE-4.1
Non-Residential
Reduction for ENERGY STAR Refrigerators in Grocery Stores

Climate Zone	Electricity Reduction
1	20%
2	17%
3	18%
4	21%
5	22%
6	19%
7	18%
8	19%
9	20%
10	18%
13	21%

Table BE-4.2
Residential
Reduction for ENERGY STAR Appliances

Climate Zone	Housing	Refrigerator[1,3]	Clothes Washer[1,3]	Dishwasher[1,3]	Ceiling Fan[2,3]
		Total Electricity Reduction			
1	Multi	2.59%	0.03%	0.10%	1.01%
	Single	1.72%	0.50%	0.12%	0.58%
	Townhome	2.28%	0.28%	0.11%	0.83%
2	Multi	2.86%	0.03%	0.11%	1.12%
	Single	1.79%	0.53%	0.13%	0.61%
	Townhome	2.61%	0.32%	0.13%	0.96%
3	Multi	2.62%	0.03%	0.10%	1.02%
	Single	1.69%	0.50%	0.12%	0.58%
	Townhome	2.44%	0.30%	0.12%	0.89%
4	Multi	2.97%	0.03%	0.12%	1.16%
	Single	1.90%	0.56%	0.14%	0.65%
	Townhome	2.64%	0.33%	0.13%	0.97%
5	Multi	3.07%	0.03%	0.12%	1.20%
	Single	1.99%	0.58%	0.14%	0.68%
	Townhome	2.78%	0.35%	0.14%	1.02%
7	Multi	2.54%	0.03%	0.10%	0.99%
	Single	1.74%	0.51%	0.12%	0.59%
	Townhome	2.39%	0.30%	0.12%	0.88%
8	Multi	3.08%	0.03%	0.12%	1.20%
	Single	1.94%	0.57%	0.14%	0.66%
	Townhome	2.71%	0.34%	0.14%	0.99%
9	Multi	3.13%	0.03%	0.12%	1.22%
	Single	1.85%	0.54%	0.13%	0.63%
	Townhome	2.65%	0.33%	0.13%	0.97%
10	Multi	2.52%	0.03%	0.10%	0.98%
	Single	1.71%	0.50%	0.12%	0.58%
	Townhome	2.27%	0.28%	0.11%	0.83%
11	Multi	3.21%	0.03%	0.13%	1.25%
	Single	1.97%	0.58%	0.14%	0.67%
	Townhome	2.83%	0.35%	0.14%	1.04%
12	Multi	2.89%	0.03%	0.11%	1.13%
	Single	1.76%	0.51%	0.13%	0.60%
	Townhome	2.53%	0.32%	0.13%	0.93%
13	Multi	3.09%	0.03%	0.12%	1.21%
	Single	1.95%	0.57%	0.14%	0.66%
	Townhome	2.76%	0.34%	0.14%	1.01%

Notes:

1. Percent reductions are based on the saturation values presented in RASS. The Project Applicant may use project-specific saturation values (i.e. if 100% of homes have clothes washers, then saturation = 1).

Notes:

2. CEC's RASS does not specify a ceiling fan end-use; rather, electricity use from ceiling fans is accounted for in the Miscellaneous category, which includes interior lighting, attic fans, and other miscellaneous plug-in loads. Since the electricity usage of ceiling fans alone is not specified, a value from NREL's BARBD was used. BARBD reports that the average energy use per ceiling fan is 84.1 kWh per year. In this table, it is assumed that each multi-family, single-family, and townhome residence has one ceiling fan. The electricity savings shown here is based on installing an ENERGY STAR ceiling fan and does not account for an occupant's decreased use of cooling devices such as air conditioners.

3. Total electricity reduction is based on installing ENERGY STAR appliances instead of standard appliances. ENERGY STAR refrigerators, clothes washers, dishwashers, and ceiling fans use 15%, 25%, 40%, and 50% less electricity than standard appliances, respectively. For ceiling fans, the 50% reduction was applied to 84.1 kWh of the electricity attributed to the Miscellaneous RASS category.

Abbreviations:

BARBD - Building America Research Benchmark Definition
CEC - California Energy Commission
NREL - National Renewable Energy Laboratory
RASS - Residential Appliance Saturation Survey
USEPA - United States Environmental Protection Agency

Sources:

CEC. 2004. Residential Appliance Saturation Survey. Available online at: http://www.energy.ca.gov/appliances/rass/

NREL. 2010. Building America Research Benchmark Definition. Available online at: http://www.nrel.gov/docs/fy10osti/47246.pdf

USEPA. 2008. ENERGY STAR 2008 Annual Report. Available online at: http://www.epa.gov/cpd/annualreports/annualreports.htm

2.1.5 Install Energy Efficient Boilers

Range of Effectiveness: 1.2-18.4% of boiler GHG emissions

Measure Description:

Boilers are used in many non-residential and multi-family housing buildings to provide space heating or steam or facility operations. Boilers combust natural gas to produce steam which can be used directly or as a method to heat a building space. Boilers represent 12% of installed building heating equipment for commercial and other buildings. Boiler efficiencies are regulated and commonly presented as annualized fuel utilization efficiency (AFUE), a ratio of the total useful heat delivered to the heat value from the annual amount of fuel consumed. Improving boiler efficiency decreases natural gas consumption for the same amount of energy output, thus reducing GHG emissions.

Only natural gas boilers are considered under this mitigation measure. The Project Applicant would only need to provide the annual natural gas consumptions to calculate the baseline emissions using heat content and carbon intensity factors from CCAR [3]. To determine the emission reduction, boiler efficiency is also needed, and should be obtainable from manufacturer specifications. The Consortium for Energy Efficiency (CEE) reports that the rate of high efficiency boilers (≥ 85%) has gone from 5-15% of sales in 2002 to 50%-60% of sales in 2007 [2]. The CEE study also noted that technical improvements can be made to existing boiler types to improve efficiency to 88%. Efficiency can be further enhanced to up to 98% using the condensing boiler.

A range of efficiencies from the CEE study has been presented for reference, but to take credit for this mitigation measure, the Project Applicant would also need to provide evidence from manufacturers supporting the higher efficiency from a retrofit or new boiler.

Measure Applicability:

- Natural Gas Boilers

Inputs:

The following information needs to be provided by the Project Applicant:

- Natural gas consumption of boiler
- Original or baseline efficiency of boiler
- Improved efficiency of boiler

Baseline Method:

$$\text{Emission} = \text{Consumption} \times HC \times EF \times C$$

Where:

Emission = MT CO_2e
Consumption = Natural gas consumption (ft^3)
HC = Natural gas heat content = 1,029 BTU/ft^3 (CCAR 2009)
EF = Natural gas carbon intensity factor = 0.1173 lbs CO_2e/kBTU (CCAR 2009)
C = Unit conversion factor
In this case, C = 4.54×10^{-7} kBTU x MT/BTU/lbs

Mitigation Method:

The GHG emission from a boiler with improved efficiency is:

$$\text{Mitigated GHG Emission} = \text{Consumption} \times \frac{E_O}{E_I} \times HC \times EF \times C$$

Where:

Emission = MT CO_2e
Consumption = Natural gas consumption (ft^3)
E_O = Original efficiency of boiler
E_I = Improved efficiency of boiler
HC = Natural gas heat content = 1,029 BTU/ft^3 (CCAR 2009)
EF = Natural gas carbon intensity factor = 0.1173 lbs CO_2e/kBTU (CCAR 2009)
C = Unit conversion factor

Emission Reduction Ranges and Variables:

Percentage of emissions reduction using a boiler with improved efficiency for all pollutants are the same and is calculated as follows:

$$\text{Reduction} = 1 - \frac{E_O}{E_I}$$

Where:

E_O = Original efficiency of boiler
E_I = Improved efficiency of boiler

Technology	Range of Efficiencies	Range of Emission Reduction
Atmospheric	80 – 84%	-
Fan assisted, non-condensing	85 – 88%	1.2% – 9.1%
Fan assisted, condensing	88 – 98%	4.5% – 18.4%

Discussion:

Boiler efficiency is included in product specification from manufacturer. ENERGY STAR boilers require minimum efficiency of 85%. The Consortium for Energy Efficiency (CEE) reports natural efficiency breakpoints of 85-88% for fan assisted, non-condensing commercial boilers, and 88-98% for fan assisted, condensing boilers.

Assumptions:

Data based upon the following references:

- California Climate Action Registry 2009. General Reporting Protocol, Version 3.1. Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf
- Energy Star. Boilers key Product Criteria. Available at: http://www.energystar.gov/index.cfm?c=boilers.pr_crit_boilers
- Science Applications International Corporation 2009. Prepared for California Climate Action Registry. Development of Issue Papers for GHG Reduction Project Types: Boiler Efficiency Projects. Available at: http://www.climateactionreserve.org/wp-content/uploads/2009/03/future-protocol-development_boiler-efficiency.pdf

Preferred Literature:

Boilers represent 12% of installed building heating equipment. Boiler efficiencies are regulated and commonly presented as annualized fuel utilization efficiency (AFUE), a ratio of the total useful heat delivered to the heat value from the annual amount of fuel consumed. The Climate Action Registry (CAR) Boiler Efficiency Projects estimated potential annual CO_2e emission reductions of 22,673,929 and 6,584,231 MT for commercial and residential boilers, respectively, from boiler efficiency improvement from 77% to 83% [1]. The Consortium for Energy Efficiency (CEE) reports that the rate of high efficiency boilers (≥ 85%) has gone from 5-15% of sales in 2002 to 50%-60% of sales in 2007 [2]. The CEE study also noted that technical improvements can be made to existing boiler types to improve efficiency to 88%. Efficiency can be further enhanced to up to 98% using the condensing boiler.

Only natural gas boilers are considered under this mitigation measure. The Project Applicant would only need to provide the annual natural gas consumptions to calculate the baseline emissions using heat content and carbon intensity factors from CCAR [3]. To determine the emission reduction, boiler efficiency is also needed, and should be obtainable from manufacturer specifications. A range of efficiencies from the CEE study has been presented for reference, but to take credit for this mitigation measure, the Project Applicant would also need to provide evidence from manufacturers supporting the higher efficiency from a retrofit or new boiler.

Alternative Literature:

None

Notes:

[1] Science Applications International Corporation 2009. Prepared for Climate Action Registry (CAR). Development of Issue Papers for GHG Reduction Project Types: Boiler Efficiency Projects. Available at: http://www.climateactionreserve.org/wp-content/uploads/2009/03/future-protocol-development_boiler-efficiency.pdf

[2] Consortium of Energy Efficiency (CEE) Winter Program Meeting 2008. Market Characterization of Commercial Gas Boilers.

[3] CCAR 2009. General Reporting Protocol, Version 3.1. Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

Other Literature Reviewed:

None

2.2 Lighting

2.2.1 Install Higher Efficacy Public Street and Area Lighting

Range of Effectiveness:

16-40% of outdoor lighting

Measure Description:

Lighting sources contribute to GHG emissions indirectly, via the production of the electricity that powers these lights. Public street and area lighting includes streetlights, pedestrian pathway lights, area lighting for parks and parking lots, and outdoor lighting around public buildings. Lighting design should consider the amount of light required for the area intended to be lit. Lumens are the measure of the amount of light perceived by the human eye. Different light fixtures have different efficacies or the amount of lumens produced per watt of power supplied. This is different than efficiency, and it is important that lighting improvements are based on maintaining the appropriate lumens per area when applying this measure. Installing more efficacious lamps will use less electricity while producing the same amount of light, and therefore reduces the associated indirect GHG emissions.

Measure Applicability:

- Public street and area lighting

Inputs:

The following information needs to be provided by the Project Applicant:

- Number of lighting heads (for baseline only)
- Power rating of public street and area lights
- Carbon intensity of local utility (for baseline only)

Baseline Method:

$$\text{GHG emissions} = \text{Heads} \times \text{Hours} \times \text{Days} \times \text{Power}_{baseline} \times \text{Utility}$$

Where:

GHG emissions	=	MT CO_2e/yr
Heads	=	Number of public street and area lighting heads. Provided by Applicant.
Hours	=	Hours of operation per day (12).
Days	=	Days of operation per year (365).
$Power_{baseline}$	=	Power rating of public street and area lights (kW).
Utility	=	Carbon intensity of Local Utility (CO_2e/kWh)

Mitigation Method:

The minimum reduction in annual energy cost associated with higher efficacy street lighting systems is 16%. Note that a 16% reduction in power rating and GHG emissions is the estimated minimum percent reduction associated with installing higher efficacy public street and area lighting. NYSERDA reports that a 16% reduction is expected for installing metal halide post top lights as opposed to typical mercury cobrahead lights. The percent reduction is expected to increase to 35% for installing metal halide cobrahead or metal halide cutoff lights, and 40% for installing high pressure sodium cutoff lights. For lights operating with a single local utility district, the 16% energy cost reduction is equivalent to a 16% reduction in power rating because the energy cost comparison assumes an equal number of lighting heads and equal operation times. As all other variables remain equal between the baseline and mitigated scenarios, the reduction in GHG emissions is in turn 16%. Therefore, the reduction in GHG emissions associated with installing higher efficacy public street and area lighting is:

$$\text{GHG emission reduction} = \frac{Power_{baseline} - Power_{mitigated}}{Power_{baseline}} = 16\%$$

Where:

GHG emission reduction	=	Percentage reduction in GHG emissions for public street and area lighting.
$Power_{baseline}$	=	Power rating of public street and area lights (kW).
$Power_{mitigated}$	=	Power rating of public street and area lights (kW).

If different types of lampheads result in less heads needing to be installed, the reduction will be as follows:

$$\frac{Head_{baseline} \times Power_{baseline} - Head_{mitigated} \times Power_{mitigated}}{Head_{baseline} \times Power_{baseline}}$$

Where:

$Head_{baseline}$	=	the number of heads in the baseline scenario
$Power_{baseline}$	=	the number of heads in the mitigated scenario

As it can be seen by this equation, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions.

Note that a 16% reduction in power rating and GHG emissions is the estimated minimum percent reduction associated with installing higher efficacy public street and area lighting. NYSERDA reports that a 16% reduction is expected for installing metal halide post top lights as opposed to typical mercury cobrahead lights. The percent reduction is expected to increase to 35% for installing metal halide cobrahead or metal halide cutoff lights, and 40% for installing high pressure sodium cutoff lights.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	16% for installing metal halide post top lights; 35% for installing metal halide cobrahead or cutoff lights; 40% for installing high pressure sodium cutoff lights
All other pollutants	Not Quantified[16]

Discussion:

If the applicant uses public street and area lighting, they would calculate baseline emissions as described in the baseline methodologies section. If the applicant then selects to mitigate public street and area lighting by committing to higher efficacy options, the applicant would reduce the amount of GHG emissions associated with public street and area lighting by 16%.

GHG Emissions Reduced = 16%

Assumptions:

Data based upon the following reference:

[1] New York State Energy Research and Development Authority (NYSERDA). 2002. NYSERDA How-to Guide to Effective Energy-Efficient Street Lighting for Municipal Elected/Appointed Officials.

Preferred Literature:

The New York State Energy Research and Development Authority (NYSERDA)'s 2002 How-to Guide to Effective Energy-Efficient Street Lighting reports a minimum reduction in electricity demand of 16% due to the installation of energy-efficient street lights such as metal halide and high-pressure sodium models (see page 4).

Alternative Literature:

None

Other Literature Reviewed:

[16] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

[2] The University of Rochester. Light-Emitting Diode (LED), Organic Light-Emitting Diode (OLED), and laser research for lighting applications. Homepage available online at: http://www.rochester.edu/research/sciences.html. Accessed February 2010.

[3] Chittenden County Regional Planning Commission. 1996. Outdoor Lighting Manual for Vermont Municipalities.

2.2.2 Limit Outdoor Lighting Requirements

Range of Effectiveness:

Best Management Practice, but may be quantified.

Measure Description:

Lighting sources contribute to GHG emissions indirectly, via the production of the electricity that powers these lights. When the operational hours of a light are reduced, GHG emissions are reduced. Strategies for reducing the operational hours of lights include programming lights in public facilities (parks, swimming pools, or recreational centers) to turn off after-hours, or installing motion sensors on pedestrian pathways. Since literature guidance for quantifying these reductions does not exist, this mitigation measure would be employed as a Best Management Practice. In order to take credit for this mitigation measure, the Project Applicant would need to provide detailed and substantial documentation of the reduction in operational hours of lights.

Measure Applicability:

- Outdoor lighting
- Best Management Practice unless Project Applicant supplies substantial evidence.

Inputs:

The following information needs to be provided by the Project Applicant:

- Number of outdoor lights
- Power rating of outdoor lights
- Carbon intensity of local utility (for baseline only)
- Limited hours of operation of outdoor lights

Baseline Method:

$$\text{GHG emissions} = \text{Heads} \times \text{Hours} \times \text{Power}_{baseline} \times \text{Utility}$$

Where:

GHG emissions = MT CO_2e/yr
Heads = Number of outdoor lighting heads. Provided by Applicant.
Hours = Annual hours of operation (4,280)[17].
$\text{Power}_{baseline}$ = Power rating of outdoor lights (kW).
Utility = Carbon intensity of Local Utility (CO_2e/kWh)

[17] Estimated based on the annual number of dark hours (hours between sunset and sunrise) for Los Angeles, California.

Mitigation Method:

Limiting the hours of operation of outdoor lights in turn limits the indirect GHG emissions associated with their electricity usage. Therefore, the reduction in GHG emissions associated with limiting outdoor lighting is:

$$\text{GHG emission reduction} = \frac{\text{Hours}_{\text{baseline}} - \text{Hours}_{\text{limited}}}{\text{Hours}_{\text{baseline}}}$$

Where:

GHG emission reduction	=	Percentage reduction in GHG emissions for outdoor lighting.
$\text{Hours}_{\text{baseline}}$	=	Annual hours of operation (4,280).
$\text{Hours}_{\text{limited}}$	=	Limited hours of operation per day. Provided by Applicant.

As it can be seen by this equation, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions.

Emission Reduction Ranges and Variables:

This is a best management practice measure unless the Project Applicant supplies substantial evidence justifying a reduction in hours of operation. Check with local agencies for guidance on any allowed reductions associated with implementation of best management practices.

Pollutant	Category Emissions Reductions
CO_2e	0 to 100%
All other pollutants	Not Quantified[18]

Discussion:

If the applicant uses outdoor lighting, they would calculate baseline emissions as described in the baseline methodologies document. If the applicant then selects to mitigate outdoor lighting by limiting operation to 10 hours per day, the applicant would reduce the amount of GHG emissions associated with outdoor lighting by 20%.

$$\text{GHG Emissions Reduced} = \frac{12-10}{10} = 0.20 \text{ or } 20\%$$

Assumptions:

[18] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

None

Preferred Literature:

None

Other Literature Reviewed:

None

2.2.3 Replace Traffic Lights with LED Traffic Lights

Range of Effectiveness:

90% of emissions associated with existing traffic lights.

Measure Description:

Lighting sources contribute to GHG emissions indirectly, via the production of the electricity that powers these lights. Installing higher efficiency traffic lights reduces energy demand and associated GHG emissions. As high efficiency light-emitting diodes (LEDs), which consume about 90% less energy than traditional incandescent traffic lights while still providing adequate light or lumens when viewed, are currently required to meet minimum federal efficiency standards for new traffic lights. Project Applicants may take credit only if they are retrofitting existing incandescent traffic lights.

Measure Applicability:

- Traffic lighting – retrofitting incandescent traffic lights

Inputs:

The following information needs to be provided by the Project Applicant:

- Number of incandescent traffic lights being retrofitted
- Power rating of incandescent traffic lights being retrofitted
- Carbon intensity of local utility (for baseline only)

Baseline Method:

$$\text{GHG emissions} = \text{Lights} \times \text{Hours} \times \text{Days} \times \text{Power}_{baseline} \times \text{Utility}$$

Where:

GHG emissions = MT CO_2e/yr

Lights = Number of incandescent traffic lights being retrofitted. Provided by Applicant.

Hours = Hours of operation per day (24).

Days = Days of operation per year (365).

$\text{Power}_{baseline}$ = Power rating of incandescent traffic lights being retrofitted (kW).

Utility = Carbon intensity of Local Utility (CO_2e/kWh)

Mitigation Method:

Traffic lights using LEDs consume about 90% less power than traditional incandescent traffic lights. Therefore, the reduction in GHG emissions associated with replacing incandescent traffic lights with LED-based traffic lights is:

$$\text{GHG emission reduction} = \frac{\text{Power}_{\text{baseline}} - \text{Power}_{\text{mitigated}}}{\text{Power}_{\text{baseline}}} = 90\%$$

Where:

GHG emission reduction = Percentage reduction in GHG emissions for traffic lighting.
$\text{Power}_{\text{baseline}}$ = Power rating of incandescent traffic lights (kW).
$\text{Power}_{\text{mitigated}}$ = Power rating of LED traffic lights (kW).

As it can be seen by this equation, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	90%
All other pollutants	Not Quantified[19]

Discussion:

If the applicant uses traffic lights, they would calculate baseline emissions as described in the baseline methodologies document. If the applicant then selects to mitigate traffic lights by committing to replacing all existing incandescent traffic lights with LED traffic lights, the applicant would reduce the amount of GHG emissions associated with traffic lights in an existing area by 90%.

GHG Emissions Reduced = 90%

Assumptions:

Data based upon the following references:

[1] USDOE. 2004. NREL. State Energy Program Case Studies: California Says "Go" to Energy-Saving Traffic Lights. Available online at: http://www.nrel.gov/docs/fy04osti/35551.pdf

[2] USEPA. ENERGY STAR: Traffic Signals. Available online at: http://www.energystar.gov/index.cfm?c=traffic.pr_traffic_signals. Accessed February 2010.

[19] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

Preferred Literature:

NREL reports that traffic lights based on light-emitting diodes (LEDs) consume about 90% less power than traditional incandescent traffic lights. All traffic lights manufactured on or after January 1, 2006 must meet minimum federal efficiency standards, which are consistent with ENERGY STAR specifications for LED traffic lights.

Alternative Literature:

None

Other Literature Reviewed:

[3] The University of Rochester. LED, OLED, and laser research for lighting applications. Homepage available online at: http://www.rochester.edu/research/sciences.html. Accessed February 2010.

2.3 Alternative Energy Generation

2.3.1 Establish Onsite Renewable or Carbon-Neutral Energy Systems-Generic

Range of Effectiveness:

0-100% of emissions associated with electricity use. Note some systems could increase energy use.

Measure Description:

Using electricity generated from renewable or carbon-neutral power systems displaces electricity demand which would ordinarily be supplied by the local utility. Different sources of electricity generation that local utilities use have varying carbon intensities. Renewable energy systems such as fuel cells may have GHG emissions associated with them. Carbon-neutral power systems, such as photovoltaic panels, do not emit GHGs and will be less carbon intense than the local utility. This mitigation measure describes a method to calculate GHG emission reductions from displacing utility electricity with electricity generated from an on-site power system, which may incorporate technology which has not yet been established at the time this document was written.

Measure Applicability:

- Electricity use

Inputs:

The following information needs to be provided by the Project Applicant:

- Total annual electricity demand (kWh)
- Annual amount of electricity to be provided by the on-site power system (kWh) or percent of total electricity demand to be provided by the on-site power system (%)
- Carbon intensity of local utility and on-site power system if not carbon neutral

Baseline Method:

$$\text{GHG emissions} = \text{Electricity}_{baseline} \times \text{Utility}$$

Where:

GHG emissions = MT CO_2e

$\text{Electricity}_{baseline}$ = Total electricity demand (kWh)
Provided by Applicant

Utility = Carbon intensity of Local Utility (CO_2e/kWh)

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Mitigation Method:

If the total amount of electricity to be provided by the carbon-neutral power system is known, then the GHG emission reduction is equivalent to the ratio of electricity from the carbon-neutral power system to the total electricity demand:

$$\text{GHG emission reduction} = \frac{\text{Electricity}_{\text{carbon-neutral}}}{\text{Electricity}_{\text{baseline}}}$$

Where:

GHG emission reduction	=	Percentage reduction in GHG emissions for electricity use
$\text{Electricity}_{\text{carbon-neutral}}$	=	Electricity to be provided by the carbon-neutral power system (kWh)
$\text{Electricity}_{\text{baseline}}$	=	Total electricity demand (kWh)

If the percent of total electricity demand to be provided by the carbon-neutral power system is known, then the GHG emission reduction is equivalent to that percentage.

As shown in these equations, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions for carbon neutral systems.

If the total amount of electricity to be provided by a renewable energy system that is not carbon neutral, then the GHG emission reduction is equivalent to the following equation:

$$\text{GHG emission reduction} = \frac{\text{Electricity}_{\text{renewable}}}{\text{Electricity}_{\text{baseline}}} \times \frac{(\text{Utility} - \text{Renewable})}{\text{Utility}}$$

Where

$\text{Electricity}_{\text{renewable}}$ = Electricity provided by renewable power system (kWh)

Renewable = Carbon intensity of renewable system (CO_2e/kWh)

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	Up to 100%, assuming all electricity demand is provided by a carbon-neutral power system
All other pollutants	Not Quantified[20],[21]

Discussion:

[20] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

[21] Assumes that the onsite carbon-neutral system displaces electricity use only.

If a project's total electricity demand is 10,000 kWh, and 1,000 kWh of that is provided by the carbon-neutral system, then the GHG emission reduction is 10%

$$\text{GHG Emission Reduced} = \frac{1{,}000}{10{,}000} = 0.10 \text{ or } 10\%$$

If a project instead uses a renewable system with carbon intensity of 500 CO_2e/kWh and the local utility is 100 CO_2e/kWh, then the GHG emission reduction is 5%.

$$\text{GHG Emission Reduced} = \frac{1{,}000}{10{,}000} \times \frac{(1{,}000 - 500)}{1{,}000} = 0.05 \text{ or } 5\%$$

2.3.2 Establish Onsite Renewable Energy Systems-Solar Power

Range of Effectiveness: 0-100% of GHG emissions associated with electricity use.

Measure Description:

Using electricity generated from photovoltaic (PV) systems displaces electricity demand which would ordinarily be supplied by the local utility. Since zero GHG emissions are associated with electricity generation from PV systems[22], the GHG emissions reductions from this mitigation measure are equivalent to the emissions that would have been produced had electricity been supplied by the local utility.

Measure Applicability:

- Electricity use

Inputs:

The following information needs to be provided by the Project Applicant:

- Total electricity demand (kWh)
- Amount of electricity to be provided by the PV system (kWh) or percent of total electricity demand to be provided by the PV system (%)

Baseline Method:

$$\text{GHG emissions} = \text{Electricity}_{baseline} \times \text{Utility}$$

Where:

GHG emissions = MT CO_2e

$\text{Electricity}_{baseline}$ = Total electricity demand (kWh) Provided by Applicant

Utility = Carbon intensity of Local Utility (CO_2e/kWh)

Mitigation Method:

If the total amount of electricity to be provided by the PV system is known, then the GHG emission reduction is equivalent to the ratio of electricity from the PV system to the total electricity demand:

$$\text{GHG emission reduction} = \frac{\text{Electricity}_{PV}}{\text{Electricity}_{baseline}}$$

[22] This mitigation measure does not account for GHG emissions associated with the embodied energy of PV systems.

Where:

GHG emission reduction	=	Percentage reduction in GHG emissions for electricity use
$Electricity_{PV}$	=	Electricity to be provided by PV system (kWh)
$Electricity_{baseline}$	=	Total electricity demand (kWh)

If the percent of total electricity demand to be provided by the PV system is known, then the GHG emission reduction is equivalent to that percentage.

As shown in these equations, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions.

The amount of electricity generated by a PV system depends on the size and type of the PV system and the location of the project. The Project Applicant can use a publically-available solar calculator, such as California's Public Utilities and Energy Commissions Go Solar Clean Power Estimator[23], to estimate the size of the PV system needed to generate the desired amount of electricity. The only input required for this calculator is the location (zip code). Estimates of the amount of electricity that can be generated from 1.5, 3, 5, and 10 kW PV systems in cities around California are shown in Table AE-2.1 below.

Since there is a range of PV system efficiencies, the local agency may consider checking the type of PV efficiency assumed to ensure the system that is installed meets this capacity.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	Up to 100%, assuming all electricity demand is provided by a PV system. Percent reduction would scale down linearly as the percent of electricity provided by a PV system decreases.
All other pollutants	Not Quantified[24]

Discussion:

If a project's total electricity demand is 10,000 kWh, and 1,000 kWh of that is provided by a PV system, then the GHG emission reduction is 10%

[23] Available online at http://gosolarcalifornia.cleanpowerestimator.com/gosolarcalifornia.htm.
[24] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

$$\text{GHG Emission Reduced} = \frac{1{,}000}{10{,}000} = 0.10 \text{ or } 10\%$$

Assumptions:

The data in Table AE-2.1 was generated from California's Public Utilities and Energy Commissions Go Solar Clean Power Estimator, a publically-available solar calculator which the Project Applicant can use to estimate the PV system size needed to generate the desired amount of electricity. It is available online at: http://gosolarcalifornia.cleanpowerestimator.com/gosolarcalifornia.htm.

Other publically-available solar calculators include:

- USDOE. NREL: PVWatts Calculator. Available online at: http://www.nrel.gov/rredc/pvwatts/.
- SolarEstimate.Org. Solar & Wind Estimator. Available online at: http://www.solar-estimate.org/index.php?page=solar-calculator.
- SharpUSA. Solar Calculator. Available online at: http://sharpusa.cleanpowerestimator.com/sharpusa.htm.

Preferred Literature:

None

Other Literature Reviewed:

None

Table AE-2.1
Estimated Electricity Generation from Typical PV Systems

Location			Annual kWh Generated		
Air District	**Major City**	**Zip Code**	**3 kW PV System**	**5 kW PV System**	**10 kW PV System**
Amador County	Ione	95640	4,857	8,094	16,189
Antelope Valley	Lancaster	93534	5,034	8,390	16,781
Bay Area	San Francisco	94101	4,926	8,218	16,436
Butte County	Chico	95926	4,857	8,094	16,189
Calaveras County	Rancho Calaveras	95252	4,857	8,094	16,189
Colusa County	Colusa	95932	4,857	8,094	16,189
El Dorado County	South Lake Tahoe	96150	5,275	8,792	17,584
Feather River	Yuba City	95991	4,857	8,094	16,189
Glenn County	Orland	95963	4,857	8,094	16,189
Great Basin Unified	Bishop	93514	5,507	9,179	18,358
Imperial County	El Centro	92243	5,117	8,528	17,056
Kern County	Bakersfield	93301	5,082	8,470	16,939
Lake County	Lakeport	95453	4,857	8,094	16,189
Lassen County	Susanville	96130	5,275	8,792	17,584
Mariposa County	Mariposa	95338	5,065	8,441	16,882
Mendocino County	Ukiah	95482	4,926	8,218	16,436
Modoc County	Alturas	96101	5,275	8,792	17,584
Mojave Desert	Victorville	92392	5,885	9,808	19,617
Monterey Bay Unified	Monterey	93940	4,926	8,218	16,436
North Coast Unified	Eureka	95501	4,081	6,801	13,602
Northern Sierra	Grass Valley	95949	4,857	8,094	16,189
Northern Sonoma County	Healdsburg	95448	4,931	8,218	16,436
Placer County	Roseville	95678	4,857	8,094	16,189
Sacramento Metro	Sacramento	95864	4,857	8,094	16,189
San Diego County	San Diego	92182	5,102	8,528	17,056
San Joaquin Valley Unified	Fresno	93650	5,065	8,441	16,882
San Luis Obispo County	San Luis Obispo	93405	5,320	8,932	17,865
Santa Barbara County	Santa Barbara	93101	5,320	8,932	17,865
Shasta County	Redding	96001	4,081	6,801	13,602
Siskiyou County	Yreka	96097	4,363	7,271	14,543
South Coast	Los Angeles	90071	5,034	8,390	16,781
Tehama County	Red Bluff	96080	4,857	8,094	16,189
Tuolumne County	Sonora	95370	4,857	8,094	16,189
Ventura County	Oxnard	93030	5,034	8,390	16,781
Yolo-Solano	Davis	95616	4,857	8,094	16,189

2.3.3 Establish Onsite Renewable Energy Systems-Wind Power

Range of Effectiveness: 0-100% of GHG emissions associated with electricity use.

Measure Description:

Using electricity generated from wind power systems displaces electricity demand which would ordinarily be supplied by the local utility. Since zero GHG emissions are associated with electricity generation from wind turbines[25], the GHG emissions reductions from this mitigation measure are equivalent to the emissions that would have been produced had electricity been supplied by the local utility.

Measure Applicability:

- Electricity use

Inputs:

The following information needs to be provided by the Project Applicant:

- Total electricity demand (kWh)
- Amount of electricity to be provided by the wind power system (kWh) or percent of total electricity demand to be provided by the wind power system (%)

Baseline Method:

$$\text{GHG emissions} = \text{Electricity}_{baseline} \text{ x Utility}$$

Where:

GHG emissions = MT CO_2e

$\text{Electricity}_{baseline}$ = Total electricity demand (kWh) Provided by Applicant

Utility = Carbon intensity of Local Utility (CO_2e/kWh)

Mitigation Method:

The GHG emission reduction is equivalent to the ratio of electricity from the wind power system to the total electricity demand:

$$\text{GHG emission reduction} = \frac{\text{Electricity}_{wind}}{\text{Electricity}_{baseline}}$$

[25] This mitigation measure does not account for GHG emissions associated with the embodied energy of wind turbines.

Where:

GHG emission reduction	=	Percentage reduction in GHG emissions for electricity use
$Electricity_{wind}$	=	Electricity to be provided by wind power system (kWh)
$Electricity_{baseline}$	=	Total electricity demand (kWh)

If the percent of total electricity demand to be provided by the wind power system is known, then the GHG emission reduction is equivalent to that percentage.

As shown in these equations, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	Up to 100%, assuming all electricity demand is provided by a wind power system. Percent reduction would scale down linearly as the percent of electricity provided by a wind power system decreases.
All other pollutants	None[26]

Discussion:

If a project's total electricity demand is 10,000 kWh, and 1,000 kWh of that is provided by a wind system, then the GHG emission reduction is 10%

$$\text{GHG Emission Reduced} = \frac{1{,}000}{10{,}000} = 0.10 \text{ or } 10\%$$

Assumptions:

None

Preferred Literature:

None

[26] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

Other Literature Reviewed:

None

2.3.4 Utilize a Combined Heat and Power System

Range of Effectiveness: 0-46% of GHG emissions associated with electricity use.

Measure Description:

For the same level of power output, combined heat and power (CHP) systems utilize less input energy than traditional separate heat and power (SHP) generation, resulting in fewer CO_2 emissions. In traditional SHP systems, heat created as a by-product is wasted by being released into the environment. In contrast, CHP systems harvest the thermal energy and use it to heat onsite or nearby processes, thus reducing the amount of natural gas or other fuel that would otherwise need to be combusted to heat those processes. In addition CHP systems lower the demand for grid electricity, thereby displacing the CO_2 emissions associated with the production of grid electricity.

This mitigation measure describes how to estimate CO_2 emissions savings (in MT per year) from utilizing a CHP system to supply energy demands which would otherwise be provided by separate heat and power systems (e.g. grid electricity for electricity demand and boilers for thermal demand). CO_2 emissions savings are quantified using the USEPA CHP Emission Calculator which allows users to estimate the CO_2 emissions savings associated with displaced electricity and thermal production from five CHP technologies: microturbine, fuel cell, reciprocating engine, combustion turbine, and backpressure steam turbine. The first three technologies have electricity generation capacities on a scale appropriate for residential neighborhoods, planned communities, and mixed-use and commercial developments. Combustion turbines and backpressure steam turbines are more appropriate for industrial processes or very large commercial developments. The user has the option to input project-specific data such as specific fuels, duct burner operation, cooling demand, and boiler efficiencies.

Table AE-4.1 provides examples of expected CO_2 savings for microturbines, fuel cells, and reciprocating engines of a range of electricity generating capacities for the five major California utilities (Southern California Edison (SCE), Los Angeles Department of Water and Power (LADWP), San Diego Gas and Electric (SDGE), Pacific Gas and Electric (PGE), and the Sacramento Municipal Utility District (SMUD). Default values provided by the USEPA CHP Calculator were used wherever possible (see the Assumptions section below). The magnitude of CO_2 reductions depends on the baseline power sources. For thermal demand, the baseline is assumed to be a new boiler with 80% efficiency. For electricity demand, the baseline is the carbon intensity of the local utility, which varies by utility. For reference, Table AE-4.2 provides the 2006 carbon intensity of delivered electricity for the five utilities. As shown in Table AE-4.1, certain CHP systems may not be appropriate for certain locations, especially in Northern California where PGE and SMUD have relatively low carbon intensities.

Measure Applicability:

- Grid electricity use
- Natural gas combustion

Inputs:

The following information needs to be provided by the Project Applicant:

- Expected CHP technology (microturbine, fuel cell, or reciprocating engine)
- Expected electricity demand

Baseline Method:

GHG emissions = CO_2 emissions displaced

Where:

GHG emissions	=	MT CO_2e
CO_2 emissions displaced	=	MT CO_2 from separate heat and power system Provided in Table AE-4.1 or calculated using USEPA CHP Calculator

Here it is assumed that all GHG emissions produced from fuel combustion and electricity generation are CO_2 emissions.

Mitigation Method:

GHG emission reduction = Percent Reduction in CO_2 emissions

Provided in Table A E-4.1 or calculated using USEPA CHP Calculator

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	Up to 100%, assuming all electricity demand is provided by a CHP system. Percent reduction would scale down linearly as the percent of electricity provided by a CHP system decreases.
All other pollutants	0-70%[27] Depends on CHP technology, electricity generating capacity, sulfur content of fuel, and displaced thermal generation technology. Reductions in CO_2 may produce increases in SO_2 and/or NOx, or vice versa.

[27] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

Discussion:

Assume a project is located in SCE's service area and has an expected electricity demand of 100 kW. Using Table AE-4:

- A 100 kW microturbine will generate more CO_2 emissions than a separate heat and power system of equivalent power capacity.
- A 100 kW fuel cell will generate about the same CO_2 emissions than a separate heat and power system of equivalent power capacity.
- A 100 kW reciprocating engine will generate 14% less CO_2 emissions as a separate heat and power system of equivalent power capacity.

Therefore, the Project Applicant should choose the reciprocating engine. This system would generate 568 MT CO_2 compared to 657 MT CO_2 from the separate heat and power system.

Assumptions:

Table AE-4.1 was prepared using the 2009 USEPA CHP Calculator, a publically-available tool found online at: http://www.epa.gov/chp/basic/calculator.html. The following defaults and assumptions were made to generate the data in Table AE-4.1:

- The range of electricity generating capacity shown in Table AE-4.1 is based on the normal range for the technology (as per Calculator default)
- Operates 8,760 hours per year
- Provides heat only (no cooling)
- Combusts natural gas fuel (116.7 CO_2/MMBtu emission rate and 1,020 Btu/scf HHV as per Calculator defaults)
- No supplementary duct burner
- Assumes 8% transmission loss for displaced electricity

Table AE-4.2 was prepared using data from the California Climate Action Registry (CCAR) Power/Utility Protocol (PUP) public reports for reporting year 2006. These PUP reports are available online at:
https://www.climateregistry.org/CARROT/public/reports.aspx.

Preferred Literature:

The USEPA CHP Emissions Calculator compares the anticipated emissions from a CHP system to the emissions from SHP systems. The Calculator was developed by the U.S. Department of Energy's Distributed Energy Program, Oak Ridge National Laboratory, and the U.S. Environmental Protection Agency's CHP Partnership. Users can choose from five different CHP technologies (microturbine, fuel cell, reciprocating engine, combustion turbine, and backpressure steam turbine) and compare their performance to a number of different SHP systems (e.g. local electricity utility and existing or new gas boiler, fuel oil boiler, or heat bump). Additionally, users have the option to refine the analysis with project-specific inputs such as the cooling demand and additional duct burning. Details such as the cooling efficiency of the displaced cooling system must be known to perform more detailed analysis. The calculator can be used to estimate expected reductions in CO_2, SO_2, and NOx emissions as well as fuel usage.

Alternative Literature:

The USEPA Combined Heat and Power Partnership Catalog of CHP Technologies presents performance details of six CHP technologies: gas turbine, microturbine, spark and compression ignition reciprocating engines, steam turbine, and fuel cell. Table I of the Introduction presents the equations necessary to calculate the percent fuel savings from using a CHP system instead of traditional separate heat and power generation. Subsequent chapters describe performance details of each of the CHP technologies, including estimated CO_2 emissions. The GHG emissions reductions associated with this mitigation measure are the change in emissions from using a CHP system rather than a SHP system in a building. The USEPA CHP Calculator methodologies are based in part on this Catalog of CHP Technologies document.

Other Literature Reviewed:

None

Table AE-4.1
Estimated CO_2 Emissions Savings from CHP Systems in California[1,2]

Utility	CHP Technology	Electricity Generating Capacity	Electric Efficiency	Power to Heat Ratio	CO_2 Emissions from CHP	CO_2 Emissions Displaced	Percent Reduction in CO_2 Emissions[3]
		(kW)	(% HHV)	--	(MT/year)	(MT/year)	(%)
SCE	Microturbine	30	24%	0.51	200	200	0%
		50	24%	0.51	334	333	0%
		100	26%	0.7	607	559	-9%
		250	26%	0.92	1517	1229	-23%
	Fuel Cell	5	30%	0.79	26	26	0%
		100	30%	0.79	527	527	0%
		1000	43%	1.95	3679	3783	3%
		2000	46%	1.92	6884	7597	9%
	Reciprocating Engine (Rich Burn)	55	30%	0.63	290	325	11%
		100	28%	0.52	568	657	14%
		1000	29%	0.64	5514	5859	6%
		1200	28%	0.63	6759	7052	4%
LADWP	Microturbine	30	24%	0.51	200	277	28%
		50	24%	0.51	334	462	28%
		100	26%	0.7	607	817	26%
		250	26%	0.92	1517	1875	19%
	Fuel Cell	5	30%	0.79	26	39	33%
		100	30%	0.79	527	786	33%
		1000	43%	1.95	3679	6366	42%
		2000	46%	1.92	6884	12762	46%
	Reciprocating Engine (Rich Burn)	55	30%	0.63	290	466	38%
		100	28%	0.52	568	915	38%
		1000	29%	0.64	5514	8441	35%
		1200	28%	0.63	6759	10188	34%
SDGE	Microturbine	30	24%	0.51	200	218	8%
		50	24%	0.51	334	363	8%
		100	26%	0.7	607	620	2%
		250	26%	0.92	1517	1381	-10%
	Fuel Cell	5	30%	0.79	26	30	12%
		100	30%	0.79	527	588	10%
		1000	43%	1.95	3679	4387	16%
		2000	46%	1.92	6884	8806	22%

Utility	CHP Technology	Electricity Generating Capacity (kW)	Electric Efficiency (% HHV)	Power to Heat Ratio --	CO_2 Emissions from CHP (MT/year)	CO_2 Emissions Displaced (MT/year)	Percent Reduction in CO_2 Emissions[3] (%)
	Reciprocating Engine (Rich Burn)	55	30%	0.63	290	358	19%
		100	28%	0.52	568	717	21%
		1000	29%	0.64	5514	6463	15%
		1200	28%	0.63	6759	7814	14%
PGE	Microturbine	30	24%	0.51	200	175	-15%
		50	24%	0.51	334	293	-14%
		100	26%	0.7	607	479	-27%
		250	26%	0.92	1517	1030	-47%
	Fuel Cell	5	30%	0.79	26	23	-16%
		100	30%	0.79	527	447	-18%
		1000	43%	1.95	3679	2984	-23%
		2000	46%	1.92	6884	5999	-15%
	Reciprocating Engine (Rich Burn)	55	30%	0.63	290	280	-4%
		100	28%	0.52	568	577	2%
		1000	29%	0.64	5514	5059	-9%
		1200	28%	0.63	6759	6130	-10%
SMUD	Microturbine	30	24%	0.51	200	188	-7%
		50	24%	0.51	334	314	-6%
		100	26%	0.7	607	522	-16%
		250	26%	0.92	1517	1137	-33%
	Fuel Cell	5	30%	0.79	26	24	-7%
		100	30%	0.79	527	490	-8%
		1000	43%	1.95	3679	3411	-8%
		2000	46%	1.92	6884	6855	0%
	Reciprocating Engine (Rich Burn)	55	30%	0.63	290	304	4%
		100	28%	0.52	568	620	8%
		1000	29%	0.64	5514	5487	0%
		1200	28%	0.63	6759	6643	-2%

Abbreviations:
CHP - combined heat and power
CO_2 - carbon dioxide
HHV - higher heating value
kW - kilowatt
LADWP - Los Angeles Department of Water and Power

PGE - Pacific Gas and Electric
SCE - Southern California Edison
SDGE - San Diego Gas and Electric
SMUD - Sacramento Municipal Utility District
USEPA - United State Environmental Protection Agency

Notes:
1. All data in this table generated using the USEPA CHP Calculator using utility-specific CO_2 intensity factors (see Table B). The following defaults and assumptions for the CHP system were used:
   - electricity generating capacity based on normal range for the technology (as per Calculator default)
   - operate 8,760 hours per year
   - heating only (no cooling)
   - natural gas fuel (116.7 CO_2/MMBtu emission rate and 1,020 Btu/scf HHV as per Calculator defaults)
   - no duct burner
   - assumed 8% transmission loss for displaced electricity
2. All CHP systems were compared to a baseline separate heat and power system consisting of a "new gas boiler" (assumed 80% efficiency as per Calculator default) and the local utility CO_2 intensity factor as provided in Table B.
3. A negative value indicates that the proposed CHP system is expected to generate more CO_2 emissions than the baseline separate heat and power system.

Source:
USEPA. 2009. CHP Emissions Calculator. Available online at: http://www.epa.gov/chp/basic/calculator.html. Accessed April 2010.

Table AE-4.2
Carbon Intensity of California Utilities

Utility	Total From All Generation Sources[1]		
	Electricity (MWh)	CO_2 Emissions (MT)	CO_2 intensity factor (lb/MWh)
SCE	82,776,309	24,077,133	641
LADWP	29,029,883	16,308,526	1,239
SDGE	19,108,166	6,767,326	781
PGE	79,211,982	16,377,172	456
SMUD	15,133,569	3,811,571	555
eGRID National Average (default in USEPA CHP Calculator)[2,3]			540
eGRID National Fossil Fuel Average (default in USEPA CHP Calculator)[2,4]			1,076

Abbreviations:
CHP - combined heat and power
CO_2 - carbon dioxide
eGRID - Emissions and Generation Resource Integrated Database
LADWP - Los Angeles Department of Water and Power
lb - pound
MWh - megawatt-hour
PGE - Pacific Gas and Electric
SCE - Southern California Edison
SDGE - San Diego Gas and Electric
SMUD - Sacramento Municipal Utility District
USEPA - United State Environmental Protection Agency

Notes:
1. Total electricity and CO_2 emissions reported by the utility in the California Climate Action Registry Power/Utility Protocol (PUP) Reports for reporting year 2006. PUP Reports available online at: https://www.climateregistry.org/CARROT/public/reports.aspx.
2. eGRID is a comprehensive inventory of environmental attributes of electricity generation (such as the carbon intensity of power generation), compiled from data from three federal agencies: EPA, the Energy Information Administration (EIA), and the Federal Energy Regulatory Commission (FERC). The USEPA CHP Calculator provides default 2005 eGRID carbon intensities for the U.S. and California. For more information, see: http://www.epa.gov/rdee/energy-resources/egrid/index.html.
3. eGRID National Average represents the national average carbon intensity for electricity generation from all power sources (hydropower, nuclear, renewables, and fossil fuels including oil, natural gas, and coal).
4. eGRID National Fossil Fuel Average represents the national average carbon intensity for electricity generation from fossil fuel sources only (oil, natural gas, and coal).

2.3.5 Establish Methane Recovery in Landfills

Range of Effectiveness: 73-77% reduction in GHG emissions from landfills without methane recovery

Measure Description:

One of the U.S.'s largest sources of methane emissions is from the decomposition of waste in landfills. Methane (CH_4) is a potent GHG and has a global warming potential (GWP) over 20 times that of CO_2. Capturing methane in landfills and combusting it to generate electricity for on-site energy needs reduces GHG emissions in two ways: it reduces direct methane emissions, and it displaces electricity demand and the associated indirect GHG emissions from electricity production.

Measure Applicability:

- Electricity from utility
- Note: this mitigation measure does not include energy generation from burning municipal solid waste.

Inputs:

The following information needs to be provided by the Project Applicant:

- Amount of mixed solid waste (short tons)

Baseline Method:

In landfills without landfill gas recovery systems, greenhouse gases are emitted directly to the atmosphere.

$$CO_2e_{baseline} = MSW \times LFM \times (44/12)$$

Where

$CO_2e_{baseline}$	=	Amount of CO_2e generated from landfilling mixed solid waste (MT)
MSW	=	Amount of mixed solid waste (short tons) Provided by Applicant
LFM	=	Landfill methane generated from mixed solid waste 0.580 MTCE / short ton MSW
(44/12)	=	Conversion from MTCE to MT CO_2e

Mitigation Method:

Mitigation Option 1 – Methane is captured and flared

USEPA assumes that 10% of the landfill CH4 generated is either converted by bacteria or chemically oxidized to CO_2. The remaining 90% remains as CH4 and is either captured and flared[28] or released directly to the atmosphere as fugitive CH_4 emissions. Assume a 99% combustion conversion efficiency.

$$CO_2e_{Mit1} = MSW \times LFM \times 1/(12/44 \times 21) \times [(CO_{2oxidation} + CO_{2flare}) \times 1 + (CH_{4fugitive} + CH_{4unflare}) \times 21]$$

Where

CO_2e_{Mit1}	=	Amount of CO_2e from flaring landfill methane (MT)
MSW	=	Amount of mixed solid waste (short tons) Provided by Applicant
LFM	=	MTCE[29] methane generated per short ton MSW 0.580 MTCE / short ton MSW
1/(12/44 x 21)	=	Conversion from MTCE to MT CH_4
$CO_{2oxidation}$	=	Contribution from CO_2 generated from chemical or biological oxidation. 0.10
CO_{2flare}	=	Contribution from CO_2 generated from the flaring of methane. (1-0.10) x 0.75 x 0.99 = 0.66825
1	=	Global warming potential of CO_2, used to convert from CO_2 to CO_2e
$CH_{4fugitive}$	=	Contribution from CH_4 which remains unoxidized to CO_2 and is not captured for flaring, and therefore is released directly to the atmosphere. (1-0.10) x (1-0.75) = 0.225

[28] Seek local agency guidance on whether to include CO_{2flare} emissions. USEPA and IPCC consider these emissions to be biogenic; therefore, the emissions are not included in USEPA and IPCC greenhouse gas emissions inventories.
[29] MTCE = metric MTMTMTMT carbon equivalent. The MTCE equivalent of 1 MT of a greenhouse gas is (12/44) multiplied by the greenhouse gas global warming potential.

$CH_{4unflare}$ = Contribution from CH_4 which remains unoxidized and is captured for flaring, but remains unconverted due to incomplete combustion.
(1-0.10) x 0.75 x (1-0.99) = 0.00675

21 = Global warming potential of CH_4, used to convert from CH_4 to CO_2e

Therefore:

CO_2e_{Mit1} = MSW x 0.580 x 1/(12/44 x 21) x [(0.76825 x 1) + (0.23175 x 21)]

CO_2eMit1 = MSW x 0.571

And then the percent reduction in GHG emissions from Mitigation Option 1 is:

$$\text{GHG reduction}_{Mit1} = \frac{CO_2e_{baseline} - CO_2e_{Mit1}}{CO_2e_{baseline}}$$

GHG reduction$_{Mit1}$ = 73%

As shown from this equation, the percent reduction in greenhouse gas emissions does not depend on the amount of mixed solid waste in the landfill.

Mitigation Option 2 – Methane is captured and combusted for cogeneration

If a cogeneration system is used to generate electricity from the combusted methane, the following equation is used to calculate the amount of electricity generated:

Electricity = MSW x LFM x 1/(12/44 x 21) x Combust x Density x 10^6 x HHV x ECF x EFF x

Where

Electricity = Amount of electricity generated from combustion of methane (kWh)

LFM = MTCE methane generated per short ton MSW
0.580 MTCE / short ton MSW

1/(12/44 x 21) = Conversion from MTCE to MT CH_4

Combust = Fraction of CH_4 captured and combusted for cogeneration

(1-0.10) x 0.75 = 0.675; assumes 10% of methane is oxidized prior to capture and 75% capture efficiency

Density = Density of CH_4
0.05 ft^3 CH_4 / gram CH_4

10^6 = Conversion from grams to MT

HHV = Heating value of CH4
1,012 BTU / ft^3 CH_4

ECF = Energy conversion factor
0.00009 kWh/BTU

EFF = Efficiency Factor
0.85; USEPA assumes a 15% system efficiency loss to account for system down-time

Therefore:

Electricity = MSW x 265

Since this amount of electricity is generated on-site and no longer needs to be supplied by the local electricity utility, the indirect CO_2e emissions associated with that utility electricity generation are also avoided:

$$CO_2e_{displaced} = \text{Electricity} \times \text{Utility}$$

Where

Utility = Carbon intensity of Local Utility (MT CO_2e/kWh) from table below

Power Utility	Carbon-Intensity (lbs CO_2e/MWh)
LADW&P	1,238
PG&E	456
SCE	641
SDGE	781
SMUD	555

Therefore:

$$\mathbf{CO_2e_{Mit2} = CO_2e_{Mit1} - CO_2e_{displaced}}$$

And then the percent reduction in GHG emissions from Mitigation 2 is:

$$\text{GHG reduction}_{Mit2} = \frac{CO_2e_{baseline} - (CO_2e_{Mit1} - CO_2e_{displaced})}{CO_2e_{baseline}}$$

$$\textbf{GHG reductionMit2} = \frac{1.556 + (265 \times \text{Utility})}{2.127}$$

As shown from these equations, the percent reduction in GHG emissions does not depend on the amount of mixed solid waste in the landfill.

Note that further reductions could be achieved if the heat generated from combustion and cogeneration were recovered and used to displace thermal energy that otherwise would have been generated from a separate heat system, such as a boiler. The magnitude of reductions depends on the system being displaced, including the boiler efficiency and the heating value of the fuel as compared to the heating value of methane. To take credit for this additional reduction, the Project Applicant would need to quantify displaced GHG emissions using the baseline document and the Mitigation Measure BE-5, Install Energy Efficient Boilers.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	73-77%
All other pollutants	Not Quantified[30]

Discussion:

In Southern California Edison's service area, a landfill which captures and flares methane achieves a 73% reduction in GHG emissions compared to a landfill without a methane recovery system. A landfill which captures and combusts methane for cogeneration achieves a 77% reduction in GHG emissions compared to a landfill without a methane recovery system:

$$\text{GHG reduction Mit2} = \frac{1.556 + (265 \times 2.909 \times 10^{-4})}{2.127} = 77\%$$

Assumptions:

[30] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

Data based upon the following reference:

- USEPA. 2006. Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks, 3rd Ed. Available online at: http://www.epa.gov/climatechange/wycd/waste/downloads/fullreport.pdf

Preferred Literature:

Section 6 of USEPA's Solid Waste Management and Greenhouse Gases report presents methodology for calculating greenhouse gas emissions associated with three different landfill management systems: landfills which do not capture landfill gas, landfills which recover methane and flare it, and landfills which recover methane and combust it for cogeneration. Column (b) of Exhibit 6-6 shows methane generation factors for various types of landfill waste in MTCE per short ton of waste. For this analysis, the value for mixed solid waste is used. Section 6.2 provides USEPA defaults for percent of methane chemically or biologically oxidized to CO_2 (10%) and the efficiency of methane capture systems (75%). Exhibit 6-7 provides USEPA defaults used for calculating the amount of electricity generated from methane combustion and cogeneration.

Alternative Literature:

None

Other Literature Reviewed:

- CAR. 2009. Landfill Project Protocol: Collecting and Destroying Methane from Landfills. Version 3.0. Available online at: http://www.climateactionreserve.org/how/protocols/adopted/landfill/current-landfill-project-protocol/
- CalRecycle (CIWMB). Climate Change and Solid Waste Management: Draft Final Report and Draft GHG Calculator Tool. Available online at: http://www.calrecycle.ca.gov/Climate/Organics/LifeCycle/default.htm. Accessed February 2010.
- CARB. 2008. Local Government Operations Protocol. Version 1.0. Available online at: http://www.arb.ca.gov/cc/protocols/localgov/pubs/final_lgo_protocol_2008-09-25.pdf
- American Carbon Registry. Standards. Available online at: http://www.americancarbonregistry.org/carbon-accounting/standards/?searchterm=landfill. Accessed February 2010.

2.3.6 Establish Methane Recovery in Wastewater Treatment Plants

Range of Effectiveness: 95-97% reduction in GHG emissions from wastewater treatment plants without recovery.

Measure Description:

Methane (CH_4) is a potent GHG and has a global warming potential (GWP) over 20 times that of CO_2. Capturing methane from wastewater treatment (WWT) plants and combusting it to generate electricity for on-site energy needs reduces GHG emissions in two ways: it reduces direct methane emissions, and it displaces electricity demand and the associated indirect GHG emissions from electricity production.

Measure Applicability:

- Electricity from utility

Inputs:

The following information needs to be provided by the Project Applicant:

- Liters of wastewater

Baseline Method:

Centralized wastewater treatment facilities may use anaerobic or facultative lagoons or anaerobic digesters to treat wastewater. The methane emissions expected from anaerobic or facultative lagoons is calculated using the following equation from the California Air Resources Board (CARB)'s Local Government Reporting Protocol:

$$CO_2e_{baseline} = \text{Wastewater} \times BOD_5 \text{ load} \times 10^{-6} \times Bo \times MCF_{anaerobic} \times 10^{-3} \times 21$$

Where

$CO_2e_{baseline}$	=	Amount of CO_2e generated from wastewater treatment (MT)
Wastewater	=	Volume of wastewater (liters) Provided by Applicant
BOD_5 load	=	Concentration of BOD_5 in wastewater 200 mg / liter wastewater
10^{-6}	=	Conversion from mg to kg
Bo	=	Maximum CH_4-producing capacity for domestic wastewater 0.6 kg CH_4 / kg BOD_5 removed
$MCF_{anaerobic}$	=	CH_4 correction factor for anaerobic systems 0.8
10^{-3}	=	Conversion from kg to MT

21	=	Global warming potential of CH_4, used to convert from CH_4 to CO_2e

Therefore:

$$\mathbf{CO_2e_{baseline} = Wastewater \times 2.02 \times 10^{-6}}$$

Mitigation Method:

Mitigation Option 1 – Methane is captured and flared

Anaerobic digesters produce methane-rich biogas which can be combusted and converted to CO_2.[31] Inherent inefficiencies in the system results in incomplete combustion of the biogas, which results in remaining methane emissions:

$$CO_2e_{Mit1} = \text{Wastewater} \times 0.2642 \times \text{Digester Gas} \times FCH_4 \times (CH_4\text{unflare} + CO_2\text{flare})$$

Where

CO_2e_{Mit1}	=	Amount of CO_2e generated from flaring methane from wastewater treatment plant (MT)
Wastewater	=	Volume of wastewater (liters) Provided by Applicant
0.2642	=	Conversion from liters to gallons
Digester Gas	=	Volume of biogas generated per volume of wastewater treated ft^3 biogas / gallon wastewater 0.01
F_{CH4}	=	Fraction of CH_4 in biogas 0.65
$CH_{4unflare}$	=	Contribution from CH_4 which is captured for flaring, but remains unconverted due to incomplete combustion $CH_{4unflare} = \rho_{CH4} \times (1\text{-}DE) \times 0.0283 \times 10^{-6} \times 21 = 3.93 \times 10^{-6}$
ρ_{CH4}	=	Density of CH4 at standard conditions 662 g/m^3
DE	=	CH_4 destruction efficiency 0.99
0.0283	=	Conversion factor from ft^3 to m^3
10^{-6}	=	Conversion factor from g to MT
21	=	Global warming potential of CH_4, used to convert from CH_4 to CO_2e
CO_2flare	=	Contribution from CO_2 generated from the flaring of methane
CO_2flare	=	EF / 2204.623 x 1= 5.44×10^{-5}
EF	=	Emission factor for methane combustion

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[31] Seek local agency guidance on whether to include CO_2 combustion emissions. USEPA and IPCC consider these emissions to be biogenic; therefore, the emissions are not included in USEPA and IPCC greenhouse gas emissions inventories.

0.120 lb CO_2/ft^3 CH_4

2204.623	=	Conversion factor from lb to MT
1	=	Global warming potential of CO_2, used to convert from CO_2 to CO_2e

Therefore:

$$\mathbf{CO_2e_{Mit1} = \text{Wastewater} \times 1.00 \times 10^{-7}}$$

And then the percent reduction in GHG emissions from Mitigation Option 1 is:

$$\text{GHG reduction}_{Mit1} = \frac{CO_2e_{baseline} - CO_2e_{Mit1}}{CO_2e_{baseline}}$$

GHG reduction$_{Mit1}$ = 95%

As shown from this equation, the percent reduction in greenhouse gas emissions does not depend on the amount of wastewater being treated.

Mitigation Option 2 – Methane is captured and combusted for cogeneration

If a cogeneration system is used to generate electricity from the combusted biogas, the following equation is used to calculate the amount of electricity generated:

$$\text{Electricity} = \text{Wastewater} \times 0.2642 \times \text{Digester Gas} \times F_{CH4} \times HHV_{CH4} \times ECF \times EFF$$

Where:

Electricity	=	Amount of electricity generated from combustion of methane (kWh)
Wastewater	=	Volume of wastewater (liters) Provided by Applicant
0.2642	=	Conversion from liters to gallons
Digester Gas	=	Volume of biogas generated per volume of wastewater treated 0.01 ft^3 biogas / gallon wastewater
F_{CH4}	=	Fraction of CH_4 in biogas 0.65
HHV	=	Heating value of methane 1,012 BTU / ft^3 CH_4
ECF	=	Energy conversion factor 0.00009 kWh/BTU
EFF	=	Efficiency Factor 0.85; USEPA assumes a 15% system efficiency loss to account for system down-time

Therefore:

$$\text{Electricity} = \text{Wastewater} \times 1.33 \times 10^{-4}$$

Since this amount of electricity is generated on-site and no longer needs to be supplied by the local electricity utility, the indirect CO_2e emissions associated with that utility electricity generation are also avoided:

$$CO_2e_{displaced} = \text{Electricity} \times \text{Utility}$$

Where

Utility = Carbon intensity of Local Utility (MT CO_2e/kWh) from table below

Power Utility	Carbon-Intensity (lbs CO_2e/MWh)
LADW&P	1,238
PG&E	456
SCE	641
SDGE	781
SMUD	555

Therefore:

$$\mathbf{CO_2e_{Mit2} = CO_2e_{Mit1} - CO_2e_{displaced}}$$

And then the percent reduction in GHG emissions from Mitigation 2 is:

$$\text{GHG reduction}_{Mit2} = \frac{CO2e_{baseline} - (CO2e_{Mit1} - CO2e_{displaced})}{CO2e_{baseline}}$$

$$\textbf{GHG reductionMit2} = \frac{1.92 \times 10^{-6} + (1.33 \times 10^{-4} \times \text{Utility})}{2.02 \times 10^{-6}}$$

As shown from these equations, the percent reduction in GHG emissions does not depend on the amount of wastewater being treated.

Note that further reductions could be achieved if the heat generated from combustion and cogeneration were recovered and used to displace thermal energy that otherwise would have been generated from a separate heat system, such as a boiler. The magnitude of reductions depends on the system being displaced, including the boiler efficiency and the heating value of the fuel as compared to the heating value of methane. To take credit for this additional reduction, the Project Applicant would need to quantify displaced GHG emissions using the baseline document and the Mitigation Measure BE-5, Install Energy Efficient Boilers.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	95-97%
All other pollutants	Not Quantified[32]

Discussion:

In Southern California Edison's service area, a WWT plant which captures and flares methane achieves a 95% reduction in GHG emissions compared to a WWT plant without a methane recovery system. A WWT plant which captures and combusts methane for cogeneration achieves a 97% reduction in GHG emissions compared to a landfill without a methane recovery system:

$$\text{GHG reduction Mit2} = \frac{1.92\times10^{-6} + \left(1.33\times10^{-4}\times2.909\times10^{-4}\right)}{2.02\times10^{-6}} = 97\%$$

Assumptions:

Data based upon the following references:

- CARB. 2008. Local Government Operations Protocol. Chapter 10: Wastewater Treatment Facilities. Available online at: http://www.arb.ca.gov/cc/protocols/localgov/pubs/final_lgo_protocol_2008-09-25.pdf
- USEPA. 2008. Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2006. Chapter 8: Waste. Available online at: http://www.epa.gov/climatechange/emissions/downloads/08_CR.pdf
- USEPA. 2006. Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks, 3rd Ed. Available online at: http://www.epa.gov/climatechange/wycd/waste/downloads/fullreport.pdf

Preferred Literature: Chapter 10 of CARB's Local Government Operations Protocol (LGOP) provides the methodology for calculating methane emissions from wastewater treatment. Centralized wastewater treatment facilities may use anaerobic or facultative lagoons or anaerobic digesters to treat wastewater. Equation 10.3 of the LGOP calculates methane emissions from anaerobic or facultative lagoons. Equation 10.1 of the LGOP calculates the methane emissions remaining due to incomplete combustion of anaerobic digester gas. Default values for the amount of digester gas produced per volume of wastewater and the fraction of methane in digester gas are taken from the 2008 USEPA Inventory of U.S. Greenhouse Gas Emissions and Sinks. Exhibit 6-7 of

[32] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

USEPA's Solid Waste Management and Greenhouse Gases report provides the methodology for calculating the amount of electricity generated from methane combustion and cogeneration.

Alternative Literature:

None

Other Literature Reviewed:

None

3.0 Transportation

3.1 Land Use/Location

3.1.1 Increase Density

Range of Effectiveness: 0.8 – 30.0% vehicle miles traveled (VMT) reduction and therefore a 0.8 – 30.0% reduction in GHG emissions.

Measure Description:

Designing the Project with increased densities, where allowed by the General Plan and/or Zoning Ordinance reduces GHG emissions associated with traffic in several ways. Density is usually measured in terms of persons, jobs, or dwellings per unit area. Increased densities affect the distance people travel and provide greater options for the mode of travel they choose. This strategy also provides a foundation for implementation of many other strategies which would benefit from increased densities. For example, transit ridership increases with density, which justifies enhanced transit service.

The reductions in GHG emissions are quantified based on reductions to VMT. The relationship between density and VMT is described by its elasticity. According to a recent study published by Brownstone, et al. in 2009, the elasticity between density and VMT is 0.12. Default densities are based on the typical suburban densities in North America which reflects the characteristics of the ITE Trip Generation Manual data used in the baseline estimates.

Measure Applicability:

- Urban and suburban context
  - Negligible impact in a rural context
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Number of housing units per acre or jobs per job acre

Mitigation Method:

% VMT Reduction = A * B [not to exceed 30%]

Where:

A = Percentage increase in housing units per acre or jobs per job acre[33] = (number of housing units per acre or jobs per job acre – number of housing units per acre or jobs per job acre for typical ITE development) / (number of housing units per acre or jobs per job acre for typical ITE development) For small and medium sites (less than ½ mile in radius) the calculation of housing and jobs per acre should be performed for the development site as a whole, so that the analysis does not erroneously attribute trip reduction benefits to measures that simply shift jobs and housing within the site with no overall increase in site density. For larger sites, the analysis should address the development as several ½-mile-radius sites, so that shifts from one area to another would increase the density of the receiving area but reduce the density of the donating area, resulting in trip generation rate decreases and increases, respectively, which cancel one another.
B = Elasticity of VMT with respect to density (from literature)

Detail:

- A: [not to exceed 500% increase]
  - If housing: (Number of housing units per acre – 7.6) / 7.6
    (See Appendix C for detail)
  - If jobs: (Number of jobs per acre – 20) / 20
    (See Appendix C for detail)
- B: 0.07 (Boarnet and Handy 2010)

Assumptions:

Data based upon the following references:

- Boarnet, Marlon and Handy, Susan. 2010. "DRAFT Policy Brief on the Impacts of Residential Density Based on a Review of the Empirical Literature." http://arb.ca.gov/cc/sb375/policies/policies.htm; Table 1.

[33] This value should be checked first to see if it exceeds 500% in which case A = 500%.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[34]
CO_2e	1.5-30% of running
PM	1.5-30% of running
CO	1.5-30% of running
NOx	1.5-30% of running
SO_2	1.5-30% of running
ROG	0.9-18% of total

Discussion:

The VMT reductions for this strategy are based on changes in density versus the typical suburban residential and employment densities in North America (referred to as "ITE densities"). These densities are used as a baseline to mirror those densities reflected in the ITE Trip Generation Manual, which is the baseline method for determining VMT.

There are two separate maxima noted in the fact sheet: a cap of 500% on the allowable percentage increase of housing units or jobs per acre (variable A) and a cap of 30% on % VMT reduction. The rationale for the 500% cap is that there are diminishing returns to any change in environment. For example, it is reasonably doubtful that increasing residential density by a factor of six instead of five would produce any additional change in travel behavior. The purpose for the 30% cap is to limit the influence of any single environmental factor (such as density). This emphasizes that community designs that implement multiple land use strategies (such as density, design, diversity, etc.) will show more of a reduction than relying on improvements from a single land use factor.

Example:

Sample calculations are provided below for housing:

Low Range % VMT Reduction (8.5 housing units per acre)

$$= (8.5 – 7.6) / 7.6 * 0.07 = 0.8\%$$

High Range % VMT Reduction (60 housing units per acre)

$$= \frac{60 - 7.6}{7.6} = 6.9 \text{ or } 690\% \quad \text{Since greater than 500\%, set to 500\%}$$

$$= 500\% \times 0.07 = 0.35 \text{ or } 35\% \quad \text{Since greater than 30\%, set to 30\%}$$

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[34] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

Sample calculations are provided below for jobs:

Low Range % VMT Reduction (25 jobs per acre)

$$= (25 - 20) / 20 * 0.12 = 3\%$$

High Range % VMT Reduction (100 jobs per acre)

$$= \frac{100 - 20}{20} = 4 \text{ or } 400\%$$

$$= 400\% \times 0.12 = 0.48 \text{ or } 48\% \quad \text{Since greater than 30\%, set to 30\%}$$

Preferred Literature:

- -0.07 = elasticity of VMT with respect to density

Boarnet and Handy's detailed review of existing literature highlighted three individual studies that used the best available methods for analyzing data for individual households. These studies provided the following elasticities: -0.12 - Brownstone (2009), -0.07 – Bento (2005), and -0.08 – Fang (2008). To maintain a conservative estimate of the impacts of this strategy, the lower elasticity of -0.07 is used in the calculations.

Alternative Literature:

- -0.05 to -0.25 = elasticity of VMT with respect to density

The *TRB Special Report 298* literature suggests that doubling neighborhood density across a metropolitan area might lower household VMT by about 5 to 12 percent, and perhaps by as much as 25 percent, if coupled with higher employment concentrations, significant public transit improvements, mixed uses, and other supportive demand management measures.

Alternative Literature References:

TRB, 2009. *Driving and the Built Environment*, Transportation Research Board Special Report 298. http://onlinepubs.trb.org/Onlinepubs/sr/sr298.pdf . Accessed March 2010. (p. 4)

Other Literature Reviewed:

None

3.1.2 Increase Location Efficiency

Range of Effectiveness: 10-65% vehicle miles traveled (VMT) reduction and therefore 10-65% reduction in GHG emissions

Measure Description:

This measure is not intended as a separate strategy but rather a documentation of empirical data to justify the “cap” for all land use/location strategies. The location of the Project relative to the type of urban landscape such as being located in an urban area, infill, or suburban center influences the amount of VMT compared to the statewide average. This is referred to as the location of efficiency since there are synergistic benefits to these urban landscapes.

To receive the maximum reduction for this location efficiency, the project will be located in an urban area/ downtown central business district. Projects located on brownfield sites/infill areas receive a lower, but still significant VMT reduction. Finally, projects in suburban centers also receive a reduction for their efficient location. Reductions are based on the typical VMT of a specific geographic area relative to the average VMT statewide.

Measure Applicability:

- Urban and suburban context
- Negligible impact in a rural context
- Appropriate for residential, retail, office, industrial and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled
$EF_{running}$ = emission factor for running emissions

Inputs:

- No inputs are needed. VMT reduction ranges are based on the geographic location of the project within the region.

Mitigation Method:

% VMT reduction =

- Urban: 65% (representing VMT reductions for the average urban area in California versus the statewide average VMT)
- Compact Infill: 30% (representing VMT reductions for the average compact infill area in California versus the statewide average VMT)
- Suburban Center: 10% (representing VMT reductions for the average suburban center in California versus the statewide average VMT)

Assumptions:

Data based upon the following references:

- Holtzclaw, et al. 2002. "Location Efficiency: Neighborhood and Socioeconomic Characteristics Determine Auto Ownership and Use – Studies in Chicago, Los Angeles, and Chicago." *Transportation Planning and Technology*, Vol. 25, pp. 1–27.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[35]
CO_2e	10-65% of running
PM	10-65% of running
CO	10-65% of running
NOx	10-65% of running
SO_2	10-65% of running
ROG	6-39% of total

Discussion:

Example:

N/A – no calculations needed

Alternative Literature:

- 13-72% reduction in VMT for infill projects

Preferred Literature:

Holtzclaw, et al., [1] studied relationships between auto ownership and mileage per car and neighborhood urban design and socio-economic characteristics in the Chicago, Los

[35] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

Angeles, and San Francisco metro areas. In all three regions, average annual vehicle miles traveled is a function of density, income, household size, and public transit, as well as pedestrian and bicycle orientation (to a lesser extent). The annual VMT for each neighborhood was reviewed to determine empirical VMT reduction "caps" for this report. These location-based caps represent the average and maximum reductions that would likely be expected in urban, infill, suburban center, and suburban locations.

Growing Cooler looked at 10 studies which have considered the effects of regional location on travel and emissions generated by individual developments. The studies differ in methodology and context but they tend to yield the same conclusion: infill locations generate substantially lower VMT per capita than do greenfield locations, ranging from 13 - 72% lower VMT.

Literature References:

[1] Holtzclaw, et al. 2002. "Location Efficiency: Neighborhood and Socioeconomic Characteristics Determine Auto Ownership and Use – Studies in Chicago, Los Angeles, and Chicago." *Transportation Planning and Technology*, Vol. 25, pp. 1–27.

[2] Ewing, et al, 2008. Growing Cooler – The Evidence on Urban Development and Climate Change. Urban Land Institute. (p.88, Figure 4-30)

Other Literature Reviewed:

None

3.1.3 Increase Diversity of Urban and Suburban Developments (Mixed Use)

Range of Effectiveness: 9-30% vehicle miles traveled (VMT) reduction and therefore 9-30% reduction in GHG emissions.

Measure Description:

Having different types of land uses near one another can decrease VMT since trips between land use types are shorter and may be accommodated by non-auto modes of transport. For example when residential areas are in the same neighborhood as retail and office buildings, a resident does not need to travel outside of the neighborhood to meet his/her trip needs. A description of diverse uses for urban and suburban areas is provided below.

Urban:

The urban project will be predominantly characterized by properties on which various uses, such as office, commercial, institutional, and residential, are combined in a single building or on a single site in an integrated development project with functional interrelationships and a coherent physical design. The mixed-use development should encourage walking and other non-auto modes of transport from residential to office/commercial/institutional locations (and vice versa). The residential units should be within ¼-mile of parks, schools, or other civic uses. The project should minimize the need for external trips by including services/facilities for day care, banking/ATM, restaurants, vehicle refueling, and shopping.

Suburban:

The suburban project will have at least three of the following on site and/or offsite within ¼-mile: Residential Development, Retail Development, Park, Open Space, or Office. The mixed-use development should encourage walking and other non-auto modes of transport from residential to office/commercial locations (and vice versa). The project should minimize the need for external trips by including services/facilities for day care, banking/ATM, restaurants, vehicle refueling, and shopping.

Measure Applicability:

- Urban and suburban context
- Negligible impact in a rural context (unless the project is a master-planned community)
- Appropriate for mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of each land use type in the project (to calculate land use index)

Mitigation Method:

% VMT Reduction = Land Use * B [not to exceed 30%]

Where

Land Use = Percentage increase in land use index versus single use development

= (land use index – 0.15)/0.15 (see Appendix C for detail)

Land use index = -a / ln(6) (from [2])

$$a = \sum_{i=1}^{6} a_i \times \ln(a_i)$$

a_i = building floor area of land use i / total square feet of area considered

- a_1 = single family residential
- a_2 = multifamily residential
- a_3 = commercial
- a_4 = industrial
- a_5 = institutional
- a_6 = park

if land use is not present and a_i is equal to 0, set a_i equal to 0.01

B = elasticity of VMT with respect to land use index (0.09 from [1])

not to exceed 500% increase

Assumptions:

Data based upon the following references:

[1] Ewing, R., and Cervero, R., "Travel and the Built Environment - A Meta-Analysis." *Journal of the American Planning Association*, <to be published> (2010). Table 4.

[2] Song, Y., and Knaap, G., “Measuring the effects of mixed land uses on housing values.” *Regional Science and Urban Economics 34 (2004) 663-680.* (p. 669) http://urban.csuohio.edu/~sugie/papers/RSUE/RSUE2005_Measuring%20the%20effects%20of%20mixed%20land%20use.pdf

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[36]
CO_2e	9-30% of running
PM	9-30% of running
CO	9-30% of running
NOx	9-30% of running
SO_2	9-30% of running
ROG	5.4-18% of total

Discussion:

In the above calculation, a land use index of 0.15 is used as a baseline representing a development with a single land use (see Appendix C for calculations).

There are two separate maxima noted in the fact sheet: a cap of 500% on the allowable percentage increase of land use index (variable A) and a cap of 30% on % VMT reduction. The rationale for the 500% cap is that there are diminishing returns to any change in environment. For example, it is reasonably doubtful that increasing the land use index by a factor of six instead of five would produce any additional change in travel behavior. The purpose for the 30% cap is to limit the influence of any single environmental factor (such as diversity). This emphasizes that community designs that implement multiple land use strategies (such as density, design, diversity, etc.) will show more of a reduction than relying on improvements from a single land use factor.

[36] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

Example:

Sample calculations are provided below:

90% single family homes, 10% commercial

- Land use index = -[0.9*ln(0.9)+ 0.1*ln(0.1)+ 4*0.01*ln(0.01)] / ln(6) = 0.3
- Low Range % VMT Reduction = (0.3 – 0.15)/0.15 *0.09 = 9%

1/6 single family, 1/6 multi-family, 1/6 commercial, 1/6 industrial, 1/6 institutional, 1/6 parks

- Land use index = -[6*0.17*ln(0.17)] / ln(6) = 1
- High Range % VMT Reduction (land use index = 1)
- Land use = (1-0.15)/0.15 = 5.6 or 566%. Since this is greater than 500%, set to 500%.
- % VMT Reduction = (5 x 0.09) = 0.45 or 45%. Since this is greater than 30%, set to 30%.

Preferred Literature:

- -0.09 = elasticity of VMT with respect to land use index

The land use (or entropy) index measurement looks at the mix of land uses of a development. An index of 0 indicates a single land use while 1 indicates a full mix of uses. Ewing's [1] synthesis looked at a total of 10 studies, where none controlled for self-selection[37]. The weighted average elasticity of VMT with respect to the land use mix index is -0.09. The methodology for calculating the land use index is described in Song and Knaap [2].

Alternative Literature:

- Vehicle trip reduction = [1 - (ABS(1.5*h-e) / (1.5*h+e)) - 0.25] / 0.25*0.03

Where :
h = study area housing units, and
e = study area employment.

Nelson\Nygaard's report [3] describes a calculation adapted from Criterion and Fehr & Peers [4]. The formula assumes an "ideal" housing balance of 1.5 jobs per household and a baseline diversity of 0.25. The maximum trip reduction with this method is 9%.

[37] Self selection occurs when residents or employers that favor travel by non-auto modes choose locations where this type of travel is possible. They are therefore more inclined to take advantage of the available options than a typical resident or employee might otherwise be.

Alternative Literature References:

[3] Nelson\Nygaard, 2005. Crediting Low-Traffic Developments (p.12). http://www.montgomeryplanning.org/transportation/documents/TripGenerationAnalysisUsingURBEMIS.pdf

[4] Criteron Planner/Engineers and Fehr & Peers Associates (2001). Index 4D Method. *A Quick-Response Method of Estimating Travel Impacts from Land-Use Changes*. Technical Memorandum prepared for US EPA, October 2001.

Other Literature Reviewed:

None

3.1.4 Increase Destination Accessibility

Range of Effectiveness: 6.7 – 20% vehicle miles traveled (VMT) reduction and therefore 6.7-20% reduction in GHG emissions.

Measure Description:

The project will be located in an area with high accessibility to destinations. Destination accessibility is measured in terms of the number of jobs or other attractions reachable within a given travel time, which tends to be highest at central locations and lowest at peripheral ones. The location of the project also increases the potential for pedestrians to walk and bike to these destinations and therefore reduces the VMT.

Measure Applicability:

- Urban and suburban context
- Negligible impact in a rural context
- Appropriate for residential, retail, office, industrial and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Distance to downtown or major job center

Mitigation Method:

% VMT Reduction = Center Distance * B [not to exceed 30%]

Where

Center Distance = Percentage decrease in distance to downtown or major job center versus typical ITE suburban development = (distance to downtown/job center for typical ITE development – distance to downtown/job center for project) / (distance to downtown/job center for typical ITE development)

Center Distance = 12 - Distance to downtown/job center for project) / 12
See Appendix C for detail

B = Elasticity of VMT with respect to distance to downtown or major job center (0.20 from [1])

Assumptions:

Data based upon the following references:

[1] Ewing, R., and Cervero, R., "Travel and the Built Environment - A Meta-Analysis." Journal of the American Planning Association, <to be published> (2010). Table 4.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[38]
CO_2e	6.7 – 20% of running
PM	6.7 – 20% of running
CO	6.7 – 20% of running
NOx	6.7 – 20% of running
SO_2	6.7 – 20% of running
ROG	4 – 12% of total

Discussion:

The VMT reductions for this strategy are based on changes in distance to key destinations versus the standard suburban distance in North America. This distance is used as a baseline to mirror the distance to destinations reflected in the land uses for the ITE Trip Generation Manual, which is the baseline method for determining VMT.

The purpose for the 30% cap on % VMT reduction is to limit the influence of any single environmental factor (such as destination accessibility). This emphasizes that community designs that implement multiple land use strategies (such as density,

[38] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

design, diversity, destination, etc.) will show more of a reduction than relying on improvements from a single land use factor.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (8 miles to downtown/job center) =
$$\frac{12-8}{12}\times 0.20 = 6.7\%$$
- High Range % VMT Reduction (0.1 miles to downtown/job center) =
$$\frac{12-0.1}{12}\times 0.20 = 20.0\%$$

Preferred Literature:

- -0.20 = elasticity of VMT with respect to job accessibility by auto
- -0.20 = elasticity of VMT with respect to distance to downtown

The Ewing and Cervero report [1] finds that VMT is strongly related to measures of accessibility to destinations. The weighted average elasticity of VMT with respect to job accessibility by auto is -0.20 (looking at five total studies). The weighted average elasticity of VMT with respect to distance to downtown is -0.22 (looking at four total studies, of which one controls for self selection[39]).

Alternative Literature:

- 10-30% reduction in vehicle trips

The VTPI literature [2] suggests a 10-30% reduction in vehicle trips for "smart growth" development practices that result in more compact, accessible, multi-modal communities where travel distances are shorter, people have more travel options, and it is possible to walk and bicycle more.

Alternative Literature References:

[2] Litman, T., 2009. "Win-Win Emission Reduction Strategies." Victoria Transport Policy Institute (VTPI). Website: http://www.vtpi.org/wwclimate.pdf. Accessed March 2010. (p. 7, Table 3)

[39] Self selection occurs when residents or employers that favor travel by non-auto modes choose locations where this type of travel is possible. They are therefore more inclined to take advantage of the available options than a typical resident or employee might otherwise be.

Other Literature Reviewed:

None

3.1.5 Increase Transit Accessibility

Range of Effectiveness: 0.5 – 24.6% VMT reduction and therefore 0.5-24.6% reduction in GHG emissions.[40]

Measure Description:

Locating a project with high density near transit will facilitate the use of transit by people traveling to or from the Project site. The use of transit results in a mode shift and therefore reduced VMT. A project with a residential/commercial center designed around a rail or bus station, is called a transit-oriented development (TOD). The project description should include, at a minimum, the following design features:

- A transit station/stop with high-quality, high-frequency bus service located within a 5-10 minute walk (or roughly ¼ mile from stop to edge of development), and/or
    - A rail station located within a 20 minute walk (or roughly ½ mile from station to edge of development)
- Fast, frequent, and reliable transit service connecting to a high percentage of regional destinations
- Neighborhood designed for walking and cycling

In addition to the features listed above, the following strategies may also be implemented to provide an added benefit beyond what is documented in the literature:

- Mixed use development [LUT-3]
- Traffic calmed streets with good connectivity [SDT-2]
- Parking management strategies such as unbundled parking, maximum parking requirements, market pricing implemented to reduce amount of land dedicated to vehicle parking [see PPT-1 through PPT-7]

Measure Applicability:

- Urban and suburban context
- Appropriate in a rural context if development site is adjacent to a commuter rail station with convenient rail service to a major employment center
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Baseline Method:

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[40] Transit vehicles may also result in increases in emissions that are associated with electricity production or fuel use. The Project Applicant should consider these potential additional emissions when estimating mitigation for these measures.

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Distance to transit station in project

Mitigation Method:

% VMT = Transit * B [not to exceed 30%]

Where

Transit = Increase in transit mode share = % transit mode share for project - % transit mode share for typical ITE development (1.3% as described in Appendix C)

% transit mode share for project (see Table)

Distance to transit	Transit mode share calculation equation (where x = distance of project to transit)
0 – 0.5 miles	-50*x + 38
0.5 to 3 miles	-4.4*x + 15.2
> 3 miles	no impact
Source: Lund et al, 2004; Fehr & Peers 2010 (see Appendix C for calculation detail)	

B = adjustments from transit ridership increase to VMT (0.67, see Appendix C for detail)

Assumptions:

Data based upon the following references:

[1] Lund, H. and R. Cervero, and R. Willson (2004). *Travel Characteristics of Transit-Oriented Development in California*. (p. 79, Table 5-25)

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[41]
CO_2e	0.5 – 24.6% of running
PM	0.5 – 24.6% of running
CO	0.5 – 24.6% of running
NOx	0.5 – 24.6% of running
SO_2	0.5 – 24.6% of running
ROG	0.3 – 14.8% of total

Discussion:

The purpose for the 30% cap on % VMT reduction is to limit the influence of any single environmental factor (such as transit accessibility). This emphasizes that community designs that implement multiple land use strategies (such as density, design, diversity, transit accessibility, etc.) will show more of a reduction than relying on improvements from a single land use factor.

Example:

Sample calculations are provided below for a rail station:

- Low Range % VMT Reduction (3 miles from station) = [(-4.4*3+15.2) – 1.3%] * 0.67 = 0.5%
- High Range % VMT Reduction (0 miles from station) = [(-50*0+38) – 1.3%] * 0.67 = 24.6%

Preferred Literature:

- 13 to 38% transit mode share (residents in TODs with ½ mile of rail station)
- 5 to 13% transit mode share (residents in TODs from ½ mile to 3 miles of rail station)

The *Travel Characteristics* report [1] surveyed TODs and surrounding areas in San Diego, Los Angeles, San Jose, Sacramento, and Bay Area regions. Survey sites are all located in non-central business district locations, are within walking distance of a transit station with rail service headways of 15 minutes or less, and were intentionally developed as TODs.

[41] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

Alternative Literature:

Alternate:

- -0.05 = elasticity of VMT with respect to distance to nearest transit stop

Ewing and Cervero's meta-analysis [2] provides this weighted average elasticity based on six total studies, of which one controls for self-selection. The report does not provide the range of distances where this elasticity is valid.

Alternate:

- 5.9 – 13.3% reduction in VMT

The Bailey, et al. 2008 report [3] predicted a reduction of household daily VMT of 5.8 miles for a location next to a rail station and 2.6 miles for a location next to a bus station. Using the report's estimate of 43.75 daily average miles driven, the estimated reduction in VMT for rail accessibility is 13.3% (5.8/43.75) and for bus accessibility is 5.9% (2.6/43.75).

Alternate:

- 15% reduction in vehicle trips
- 2 to 5 times higher transit mode share

TCRP Report 128 [4] concludes that transit-oriented developments, compared to typical developments represented by the *ITE Trip Generation Manual*, have 47% lower vehicle trip rates and have 2 to 5 times higher transit mode share. *TCRP Report 128* notes that the *ITE Trip Generation Manual* shows 6.67 daily trips per unit while detailed counts of 17 residential TODs resulted in 3.55 trips per unit (a 47% reduction in vehicle trips). This study looks at mid-rise and high-rise apartments at the residential TOD sites. A more conservative comparison would be to look at the *ITE Trip Generation Manual* rates for high-rise apartments, 4.2 trips per unit. This results in a 15% reduction in vehicle trips.

Alternative Literature References:

[2] Ewing, R., and Cervero, R., "Travel and the Built Environment - A Meta-Analysis." *Journal of the American Planning Association*, <to be published> (2010). Table 4.

[3] Bailey, L., Mokhtarian, P.L., & Little, A. (2008). "The Broader Connection between Public Transportation, Energy Conservation and Greenhouse Gas Reduction." ICF International. (Table 4 and 5)

[4] TCRP, 2008. *TCRP Report 128 - Effects of TOD on Housing, Parking, and Travel.* http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_128.pdf (p. 11, 69).

Other Literature Reviewed:

None

3.1.6 Integrate Affordable and Below Market Rate Housing

Range of Effectiveness: 0.04 – 1.20% vehicle miles traveled (VMT) reduction and therefore 0.04-1.20% reduction in GHG emissions.

Measure Description:

Income has a statistically significant effect on the probability that a commuter will take transit or walk to work [4]. BMR housing provides greater opportunity for lower income families to live closer to jobs centers and achieve jobs/housing match near transit. It also addresses to some degree the risk that new transit oriented development would displace lower income families. This strategy potentially encourages building a greater percentage of smaller units that allow a greater number of families to be accommodated on infill and transit-oriented development sites within a given building footprint and height limit. Lower income families tend to have lower levels of auto ownership, allowing buildings to be designed with less parking which, in some cases, represents the difference between a project being economically viable or not.

Residential development projects of five or more dwelling units will provide a deed-restricted low-income housing component on-site.

Measure Applicability:

- Urban and suburban context
- Negligible impact in a rural context unless transit availability and proximity to jobs/services are existing characteristics
- Appropriate for residential and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of units in project that are deed-restricted BMR housing

Mitigation Method:

% VMT Reduction = 4% * Percentage of units in project that are deed-restricted BMR housing [1]

Assumptions:

Data based upon the following references:

[1] Nelson\Nygaard, 2005. Crediting Low-Traffic Developments (p.15). http://www.montgomeryplanning.org/transportation/documents/TripGenerationAnalysisUsingURBEMIS.pdf

Criteron Planner/Engineers and Fehr & Peers Associates (2001). Index 4D Method. *A Quick-Response Method of Estimating Travel Impacts from Land-Use Changes*. Technical Memorandum prepared for US EPA, October 2001.

Holtzclaw, John; Clear, Robert; Dittmar, Hank; Goldstein, David; and Haas, Peter (2002), "Location Efficiency: Neighborhood and Socio-Economic Characteristics Determine Auto Ownership and Use – Studies in Chicago, Los Angeles and San Francisco", *Transportation Planning and Technology*, 25 (1): 1-27.

All trips affected are assumed average trip lengths to convert from percentage vehicle trip reduction to VMT reduction (%VT = %VMT)

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[42]
CO_2e	0.04 – 1.20% of running
PM	0.04 – 1.20% of running
CO	0.04 – 1.20% of running
NOx	0.04 – 1.20% of running
SO_2	0.04 – 1.20% of running
ROG	0.024 – 0.72% of total

Discussion:

At a low range, 1% BMR housing is assumed. At a medium range, 15% is assumed (based on the requirements of the San Francisco BMR Program[5]). At a high range, the San Francisco program is doubled to reach 30% BMR. Higher percentages of BMR are possible, though not discussed in the literature or calculated.

[42] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction = 4% * 1% = 0.04%
- High Range % VMT Reduction = 4% * 30% = 1.20%

Preferred Literature:

Nelson\Nygaard [1] provides a 4% reduction in vehicle trips for each deed-restricted BMR unit. This is calculated from Holtzclaw [3], with the following assumptions: 12,000 average annual VMT per vehicle, $33,000 median per capita income (2002 figures per CA State Department of Finance), and average income in BMR units 25% below median. With a coefficient of -0.0565 (estimate for VMT/vehicle as a function of $/capita) from [3], the VMT reduction is 0.0565*33,000*0.25/12,000 = 4%.

Alternative Literature:

- 50% greater transit school trips than higher income households

Fehr & Peers [6] developed Direct Ridership Models to predict the Bay Area Rapid Transit (BART) ridership activity. One of the objectives of this assessment was to understand the land use and system access factors that influence commute period versus off-peak travel on BART. The analysis focused on the Metropolitan Transportation Commission 2000 Bay Area Travel Survey [7], using the data on household travel behavior to extrapolate relationships between household characteristics and BART mode choice. The study found that regardless of distance from BART, lower income households generate at least 50% higher BART use for school trips than higher income households. More research would be needed to provide more applicable information regarding other types of transit throughout the state.

Other Literature Reviewed:

[4] Bento, Antonio M., Maureen L. Cropper, Ahmed Mushfiq Mobarak, and Katja Vinha. 2005. “The Effects of Urban Spatial Structure on Travel Demand in the United States.” *The Review of Economics and Statistics* 87,3: 466-478. (cited in Measure Description section)

[5] San Francisco BMR Program: http://www.ci.sf.ca.us/site/moh_page.asp?id=48083 (p.1) (cited in Discussion section).

[6] Fehr & Peers. *Access BART*. 2006.

[7] BATS. 2000. 2000 Bay Area Travel Survey.

3.1.7 Orient Project Toward Non-Auto Corridor

Range of Effectiveness: Grouped strategy. [See LUT-3]

Measure Description:

A project that is designed around an existing or planned transit, bicycle, or pedestrian corridor encourages alternative mode use. For this measure, the project is oriented towards a planned or existing transit, bicycle, or pedestrian corridor. Setback distance is minimized.

The benefits of Orientation toward Non-Auto Corridor have not been sufficiently quantified in the existing literature. This measure is most effective when applied in combination of multiple design elements that encourage this use. There is not sufficient evidence that this measure results in non-negligible trip reduction unless combined with measures described elsewhere in this report, including neighborhood design, density and diversity of development, transit accessibility and pedestrian and bicycle network improvements. Therefore, the trip reduction percentages presented below should be used only as reasonableness checks. They may be used to assess whether, when applied to projects oriented toward non-auto corridors, analysis of all of those other development design factors presented in this report produce trip reductions at least as great as the percentages listed below.

Measure Applicability:

- Urban or suburban context; may be applicable in a master-planned rural community
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Alternative Literature:

Alternate:

- 0.25 – 0.5% reduction in vehicle miles traveled (VMT)

The Sacramento Metropolitan Air Quality Management District (SMAQMD) Recommended Guidance for Land Use Emission Reductions attributes 0.5% reduction for a project oriented towards an *existing* corridor. A 0.25% reduction is attributed for a project oriented towards a *planned* corridor. The planned transit, bicycle, or pedestrian corridor must be in a General Plan, Community Plan, or similar plan.

Alternate:

- 0.5% reduction in VMT per 1% improvement in transit frequency
- 0.5% reduction in VMT per 10% increase in transit ridership

The *Center for Clean Air Policy (CCAP) Guidebook* [2] attributes a 0.5 % reduction per 1% improvement in transit frequency. Based on a case study presented in the CCAP report, a 10% increase in transit ridership would result in a 0.5% reduction. (This information is based on a TIAX review for SMAQMD).

The sources cited above reflect existing guidance rather than empirical studies.

Alternative Literature References:

[1] Sacramento Metropolitan Air Quality Management District (SMAQMD). "Recommended Guidance for Land Use Emission Reductions." http://www.airquality.org/ceqa/GuidanceLUEmissionReductions.pdf

[2] Center for Clean Air Policy (CCAP). *Transportation Emission Guidebook*. http://www.ccap.org/safe/guidebook/guide_complete.html
TIAX Results of 2005 Literature Search Conducted by TIAX on behalf of SMAQMD

Other Literature Reviewed:

None

3.1.8 Locate Project near Bike Path/Bike Lane

Range of Effectiveness: Grouped strategy. [See LUT-4]

Measure Description:

A Project that is designed around an existing or planned bicycle facility encourages alternative mode use. The project will be located within 1/2 mile of an existing Class I path or Class II bike lane. The project design should include a comparable network that connects the project uses to the existing offsite facilities.

This measure is most effective when applied in combination of multiple design elements that encourage this use. Refer to Increase Destination Accessibility (LUT-4) strategy. The benefits of Proximity to Bike Path/Bike Lane are small as a standalone strategy. The strategy should be grouped with the Increase Destination Accessibility strategy to increase the opportunities for multi-modal travel.

Measure Applicability:

- Urban or suburban context; may be applicable in a rural master planned community
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Alternative Literature:

Alternate:

- 0.625% reduction in vehicle miles traveled (VMT)

As a rule of thumb, the *Center for Clean Air Policy (CCAP) Guidebook* [1] attributes a 1% to 5% reduction associated with comprehensive bicycle programs. Based on the CCAP guidebook, the TIAX report allots 2.5% reduction for all bicycle-related measures and a 1/4 of that for this measure alone. (This information is based on a TIAX review for SMAQMD).

Alternative Literature References:

[1] Center for Clean Air Policy (CCAP). *Transportation Emission Guidebook*. http://www.ccap.org/safe/guidebook/guide_complete.html; TIAX Results of 2005 Literature Search Conducted by TIAX on behalf of SMAQMD.

Other Literature Reviewed:

None

3.1.9 Improve Design of Development

Range of Effectiveness: 3.0 – 21.3% vehicle miles traveled (VMT) reduction and therefore 3.0-21.3% reduction in GHG emissions.

Measure Description:

The project will include improved design elements to enhance walkability and connectivity. Improved street network characteristics within a neighborhood include street accessibility, usually measured in terms of average block size, proportion of four-way intersections, or number of intersections per square mile. Design is also measured in terms of sidewalk coverage, building setbacks, street widths, pedestrian crossings, presence of street trees, and a host of other physical variables that differentiate pedestrian-oriented environments from auto-oriented environments.

Measure Applicability:

- Urban and suburban context
- Negligible impact in a rural context
- Appropriate for residential, retail, office, industrial and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Number of intersections per square mile

Mitigation Method:

$$\% \text{ VMT Reduction} = \text{Intersections} * B$$

Where

Intersections = Percentage increase in intersections versus a typical ITE suburban development

$$= \frac{\text{Intersections per square mile of project} - \text{Intersections per square mile of typical ITE suburban development}}{\text{Intersections per square mile of typical ITE suburban development}}$$

$$= \frac{\text{Intersections per square mile of project} - 36}{36}$$

See Appendix C for detail [not to exceed 500% increase]

B = Elasticity of VMT with respect to percentage of intersections (0.12 from [1])

Assumptions:

Data based upon the following references:

[1] Ewing, R., and Cervero, R., "Travel and the Built Environment - A Meta-Analysis." *Journal of the American Planning Association*, <to be published> (2010). Table 4.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[43]
CO_2e	3.0 – 21.3% of running
PM	3.0 – 21.3% of running
CO	3.0 – 21.3% of running
NOx	3.0 – 21.3% of running
SO_2	3.0 – 21.3% of running
ROG	1.8 – 12.8% of total

Discussion:

The VMT reductions for this strategy are based on changes in intersection density versus the standard suburban intersection density in North America. This standard density is used as a baseline to mirror the density reflected in the *ITE Trip Generation Manual*, which is the baseline method for determining VMT.

The calculations in the Example section look at a low and high range of intersection densities. The low range is simply a slightly higher density than the typical ITE

[43] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

development. The high range uses an average intersection density of mixed use/transit-oriented development sites (TOD Site surveys in the Bay Area for *Candlestick-Hunters Point Phase II TIA,* Fehr & Peers, 2009).

There are two separate maxima noted in the fact sheet: a cap of 500% on the allowable percentage increase of intersections per square mile (variable A) and a cap of 30% on % VMT reduction. The rationale for the 500% cap is that there are diminishing returns to any change in environment. For example, it is reasonably doubtful that increasing intersection density by a factor of six instead of five would produce any additional change in travel behavior. The purpose for the 30% cap is to limit the influence of any single environmental factor (such as design). This emphasizes that community designs that implement multiple land use strategies (such as density, design, diversity, etc.) will show more of a reduction than relying on improvements from a single land use factor.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (45 intersections per square mile) = (45 – 36) / 36 * 0.12 = 3.0%
- High Range % VMT Reduction (100 intersections per square mile) = (100 – 36) / 36 * 0.12 = 21.3%

Preferred Literature:

- -0.12 = elasticity of VMT with respect to design (intersection/street density)
- -0.12 = elasticity of VMT with respect to design (% of 4-way intersections)

Ewing and Cervero's [1] synthesis showed a strong relationship of VMT to design elements, second only to destination accessibility. The weighted average elasticity of VMT to intersection/street density was -0.12 (looking at six studies). The weighted average elasticity of VMT to percentage of 4-way intersections was -0.12 (looking at four studies, of which one controlled for self-selection[44]).

Alternative Literature:

Alternate:

- 2-19% reduction in VMT

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[44] Self selection occurs when residents or employers that favor travel by non-auto modes choose locations where this type of travel is possible. They are therefore more inclined to take advantage of the available options than a typical resident or employee might otherwise be.

Growing Cooler [2] looked at various reports which studied the effect of site design on VMT, showing a range of 2-19% reduction in VMT. In each case, alternative development plans for the same site were compared to a baseline or trend plan. Results suggest that VMT and CO_2 per capita decline as site density increases as well as the mix of jobs, housing, and retail uses become more balanced. *Growing Cooler* notes that the limited number of studies, differences in assumptions and methodologies, and variability of results make it difficult to generalize.

Alternate:

- 3 – 17% shift in mode share from auto to non-auto

The Marshall and Garrick paper [3] analyzes the differences in mode shares for grid and non-grid ("tree") neighborhoods. For a city with a tributary tree street network, a neighborhood with a tree network had auto mode share of 92% while a neighborhood with a grid network had auto mode share of 89% (3% difference). For a city with a tributary radial street network, a tree neighborhood had auto mode share of 97% while a grid neighborhood had auto mode share of 84% (13% difference). For a city with a grid network, a tree neighborhood had auto mode share of 95% while a grid neighborhood had auto mode share of 78% (17% difference). The research is based on 24 California cities with populations between 30,000 and 100,000.

Alternative Literature References:

[2] Ewing, et al, 2008. Growing Cooler – The Evidence on Urban Development and Climate Change. Urban Land Institute.

[3] Marshall and Garrick, 2009. "The Effect of Street Network Design on Walking and Biking." Submitted to the 89th Annual Meeting of Transportation Research Board, January 2010. (Table 3)

Other Literature Reviewed:

None

3.2 Neighborhood/Site Enhancements

3.2.1 Provide Pedestrian Network Improvements

Range of Effectiveness: 0 - 2% vehicle miles traveled (VMT) reduction and therefore 0 - 2% reduction in GHG emissions.

Measure Description:

Providing a pedestrian access network to link areas of the Project site encourages people to walk instead of drive. This mode shift results in people driving less and thus a reduction in VMT. The project will provide a pedestrian access network that internally links all uses and connects to all existing or planned external streets and pedestrian facilities contiguous with the project site. The project will minimize barriers to pedestrian access and interconnectivity. Physical barriers such as walls, landscaping, and slopes that impede pedestrian circulation will be eliminated.

Measure Applicability:

- Urban, suburban, and rural context
- Appropriate for residential, retail, office, industrial and mixed-use projects
- Reduction benefit only occurs if the project has both pedestrian network improvements on site and connections to the larger off-site network.

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The project applicant must provide information regarding pedestrian access and connectivity within the project and to/from off-site destinations.

Mitigation Method:

Estimated VMT Reduction	Extent of Pedestrian Accommodations	Context
2%	Within Project Site and Connecting Off-Site	Urban/Suburban
1%	Within Project Site	Urban/Suburban
< 1%	Within Project Site and Connecting Off-Site	Rural

Assumptions:

Data based upon the following references:

- Center for Clean Air Policy (CCAP) Transportation Emission Guidebook. http://www.ccap.org/safe/guidebook/guide_complete.html (accessed March 2010)
- 1000 Friends of Oregon (1997) "Making the Connections: A Summary of the LUTRAQ Project" (p. 16): http://www.onethousandfriendsoforegon.org/resources/lut_vol7.html

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[45]
CO_2e	0 - 2% of running
PM	0 - 2% of running
CO	0 - 2% of running
NOx	0 - 2% of running
SO_2	0 - 2% of running
ROG	0 – 1.2% of total

Discussion:

As detailed in the preferred literature section below, the lower range of 1 – 2% VMT reduction was pulled from the literature to provide a conservative estimate of reduction potential. The literature does not speak directly to a rural context, but an assumption was made that the benefits will likely be lower than a suburban/urban context.

Example:

N/A – calculations are not needed.

Preferred Literature:

[45] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

- 1 - 2% reduction in VMT

The Center for Clean Air Policy (CCAP) attributes a 1% reduction in VMT from pedestrian-oriented design assuming this creates a 5% decrease in automobile mode share (e.g. auto split shifts from 95% to 90%). This mode split is based on the Portland Regional Land Use Transportation and Air Quality (LUTRAQ) project. The LUTRAQ analysis also provides the high end of 10% reduction in VMT. This 10% assumes the following features:

– Compact, mixed-use communities
– Interconnected street network
– Narrower roadways and shorter block lengths
– Sidewalks
– Accessibility to transit and transit shelters
– Traffic calming measures and street trees
– Parks and public spaces

Other strategies (development density, diversity, design, transit accessibility, traffic calming) are intended to account for the effects of many of the measures in the above list. Therefore, the assumed effectiveness of the Pedestrian Network measure should utilize the lower end of the 1 - 10% reduction range. If the pedestrian improvements are being combined with a significant number of the companion strategies, trip reductions for those strategies should be applied as well, based on the values given specifically for those strategies in other sections of this report. Based upon these findings, and drawing upon recommendations presented in the alternate literature below, the recommended VMT reduction attributable to pedestrian network improvements, above and beyond the benefits of other measures in the above bullet list, should be 1% for comprehensive pedestrian accommodations within the development plan or project itself, or 2% for comprehensive internal accommodations and external accommodations connecting to off-site destinations.

Alternative Literature:

Alternate:

- Walking is three times more common with enhanced pedestrian infrastructure
- 58% increase in non-auto mode share for work trips

The Nelson\Nygaard [1] report for the City of Santa Monica Land Use and Circulation Element EIR summarized studies looking at pedestrian environments. These studies have found a direct connection between non-auto forms of travel and a high quality pedestrian environment. Walking is three times more common with communities that have pedestrian friendly streets compared to less pedestrian friendly communities. Non-auto mode share for work trips is 49% in a pedestrian friendly community, compared to 31% in an auto-oriented community. Non-auto mode share for non-work trips is 15%, compared to 4% in an auto-oriented community. However, these effects also depend upon other aspects of the pedestrian friendliness being present, which are accounted for separately in this report through land use strategy mitigation measures such as density and urban design.

Alternate:

- 0.5% - 2.0% reduction in VMT

The Sacramento Metropolitan Air Quality Management District (SMAQMD) Recommended Guidance for Land Use Emission Reductions [2] attributes 1% reduction for a project connecting to *existing* external streets and pedestrian facilities. A 0.5% reduction is attributed to connecting to *planned* external streets and pedestrian facilities (which must be included in a pedestrian master plan or equivalent). Minimizing pedestrian barriers attribute an additional 1% reduction in VMT. These recommendations are generally in line with the recommended discounts derived from the preferred literature above.

Preferred and Alternative Literature Notes:

[1] Nelson\Nygaard, 2010. City of Santa Monica Land Use and Circulation Element EIR Report, Appendix – Santa Monica Luce Trip Reduction Impacts Analysis (p.401). http://www.shapethefuture2025.net/

Nelson\Nygaard looked at the following studies: Anne Vernez Moudon, Paul Hess, Mary Catherine Snyder and Kiril Stanilov (2003), Effects of Site Design on Pedestrian Travel in Mixed Use, Medium-Density Environments, http://www.wsdot.wa.gov/research/reports/fullreports/432.1.pdf; Robert Cervero and Carolyn Radisch (1995), Travel Choices in Pedestrian Versus Automobile Oriented Neighborhoods, http://www.uctc.net/papers/281.pdf;

[2] Sacramento Metropolitan Air Quality Management District (SMAQMD) Recommended Guidance for Land Use Emission Reductions. (p. 11) http://www.airquality.org/ceqa/GuidanceLUEmissionReductions.pdf

Other Literature Reviewed:

None

3.2.2 Provide Traffic Calming Measures

Range of Effectiveness: 0.25 – 1.00% vehicle miles traveled (VMT) reduction and therefore 0.25 – 1.00% reduction in GHG emissions.

Measure Description:

Providing traffic calming measures encourages people to walk or bike instead of using a vehicle. This mode shift will result in a decrease in VMT. Project design will include pedestrian/bicycle safety and traffic calming measures in excess of jurisdiction requirements. Roadways will be designed to reduce motor vehicle speeds and encourage pedestrian and bicycle trips with traffic calming features. Traffic calming features may include: marked crosswalks, count-down signal timers, curb extensions, speed tables, raised crosswalks, raised intersections, median islands, tight corner radii, roundabouts or mini-circles, on-street parking, planter strips with street trees, chicanes/chokers, and others.

Measure Applicability:

- Urban, suburban, and rural context
- Appropriate for residential, retail, office, industrial and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of streets within project with traffic calming improvements
- Percentage of intersections within project with traffic calming improvements

Mitigation Method:

		% of streets with improvements			
		25%	*50%*	*75%*	*100%*
		% VMT Reduction			
% of intersections with improvements	*25%*	**0.25%**	**0.25%**	**0.5%**	**0.5%**
	50%	**0.25%**	**0.5%**	**0.5%**	**0.75%**
	75%	**0.5%**	**0.5%**	**0.75%**	**0.75%**
	100%	**0.5%**	**0.75%**	**0.75%**	**1%**

Assumptions:

Data based upon the following references:

[1] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.*(p. B-25) http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendices_Complete_102209.pdf

[2] Sacramento Metropolitan Air Quality Management District (SMAQMD) *Recommended Guidance for Land Use Emission Reductions.* (p.13) http://www.airquality.org/ceqa/GuidanceLUEmissionReductions.pdf

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[46]
CO_2e	0.25 – 1.00% of running
PM	0.25 – 1.00% of running
CO	0.25 – 1.00% of running
NOx	0.25 – 1.00% of running
SO_2	0.25 – 1.00% of running
ROG	0.15 – 0.6% of total

Discussion:

The table above allows the Project Applicant to choose a range of street and intersection improvements to determine an appropriate VMT reduction estimate. The Applicant will look at the rows on the left and choose the percent of intersections within

[46] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

the project which will have traffic calming improvements. Then, the Applicant will look at the columns along the top and choose the percent of streets within the project which will have traffic calming improvements. The intersection cell of the row and column selected in the matrix is the VMT reduction estimate.

Though the literature provides some difference between a suburban and urban context, the difference is small and thus a conservative estimate was used to be applied to all contexts. Rural context is not specifically discussed in the literature but is assumed to have similar impacts.

For a low range, a project is assumed to have 25% of its streets with traffic calming improvements and 25% of its intersections with traffic calming improvements. For a high range, 100% of streets and intersections are assumed to have traffic calming improvements

Example:

N/A - No calculations needed.

Preferred Literature:

- -0.03 = elasticity of VMT with respect to a pedestrian environment factor (PEF)
- 1.5% - 2.0% reduction in suburban VMT
- 0.5% - 0.6% reduction in urban VMT

Moving Cooler [1] looked at Ewing's synthesis elasticity from the Smart Growth INDEX model (-0.03) to estimate VMT reduction for a suburban and urban location. The estimated reduction in VMT came from looking at the difference between the VMT results for Moving Cooler's strategy of pedestrian accessibility only compared to an aggressive strategy of pedestrian accessibility and traffic calming.

The Sacramento Metropolitan Air Quality Management District (SMAQMD) *Recommended Guidance for Land Use Emission Reductions* [2] attributes 0.25 – 1% of VMT reductions to traffic calming measures. The table above illustrates the range of VMT reductions based on the percent of streets and intersections with traffic calming measures implemented. This range of reductions is recommended because it is generally consistent with the effectiveness ranges presented in the other preferred literature for situations in which the effects of traffic calming are distinguished from the other measures often found to co-exist with calming, and because it provides graduated effectiveness estimates depending on the degree to which calming is implemented.

Alternative Literature:

None

Alternative Literature References:

None

Other Literature Reviewed:

None

3.2.3 Implement a Neighborhood Electric Vehicle (NEV) Network

Range of Effectiveness: 0.5-12.7% vehicle miles traveled (VMT) reduction since Neighborhood Electric Vehicles (NEVs) would result in a mode shift and therefore reduce the traditional vehicle VMT and GHG emissions[47]. Range depends on the available NEV network and support facilities, NEV ownership levels, and the degree of shift from traditional

Measure Description:

The project will create local "light" vehicle networks, such as NEV networks. NEVs are classified in the California Vehicle Code as a "low speed vehicle". They are electric powered and must conform to applicable federal automobile safety standards. NEVs offer an alternative to traditional vehicle trips and can legally be used on roadways with speed limits of 35 MPH or less (unless specifically restricted). They are ideal for short trips up to 30 miles in length. To create an NEV network, the project will implement the necessary infrastructure, including NEV parking, charging facilities, striping, signage, and educational tools. NEV routes will be implemented throughout the project and will double as bicycle routes.

Measure Applicability:

- Urban, suburban, and rural context
- Small citywide or large multi-use developments
- Appropriate for mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

[47] Transit vehicles may also result in increases in emissions that are associated with electricity production or fuel use. The Project Applicant should consider these potential additional emissions when estimating mitigation for these measures.

Inputs:

The following information needs to be provided by the Project Applicant:

- low vs. high penetration

Mitigation Method:

% VMT reduction = Pop * Number * NEV

Where

Penetration	=	Number of NEVs per household (0.04 to 1.0 from [1])
NEV	=	VMT reduction rate per household (12.7% from [2])

Assumptions:

Data based upon the following reference:

[1] City of Lincoln, MHM Engineers & Surveyors, *Neighborhood Electric Vehicle Transportation Program Final Report*, Issued 04/05/05

[2] City of Lincoln, *A Report to the California Legislature as required by Assembly Bill 2353, Neighborhood Electric Vehicle Transportation Plan Evaluation,* January 1, 2008.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[48]
CO_2e	0.5 – 12.7% of running
PM	0.5 – 12.7% of running
CO	0.5 – 12.7%of running
NOx	0.5 – 12.7% of running
SO_2	0.5 – 12.7% of running
ROG	0.3 – 7.6% of total

Discussion:

The estimated number of NEVs per household may vary based on what the project estimates as a penetration rate for implementing an NEV network. Adjust according to project characteristics. The estimated reduction in VMT is for non-NEV miles traveled. The calculations below assume that NEV miles traveled replace regular vehicle travel.

▪ [48] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

This may not be the case and the project should consider applying an appropriate discount rate on what percentage of VMT is actually replaced by NEV travel..

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (low penetration) = 0.04 * 12.7% = 0.5%
- High Range % VMT Reduction (high penetration) = 1.0 * 12.7% = 12.7%

Preferred Literature:

- 12.7% reduction in VMT per household
- Penetration rates: 0.04 to 1 NEV / household

The NEV Transportation Program plans to implement the following strategies: charging facilities, striping, signage, parking, education on NEV safety, and NEV/bicycle lines throughout the community. . One estimate of current NEV ownership reported roughly 600 NEVs in the city of Lincoln in 2008[49]. With current estimated households of ~13,500[50], a low estimate of NEV penetration would be 0.04 NEV per household. A high NEV penetration can be estimated at 1 NEV per household. The 2007 survey of NEV users in Lincoln revealed an average use of about 3,500 miles per year [2]. With an estimated annual 27,500 VMT/household[51], this results in a 12.7% reduction in VMT per household.

Alternative Literature:

- 0.5% VMT reduction for neighborhoods with internal NEV connections
- 1% VMT reduction for internal and external connections to surrounding neighborhoods
- 1.5% VMT reduction for internal NEV connections and connections to other existing NEV networks serving all other types of uses.

The Sacramento Metropolitan Air Quality Management District (SMAQMD) Recommended Guidance for Land Use Emission Reductions notes that current studies show NEVs do not replace gas-fueled vehicles as the primary vehicle. For the purpose

[49] Lincoln, California: A NEV-Friendly Community, Bennett Engineering, the City of Lincoln, and LincolnNEV, August 28, 2008 - http://electrickmotorsports.com/news.php
[50] SACOG Housing Estimates Statistics (http://www.sacog.org/about/advocacy/pdf/fact-sheets/HousingStats.pdf). Linearly interpolated 2008 household numbers between 2005 and 2035 projections.
[51] SACOG SACSim forecasts for VMT per household at 75.4 daily VMT per household * 365 days = 27521 annual VMT per household

of providing incentives for developers to promote NEV use, a project will receive the above listed VMT reductions for implementation.

Alternative Literature Reference:

[1] Sacramento Metropolitan Air Quality Management District (SMAQMD) Recommended Guidance for Land Use Emission Reductions. (p. 21) http://www.airquality.org/ceqa/GuidanceLUEmissionReductions.pdf

Other Literature Reviewed:

None

3.2.4 Create Urban Non-Motorized Zones

Range of Effectiveness: Grouped strategy. [See SDT-1]

Measure Description:

The project, if located in a central business district (CBD) or major activity center, will convert a percentage of its roadway miles to transit malls, linear parks, or other non-motorized zones. These features encourage non-motorized travel and thus a reduction in VMT.

This measure is most effective when applied with multiple design elements that encourage this use. Refer to Pedestrian Network Improvements (SDT-1) strategy for ranges of effectiveness in this category. The benefits of Urban Non-Motorized Zones alone have not been shown to be significant.

Measure Applicability:

- Urban context
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Alternative Literature:

Alternate:

- 0.01 – 0.2% annual Vehicle Miles Traveled (VMT) reduction

Moving Cooler [1] assumes 2 – 6% of U.S. CBDs/activity centers will convert to non-motorized zones for the purpose of calculating the potential impact. At full implementation, this would result in a range of CBD/activity center annual VMT reduction of 0.07-0.2% and metro VMT reduction of 0.01-0.03%.

Alternate:

Pucher, Dill, and Handy (2010) [2] note several international case studies of urban non-motorized zones. In Bologna, Italy, vehicle traffic declined by 50%, and 8% of those arriving in the CBD came by bicycle after the conversion. In Lubeck, Germany, of those who used to drive, 12% switched to transit, walking, or bicycling with the conversion. In Aachen, Germany, car travel declined from 44% to 36%, but bicycling stayed constant at 3%

Notes:

No literature was identified that quantifies the benefits of this strategy at a smaller scale.

Alternative Literature References:

[1] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf

[2] Pucher J., Dill, J., and Handy, S. *Infrastructure, Programs and Policies to Increase Bicycling: An International Review.* February 2010. *Preventive Medicine 50 (2010) S106–S125.* http://policy.rutgers.edu/faculty/pucher/Pucher_Dill_Handy10.pdf

Other Literature Reviewed:

None

3.2.5 Incorporate Bike Lane Street Design (on-site)

Range of Effectiveness: Grouped strategy. [See LUT-9]

Measure Description:

The project will incorporate bicycle lanes, routes, and shared-use paths into street systems, new subdivisions, and large developments. These on-street bike accommodations will be created to provide a continuous network of routes, facilitated with markings and signage. These improvements can help reduce peak-hour vehicle trips by making commuting by bike easier and more convenient for more people. In addition, improved bicycle facilities can increase access to and from transit hubs, thereby expanding the "catchment area" of the transit stop or station and increasing ridership. Bicycle access can also reduce parking pressure on heavily-used and/or heavily-subsidized feeder bus lines and auto-oriented park-and-ride facilities.

Refer to Improve Design of Development (LUT-9) strategy for overall effectiveness levels. The benefits of Bike Lane Street Design are small and should be grouped with the Improve Design of Development strategy to strengthen street network characteristics and enhance multi-modal environments.

Measure Applicability:

- Urban and suburban context
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Alternative Literature:

Alternate:

- 1% increase in share of workers commuting by bicycle (for each additional mile of bike lanes per square mile)

Dill and Carr (2003) [1] showed that each additional mile of Type 2 bike lanes per square mile is associated with a 1% increase in the share of workers commuting by bicycle. Note that increasing by 1 mile is significant compared to the current average of 0.34 miles per square mile. Also, an increase in 1% in share of bicycle commuters would double the number of bicycle commuters in many areas with low existing bicycle mode share.

Alternate:

- 0.05 – 0.14% annual greenhouse gas (GHG) reduction
- 258 – 830% increase in bicycle community

Moving Cooler [2], based off of a national baseline, estimates 0.05% annual reduction in GHG emissions and 258% increase in bicycle commuting assuming 2 miles of bicycle lanes per square mile in areas with density > 2,000 persons per square mile. For 4 miles of bicycle lanes, estimates 0.09% GHG reductions and 449% increase in bicycle commuting. For 8 miles of bicycle lanes, estimates 0.14% GHG reductions and 830% increase in bicycle commuting. Companion strategies assumed include bicycle parking at commercial destinations, busses fitted with bicycle carriers, bike accessible rapid transit lines, education, bicycle stations, end-trip facilities, and signage.

Alternate:

- 0.075% increase in bicycle commuting with each mile of bikeway per 100,000 residents

A before-and-after study by Nelson and Allen (1997) [3] of bicycle facility implementation found that each mile of bikeway per 100,000 residents increases bicycle commuting 0.075%, all else being equal.

Alternative Literature References:

[1] Dill, Jennifer and Theresa Carr (2003). "Bicycle Commuting and Facilities in Major U.S. Cities: If You Build Tem, Commuters Will Use Them – Another Look." *TRB 2003 Annual Meeting CD-ROM*.

[2] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf

[3] Nelson, Arthur and David Allen (1997). "If You Build Them, Commuters Will Use Them; Cross-Sectional Analysis of Commuters and Bicycle Facilities." *Transportation Research Record 1578.*

Other Literature Reviewed:

None

3.2.6 Provide Bike Parking in Non-Residential Projects

Range of Effectiveness: Grouped strategy. [See LUT-9]

Measure Description:

A non-residential project will provide short-term and long-term bicycle parking facilities to meet peak season maximum demand. Refer to Improve Design of Development (LUT-9) strategy for overall effectiveness ranges. Bike Parking in Non-Residential Projects has minimal impacts as a standalone strategy and should be grouped with the Improve Design of Development strategy to encourage bicycling by providing strengthened street network characteristics and bicycle facilities.

Measure Applicability:

- Urban, suburban, and rural contexts
- Appropriate for retail, office, industrial, and mixed-use projects

Alternative Literature:

Alternate:

- 0.625% reduction in Vehicle Miles Traveled (VMT)

As a rule of thumb, the Center for Clean Air Policy (CCAP) guidebook [1] attributes a 1% to 5% reduction in VMT to the use of bicycles, which reflects the assumption that their use is typically for shorter trips. Based on the *CCAP Guidebook*, the TIAX report allots 2.5% reduction for all bicycle-related measures and a quarter of that for this bicycle parking alone. (This information is based on a TIAX review for Sacramento Metropolitan Air Quality Management District (SMAQMD).)

Alternate:

- 0.05 – 0.14% annual greenhouse gas (GHG) reduction
- 258 – 830% increase in bicycle community

Moving Cooler [2], based off of a national baseline, estimates 0.05% annual reduction in GHG emissions and 258% increase in bicycle commuting assuming 2 miles of bicycle lanes per square mile in areas with density > 2,000 persons per square mile. For 4 miles of bicycle lanes, *Moving Cooler* estimates 0.09% GHG reductions and 449% increase in bicycle commuting. For 8 miles of bicycle lanes, *Moving Cooler* estimates 0.14% GHG reductions and 830% increase in bicycle commuting. Companion strategies assumed include bicycle parking at commercial destinations, busses fitted with bicycle carriers, bike accessible rapid transit lines, education, bicycle stations, end-trip facilities, and signage.

Alternative Literature References:

[1]*Center For Clean Air Policy (CCAP) Transportation Emission Guidebook*. http://www.ccap.org/safe/guidebook/guide_complete.html; Based on results of 2005 literature search conducted by TIAX on behalf of SMAQMD.

[2] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf

Other Literature Reviewed:

None

3.2.7 Provide Bike Parking with Multi-Unit Residential Projects

Range of Effectiveness: Grouped strategy. [See LUT-9]

Measure Description:

Long-term bicycle parking will be provided at apartment complexes or condominiums without garages. Refer to Improve Design of Development (LUT-9) strategy for effectiveness ranges in this category. The benefits of Bike Parking with Multi-Unit Residential Projects have no quantified impacts and should be grouped with the Improve Design of Development strategy to encourage bicycling by providing strengthened street network characteristics and bicycle facilities.

Measure Applicability:

- Urban, suburban, or rural contexts
- Appropriate for residential projects

Alternative Literature:

No literature was identified that specifically looks at the quantitative impact of including bicycle parking at multi-unit residential sites.

Alternative Literature References:

None

Other Literature Reviewed:

None

3.2.8 Provide Electric Vehicle Parking

Range of Effectiveness: Grouped strategy. [See SDT-3]

Measure Description:

This project will implement accessible electric vehicle parking. The project will provide conductive/inductive electric vehicle charging stations and signage prohibiting parking for non-electric vehicles. Refer to Neighborhood Electric Vehicle Network (SDT-3) strategy for effectiveness ranges in this category. The benefits of Electric Vehicle Parking may be quantified when grouped with the use of electric vehicles and or Neighborhood Electric Vehicle Network.

Measure Applicability:

- Urban or suburban contexts
- Appropriate for residential, retail, office, mixed use, and industrial projects

Alternative Literature:

No literature was identified that specifically looks at the quantitative impact of implementing electric vehicle parking.

Alternative Literature References:

None

Other Literature Reviewed:

None

3.2.9 Dedicate Land for Bike Trails

Range of Effectiveness: Grouped strategy. [See LUT-9]

Measure Description:

Larger projects may be required to provide for, contribute to, or dedicate land for the provision of off-site bicycle trails linking the project to designated bicycle commuting routes in accordance with an adopted citywide or countywide bikeway plan.

Refer to Improve Design of Development (LUT-9**)** strategy for ranges of effectiveness in this category. The benefits of Land Dedication for Bike Trails have not been quantified and should be grouped with the Improve Design of Development strategy to strengthen street network characteristics and improve connectivity to off-site bicycle networks.

Measure Applicability:

- Urban, suburban, or rural contexts
- Appropriate for large residential, retail, office, mixed use, and industrial projects

Alternative Literature:

No literature was identified that specifically looks at the quantitative impact of implementing land dedication for bike trails.

Alternative Literature References:

None

Other Literature Reviewed:

None

3.3 Parking Policy/Pricing

3.3.1 Limit Parking Supply

Range of Effectiveness: 5 – 12.5% vehicle miles travelled (VMT) reduction and therefore 5 – 12.5% reduction in GHG emissions.

Measure Description:

The project will change parking requirements and types of supply within the project site to encourage "smart growth" development and alternative transportation choices by project residents and employees. This will be accomplished in a multi-faceted strategy:

- Elimination (or reduction) of minimum parking requirements[52]
- Creation of maximum parking requirements
- Provision of shared parking

Measure Applicability:

- Urban and suburban context
- Negligible in a rural context
- Appropriate for residential, retail, office, industrial and mixed-use projects
- Reduction can be counted only if spillover parking is controlled (via residential permits and on-street market rate parking) [See PPT-5 and PPT-7]

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled
$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- ITE parking generation rate for project site
- Actual parking provision rate for project site

[52] This may require changes to local ordinances and regulations.

Mitigation Method:

$$\% \text{ VMT Reduction} = \frac{\text{Actual parking provision} - \text{ITE parking generation rate}}{\text{ITE parking generation rate}} \times 0.5$$

Assumptions:

Data based upon the following references:

[1] Nelson\Nygaard, 2005. Crediting Low-Traffic Developments (p. 16) http://www.montgomeryplanning.org/transportation/documents/TripGenerationAnalysisUsingURBEMIS.pdf

All trips affected are assumed average trip lengths to convert from percentage vehicle trip reduction to VMT reduction (% vehicle trips = %VMT).

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[53]
CO_2e	5 – 12.5% of running
PM	5 – 12.5% of running
CO	5 – 12.5% of running
NOx	5 – 12.5% of running
SO_2	5 – 12.5% of running
ROG	3 – 7.5% of total

Discussion:

The literature suggests that a 50% reduction in conventional parking provision rates (per ITE rates) should serve as a typical ceiling for the reduction calculation. The upper range of VMT reduction will vary based on the size of the development (total number of spaces provided). ITE rates are used as baseline conditions to measure the effectiveness of this strategy.

Though not specifically documented in the literature, the degree of effectiveness of this measure will vary based on the level of urbanization of the project and surrounding areas, level of existing transit service, level of existing pedestrian and bicycle networks and other factors which would complement the shift away from single-occupant vehicle travel.

[53] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis.

Example:

If the ITE parking generation rate for the project is 100 spaces, for a low range a 5% reduction in spaces is assumed. For a high range a 25% reduction in spaces is assumed.

- Low range % VMT Reduction = [(100 - 95)/100] * 0.5 = 2.5%
- High range % VMT Reduction = [(100 - 75)/100] * 0.5 = 12.5%

Preferred Literature:

To develop this model, Nelson\Nygaard [1] used the Institute of Transportation Engineers' *Parking Generation* handbook as the baseline figure for parking supply. This is assumed to be unconstrained demand. Trip reduction should only be credited if measures are implemented to control for spillover parking in and around the project, such as residential parking permits, metered parking, or time-limited parking.

Alternative Literature:

- 100% increase in transit ridership
- 100% increase in transit mode share

According to *TCRP Report 95, Chapter 18* [2], the central business district of Portland, Oregon implemented a maximum parking ratio of 1 space per 1,000 square feet of new buildings and implemented surface lot restrictions which limited conditions where buildings could be razed for parking. A "before and after" study was not conducted specifically for the maximum parking requirements and data comes from various surveys and published reports. Based on rough estimates the approximate parking ratio of 3.4 per 1,000 square feet in 1973 (for entire downtown) had been reduce to 1.5 by 1990. Transit mode share increased from 20% to 40%. The increases in transit ridership and mode share are not solely from maximum parking requirements. Other companion strategies, such as market parking pricing and high fuel costs, were in place.

Alternative Literature Sources:

[1] TCRP Report 95, Chapter 18: Parking Management and Supply: Traveler Response to *Transportation System Changes*. (p. 18-6) http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_95c18.pdf

Other Literature Reviewed:

None

3.3.2 Unbundle Parking Costs from Property Cost

Range of Effectiveness: 2.6 – 13% vehicles miles traveled (VMT) reduction and therefore 2.6 – 13% reduction in GHG emissions.

Measure Description:

This project will unbundle parking costs from property costs. Unbundling separates parking from property costs, requiring those who wish to purchase parking spaces to do so at an additional cost from the property cost. This removes the burden from those who do not wish to utilize a parking space. Parking will be priced separately from home rents/purchase prices or office leases. An assumption is made that the parking costs are passed through to the vehicle owners/drivers utilizing the parking spaces.

Measure Applicability:

- Urban and suburban context
- Negligible impact in a rural context
- Appropriate for residential, retail, office, industrial and mixed-use projects
- Complementary strategy includes Workplace Parking Pricing. Though not required, implementing workplace parking pricing ensures the market signal from unbundling parking is transferred to the employee.

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Monthly parking cost for project site

Mitigation Method:

% Reduction in VMT = Change in vehicle cost * elasticity * A

Where:

- -0.4 = elasticity of vehicle ownership with respect to total vehicle costs (lower end per VTPI)
- Change in vehicle cost = monthly parking cost * (12 / $4,000), with $4,000 representing the annual vehicle cost per VTPI [1]
- A: 85% = adjustment from vehicle ownership to VMT (see Appendix C for detail)

Assumptions:

Data based upon the following references:

[1] Victoria Transport Policy Institute, *Parking Requirement Impacts on Housing Affordability;* http://www.vtpi.org/park-hou.pdf; January 2009; accessed March 2010. (Annual/monthly parking fees estimated by VTPI in 2009) (p. 8, Table 3)

- For the elasticity of vehicle ownership, VTPI cites Phil Goodwin, Joyce Dargay and Mark Hanly (2003), *Elasticities Of Road Traffic And Fuel Consumption With Respect To Price And Income: A Review*, ESRC Transport Studies Unit, University College London (www.transport.ucl.ac.uk), commissioned by the UK Department of the Environment, Transport and the Regions (now UK Department for Transport); J.O. Jansson (1989), "Car Demand Modeling and Forecasting," *Journal of Transport Economics and Policy*, May 1989, pp. 125-129; Stephen Glaister and Dan Graham (2000), *The Effect of Fuel Prices on Motorists*, AA Motoring Policy Unit (www.theaa.com) and the UK Petroleum Industry Association (http://195.167.162.28/policyviews/pdf/effect_fuel_prices.pdf); and Thomas F. Golob (1989), "The Casual Influences of Income and Car Ownership on Trip Generation by Mode", *Journal of Transportation Economics and Policy*, May 1989, pp. 141-162

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[54]
CO_2e	2.6 – 13% of running
PM	2.6 – 13% of running
CO	2.6 – 13% of running

[54] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

NOx	2.6 – 13% of running
SO_2	2.6 – 13% of running
ROG	1.6 – 7.8% of total

Discussion:

As discussed in the preferred literature section, monthly parking costs typically range from $25 to $125. The lower end of the elasticity range provided by VTPI is used here to be conservative.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction = $25* 12 / $4000 * 0.4 * 85% = 2.6%
- High Range % VMT Reduction = $125* 12 / $4000 * 0.4 * 85%= 12.8%

Preferred Literature:

- -0.4 to -1.0 = elasticity of vehicle ownership with respect to total vehicle costs

The above elasticity comes from a synthesis of literature. As noted in the VTPI report [1], a 10% increase in total vehicle costs (operating costs, maintenance, fuel, parking, etc.) reduces vehicle ownership between 4% and 10%. The report, estimating $4,000 in annual costs per vehicle, calculated vehicle ownership reductions from residential parking pricing.

Vehicle Ownership Reductions from Residential Parking Pricing

Annual (Monthly) Parking Fee	-0.4 Elasticity	-0.7 Elasticity	-1.0 Elasticity
$300 ($25)	4%	6%	8%
$600 ($50)	8%	11%	15%
$900 ($75)	11%	17%	23%
$1,200 ($100)	15%	23%	30%
$1,500 ($125)	19%	28%	38%

Alternative Literature:

None

Alternative Literature Notes:

None

Other Literature Reviewed:

None

3.3.3 Implement Market Price Public Parking (On-Street)

Range of Effectiveness: 2.8 – 5.5% vehicle miles traveled (VMT) reduction and therefore 2.8 – 5.5% reduction in GHG emissions.

Measure Description:

This project and city in which it is located will implement a pricing strategy for parking by pricing all central business district/employment center/retail center on-street parking. It will be priced to encourage “park once” behavior. The benefit of this measure above that of paid parking at the project only is that it deters parking spillover from project-supplied parking to other public parking nearby, which undermine the vehicle miles traveled (VMT) benefits of project pricing. It may also generate sufficient area-wide mode shifts to justify increased transit service to the area.

Measure Applicability:

- Urban and suburban context
- Negligible impact in a rural context
- Appropriate for retail, office, and mixed-use projects
- Applicable in a specific or general plan context only
- Reduction can be counted only if spillover parking is controlled (via residential permits)
- Study conducted in a downtown area, and thus should be applied carefully if project is not in a central business/activity center

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Location of project site: low density suburb, suburban center, or urban location

- Percent increase in on-street parking prices (minimum 25% needed)

Mitigation Method:

% VMT Reduction = Park$ * B

Where:

Park$ = Percent increase in on-street parking prices (minimum of 25% increase [1])

B = Elasticity of VMT with respect to parking price (0.11, from [2])

Assumptions:

Data based upon the following references:

[1] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. (p. B-10)

Moving Cooler's parking pricing analysis cited Victoria Transport Policy Institute, *How Prices and Other Factors Affect Travel Behavior* (http://www.vtpi.org/tdm/tdm11.htm#_Toc161022578). The VTPI paper summarized the elasticities found in the Hensher and King paper. David A. Hensher and Jenny King (2001), "Parking Demand and Responsiveness to Supply, Price and Location in Sydney Central Business District," *Transportation Research A*, Vol. 35, No. 3 (www.elsevier.com/locate/tra), March 2001, pp. 177-196.

[2] J. Peter Clinch and J. Andrew Kelly (2003), *Temporal Variance Of Revealed Preference On-Street Parking Price Elasticity*, Department of Environmental Studies, University College Dublin (www.environmentaleconomics.net). (p. 2) http://www.ucd.ie/gpep/research/workingpapers/2004/04-02.pdf As referenced in VTPI: http://www.vtpi.org/tdm/tdm11.htm#_Toc161022578

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[55]
CO_2e	2.8 – 5.5% of running

[55] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

PM	2.8 – 5.5% of running
CO	2.8 – 5.5% of running
NOx	2.8 – 5.5% of running
SO_2	2.8 – 5.5% of running
ROG	1.7 – 3.3% of total

Discussion:

The range of parking price increases should be a minimum of 25% and a maximum of 50%. The minimum is based on Moving Cooler [1] discussions which state that a less than 25% increase would not be a sufficient amount to reduce VMT. The case study [2] looked at a 50% price increase, and thus no conclusions can be made on the elasticities above a 50% increase. This strategy may certainly be implemented at a higher price increase, but VMT reductions should be capped at results from a 50% increase to be conservative.

Example:

Assuming a baseline on-street parking price of $1, sample calculations are provided below:

- Low Range % VMT Reduction (25% increase) = ($1.25 - $1)/$1 * 0.11 = 2.8%
- High Range % VMT Reduction (50% increase) = ($1.50 - $1)/$1 * 0.11 = 5.5%

Preferred Literature:

- -0.11 parking demand elasticity with respect to parking prices

The Clinch & Kelly study [2] of parking meters looked at the impacts of a 50% price increase in the cost of on-street parking. The case study location was a central on-street parking area with a 3-hour time limit and a mix of business and non-business uses. The study concluded the parking increases resulted in an estimated average price elasticity of demand of -0.11, while factoring in parking duration results in an elasticity of -0.2 (cost increases also affect the amount of time cars are parked). Though this study is international (Dublin, Ireland), it represents a solid study of parking meter price increases and provides a conservative estimate of elasticity compared to the alternate literature.

Alternative Literature:

Alternate:

- -0.19 shopper parking elasticity with respect to parking price
- -0.48 commuter parking elasticity with respect to parking price

The *TCRP 95 Chapter 13* [3] report looked at a case study of the city of San Francisco implementing a parking tax on all public and private off-street parking (in 1970). Based on the number of cars parked, the report estimated parking price elasticities of -0.19 to -0.48, an average over a three year period.

Alternate:

- -0.15 VMT elasticity with respect to parking prices (for low density regions)
- -0.47 VMT elasticity with respect to parking prices (for high density regions)

The Moving Cooler analysis assumes a 25 percent increase in on-street parking fees is a starting point sufficient to reduce VMT. Using the elasticities stated above, Moving Cooler estimates an annual percent VMT reduction from 0.42% - 1.14% for a range of regions from a large low density region to a small high density region. The calculations assume that pricing occurs at the urban central business district/employment cent/retail center, one-fourth of all person trips are commute based trips, and approximately 15% of commute trips are to the CBD or regional activity centers.

Alternative Literature References:

[3] TCRP Report 95. *Chapter 13: Parking Pricing and Fees - Traveler Response to Transportation System Changes.* http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_95c13.pdf. (p.13-42)

Other Literature Reviewed:

None

3.3.4 Require Residential Area Parking Permits

Range of Effectiveness: Grouped strategy. (See PPT-1, PPT-2, and PPT-3)

Measure Description:

This project will require the purchase of residential parking permits (RPPs) for long-term use of on-street parking in residential areas. Permits reduce the impact of spillover parking in residential areas adjacent to commercial areas, transit stations, or other locations where parking may be limited and/or priced. Refer to Parking Supply Limitations (PPT-1), Unbundle Parking Costs from Property Cost (PPT-2), or Market Rate Parking Pricing (PPT-3) strategies for the ranges of effectiveness in these categories. The benefits of Residential Area Parking Permits strategy should be combined with any or all of the above mentioned strategies, as providing RPPs are a key complementary strategy to other parking strategies.

Measure Applicability:

- Urban context
- Appropriate for residential, retail, office, mixed use, and industrial projects

Alternative Literature:

- -0.45 = elasticity of vehicle miles traveled (VMT) with respect to price
- 0.08% greenhouse gas (GHG) reduction
- 0.09-0.36% VMT reduction

Moving Cooler [1] suggested residential parking permits of $100-$200 annually. This mitigation would impact home-based trips, which are reported to represent approximately 60% of all urban trips. The range of VMT reductions can be attributed to the type of urban area. VMT reductions for $100 annual permits are 0.09% for large, high-density; 0.12% for large, low-density; 0.12% for medium, high-density; 0.18% for medium, low-density; 0.18% for small, high-density; and 0.12% for small, low-density. VMT reductions for $200 annual permits are 0.18% for large, high-density; 0.24% for large, low-density; 0.24% for medium, high-density; 0.36% for medium, low-density; 0.36% for small, high-density; and 0.24% for small, low-density.

Alternative Literature References:

[1] Cambridge Systematics. Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions. Technical Appendices. Prepared for the Urban Land Institute. http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf

3.4 Commute Trip Reduction Programs

3.4.1 Implement Commute Trip Reduction Program - Voluntary

Commute Trip Reduction Program – Voluntary, is a multi-strategy program that encompasses a combination of individual measures described in sections 3.4.3 through 3.4.9. It is presented as a means of preventing double-counting of reductions for individual measures that are included in this strategy. It does so by setting a maximum level of reductions that should be permitted for a combined set of strategies within a voluntary program.

Range of Effectiveness: 1.0 – 6.2% commute vehicle miles traveled (VMT) Reduction and therefore 1.0 – 6.2% reduction in commute trip GHG emissions.

Measure Description:

The project will implement a voluntary Commute Trip Reduction (CTR) program with employers to discourage single-occupancy vehicle trips and encourage alternative modes of transportation such as carpooling, taking transit, walking, and biking. The main difference between a voluntary and a required program is:

- Monitoring and reporting is not required
- No established performance standards (i.e. no trip reduction requirements)

The CTR program will provide employees with assistance in using alternative modes of travel, and provide both “carrots” and “sticks” to encourage employees. The CTR program should include all of the following to apply the effectiveness reported by the literature:

- Carpooling encouragement
- Ride-matching assistance
- Preferential carpool parking
- Flexible work schedules for carpools
- Half time transportation coordinator
- Vanpool assistance
- Bicycle end-trip facilities (parking, showers and lockers)

Other strategies may also be included as part of a voluntary CTR program, though they are not included in the reductions estimation and thus are not incorporated in the estimated VMT reductions. These include: new employee orientation of trip reduction and alternative mode options, event promotions and publications, flexible work schedule for all employees, transit subsidies, parking cash-out or priced parking, shuttles, emergency ride home, and improved on-site amenities.

TRT-1 Commute Trip Reduction

Measure Applicability:

- Urban and suburban context
- Negligible in a rural context, unless large employers exist, and suite of strategies implemented are relevant in rural settings
- Appropriate for retail, office, industrial and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of employees eligible
- Location of project site: low density suburb, suburban center, or urban location

Mitigation Method:

% VMT Reduction = A * B

Where

A = % reduction in commute VMT (from [1])
B = % employees eligible

Detail:

- A: 5.2% (low density suburb), 5.4% (suburban center), 6.2% (urban) annual reduction in commute VMT (from [1])

Assumptions:

Data based upon the following references:

- Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. (Table 5.13) http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[56]
CO_2e	1.0 – 6.2% of running
PM	1.0 – 6.2% of running
CO	1.0 – 6.2% of running
NOx	1.0 – 6.2% of running
SO_2	1.0 – 6.2% of running
ROG	0.6 –3.7% of total

Discussion:

This set of strategies typically serves as a complement to the more effective workplace CTR strategies such as pricing and parking cash out.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (low density suburb and 20% eligible) = 5.2% * 0.2 = 1.0%
- High Range % VMT Reduction (urban and 100% eligible) = 6.2% * 1 = 6.2%

Preferred Literature:

- 5.2 - 6.2% commute VMT reduction

Moving Cooler assumes the employer support program will include: carpooling, ride-matching, preferential carpool parking, flexible work schedules for carpools, a half-time transportation coordinator, vanpool assistance, bicycle parking, showers, and locker facilities. The report assigns 5.2% reduction to large metropolitan areas, 5.4% to medium metropolitan areas, and 6.2% to small metropolitan areas.

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[56] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

Alternative Literature:

Alternate:

- 15-19% reduction in commute vehicle trips

TCRP 95 Draft Chapter 19 [2] looked at a sample of 82 Transportation Demand Management (TDM) programs. Low support TDM programs had a 15% reduction, medium support programs 15.9%, and high support 19%. Low support programs had little employer effort. These programs may include rideshare matching, distribution of transit flyers, but have little employer involvement. With medium support programs, employers were involved with providing information regarding commute options and programs, a transportation coordinator (even if part-time), and assistance for ridesharing and transit pass purchases. With high support programs, the employer was providing most of the possible strategies. The sample of programs should not be construed as a random sample and probably represent above average results.

Alternate:

- 4.16 – 4.76% reduction in commute VMT

The Herzog study [3] compared a group of employees, who were eligible for comprehensive commuter benefits (with financial incentives, services such as guaranteed ride home and carpool matching, and informational campaigns) and general marketing information, to a reference group of employees not eligible for commuter benefits. The study showed a 4.79% reduction in VMT, assuming 75% of the carpoolers were traveling to the same worksite. There was a 4.16% reduction in VMT, assuming only 50% of carpoolers were traveling to the same worksite.

Alternate:

- 8.5% reduction in vehicle commute trips

Employer survey results [4] showed that employees at the surveyed companies made 8.5% fewer vehicle trips to work than had been found in the baseline surveys conducted by large employers under the area's trip reduction regulation (i.e. comparing voluntary program with a mandatory regulation). This implied that the 8.5% reduction is a conservative estimate as it is compared to another trip reduction strategy, rather than comparing to a baseline with no reduction strategies implemented. Another survey also showed that 68% of commuters drove alone to work when their employer did not encourage trip reduction. It revealed that with employer encouragement, the drive-alone rate fell 5 percentage points to 63%.

This strategy assumes a companion strategy of employer encouragement. The literature did not specify what commute options each employer provided as part of the program. Options provided may have ranged from simply providing public transit information to implementing a full TDM program with parking cash out, flex hours, emergency ride home, etc. This San Francisco Bay Area survey worked to determine the extent and impact of the emissions saved through voluntary trip reduction efforts (www.cleanairpartnership.com). It identified 454 employment sites with voluntary trip reduction programs and conducted a selected random survey of the more than 400,000 employees at those sites. The study concluded that employer encouragement makes a significant difference in employees' commute choices.

Alternative Literature References:

[2] Pratt, Dick. Personal Communication Regarding the Draft of TCRP 95 Traveler Response to Transportation System Changes – Chapter 19 Employer and Institutional TDM Strategies.

[3] Herzog, Erik, Stacey Bricka, Lucie Audette, and Jeffra Rockwell. 2006. "Do Employee Commuter Benefits Reduce Vehicle Emissions and Fuel Consumption? Results of Fall 2004 Survey of Best Workplaces for Commuters." *Transportation Research Record 1956*, 34-41. (Table 8)

[4] Transportation Demand Management Institute of the Association for Commuter Transportation. *TDM Case Studies and Commuter Testimonials*. Prepared for the US EPA. 1997. (p. 25-28) http://www.epa.gov/OMS/stateresources/rellinks/docs/tdmcases.pdf

Other Literature Reviewed:

None

3.4.2 Implement Commute Trip Reduction Program – Required Implementation/Monitoring

Commute Trip Reduction Program – Required, is a multi-strategy program that encompasses a combination of individual measures described in sections 3.4.3 through 3.4.9. It is presented as a means of preventing double-counting of reductions for individual measures that are included in this strategy. It does so by setting a maximum level of reduction that should be permitted for a combined set of strategies within a program that is contractually required of the development sponsors and managers and accompanied by a regular performance monitoring and reporting program.

Range of Effectiveness: 4.2 – 21.0% commute vehicle miles traveled (VMT) reduction and therefore 4.2 – 21.0% reduction in commute trip GHG emissions.

Measure Description:

The jurisdiction will implement a Commute Trip Reduction (CTR) ordinance. The intent of the ordinance will be to reduce drive-alone travel mode share and encourage alternative modes of travel. The critical components of this strategy are:

- Established performance standards (e.g. trip reduction requirements)
- Required implementation
- Regular monitoring and reporting

Regular monitoring and reporting will be required to assess the project's status in meeting the ordinance goals. The project should use existing ordinances, such as those in the cities of Tucson, Arizona and South San Francisco, California, as examples of successful CTR ordinance implementations. The City of Tucson requires employers with 100+ employees to participate in the program. An Alternative Mode Usage (AMU) goal and VMT reduction goal is established and each year the goal is increased. Employers persuade employees to commute via an alternative mode of transportation at least one day a week (including carpooling, vanpooling, transit, walking, bicycling, telecommuting, compressed work week, or alternatively fueled vehicle). The Transportation Demand Management (TDM) Ordinance in South San Francisco requires all non-residential developments that produce 100 average daily vehicle trips or more to meet a 35% non-drive-alone peak hour requirement with fees assessed for non-compliance. Employers have established significant CTR programs as a result.

Measure Applicability:

- Urban and suburban context
- Negligible in a rural context, unless large employers exist, and suite of strategies implemented are relevant in rural settings
- Jurisdiction level only
- Strategies in this case study calculations included:

- ○ Parking cash out
- ○ Employer sponsored shuttles to transit station
- ○ Employer sponsored bus servicing the Bay Area
- ○ Transit subsidies

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of employees eligible

Mitigation Method:

$$\% \text{ VMT Reduction} = A * B$$

Where

A = % shift in vehicle mode share of commute trips (from [1])

B = % employees eligible

C = Adjustment from vehicle mode share to commute VMT

Detail:

- A: 21% reduction in vehicle mode share (from [1])
- C: 1.0 (see Appendix C for detail)

Assumptions:

Data based upon the following references:

[1] Nelson/Nygaard (2008). *South San Francisco Mode Share and Parking Report for Genentech, Inc*.(p. 8)

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[57]
CO_2e	4.2 – 21.0% of running
PM	4.2 – 21.0% of running
CO	4.2 – 21.0% of running
NOx	4.2 – 21.0% of running
SO_2	4.2 – 21.0% of running
ROG	2.5 – 12.6% of total

Discussion:

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (20% eligibility) = 21% * 20% = 4.2%
- High Range % VMT Reduction (100% eligibility) = 21% * 100% = 21%

Preferred Literature:

- 21% reduction in vehicle mode share

Genentech, in South San Francisco [1], achieved a 34% non-single-occupancy vehicle (non-SOV) mode share (66% SOV) in 2008. Since 2006 when SOV mode share was 74% (26% non-SOV), there has been a reduction of over 10% in drive alone share. Carpool share was 12% in 2008, compared to 11.57% in 2006. Genentech has a significant TDM program including parking cash out ($4/day), express GenenBus service around the Bay Area, free shuttles to Bay Area Rapid Transit (BART) and Caltrain, and transit subsidies. The Genentech campus surveyed for this study is a large, single-tenant campus. Taking an average transit mode share in a suburban development of 1.3% (NHTS,

[57] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

http://www.dot.ca.gov/hq/tsip/tab/documents/travelsurveys/Final2001_Stw Travel Survey WkdayRpt.pdf (SCAG, SANDAG, Fresno County)), this is an estimated decrease from 98.7% to 78% vehicle mode share (66% SOV + 12% carpool), a 21% reduction in vehicle mode share.

Alternative Literature:

Alternate:

- 10.7% average annual increase in use of non-SOV commute modes

For the City of Tucson [2], use of alternative commute modes increased 64.3% between 1989 and 1995. Employers integrated several key activities into their TDM plans: disseminating information, developing company policies to support TDM, investing in facility enhancements, conducting promotional campaigns, and offering subsidies or incentives to encourage AMU.

Alternative Literature References:

[2] Transportation Demand Management Institute of the Association for Commuter Transportation. *TDM Case Studies and Commuter Testimonials*. Prepared for the US EPA. 1997. (p. 17-19) http://www.epa.gov/OMS/stateresources/rellinks/docs/tdmcases.pdf

Other Literature Reviewed:

None

3.4.3 Provide Ride-Sharing Programs

Range of Effectiveness: 1 – 15% commute vehicle miles traveled (VMT) reduction and therefore 1 - 15% reduction in commute trip GHG emissions.

Measure Description:

Increasing the vehicle occupancy by ride sharing will result in fewer cars driving the same trip, and thus a decrease in VMT. The project will include a ride-sharing program as well as a permanent transportation management association membership and funding requirement. Funding may be provided by Community Facilities, District, or County Service Area, or other non-revocable funding mechanism. The project will promote ride-sharing programs through a multi-faceted approach such as:

- Designating a certain percentage of parking spaces for ride sharing vehicles
- Designating adequate passenger loading and unloading and waiting areas for ride-sharing vehicles
- Providing a web site or message board for coordinating rides

Measure Applicability:

- Urban and suburban context
- Negligible impact in many rural contexts, but can be effective when a large employer in a rural area draws from a workforce in an urban or suburban area, such as when a major employer moves from an urban location to a rural location.
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of employees eligible

- Location of project site: low density suburb, suburban center, or urban location

Mitigation Method:

% VMT Reduction = Commute * Employee

Where

Commute = % reduction in commute VMT (from [1])
Employee = % employees eligible

Detail:

- Commute: 5% (low density suburb), 10% (suburban center), 15% (urban) annual reduction in commute VMT (from [1])

Assumptions:

Data based upon the following references:

[1] VTPI. *TDM Encyclopedia*. http://www.vtpi.org/tdm/tdm34.htm; Accessed 3/5/2010.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[58]
CO_2e	1 – 15% of running
PM	1 – 15% of running
CO	1 – 15% of running
NOx	1 – 15% of running
SO_2	1 – 15% of running
ROG	0.6 – 9% of total

Discussion:

This strategy is often part of Commute Trip Reduction (CTR) Program, another strategy documented separately (see TRT-1 and TRT-2). The Project Applicant should take care not to double count the impacts.

Example:

Sample calculations are provided below:

[58] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

- Low Range % VMT Reduction (low density suburb and 20% eligible) = 5% * 20% = 1%
- High Range % VMT Reduction (urban and 100% eligible) = 15% * 1 = 15%

Preferred Literature:

- 5 – 15% reduction of commute VMT

The *Transportation Demand Management (TDM) Encyclopedia* notes that because rideshare passengers tend to have relatively long commutes, mileage reductions can be relatively large with rideshare. If ridesharing reduces 5% of commute trips it may reduce 10% of vehicle miles because the trips that are reduced are twice as long as average. Rideshare programs can reduce up to 8.3% of commute VMT, up to 3.6% of total regional VMT, and up to 1.8% of regional vehicle trips (Apogee, 1994; TDM Resource Center, 1996). Another study notes that ridesharing programs typically attract 5-15% of commute trips if they offer only information and encouragement, and 10-30% if they also offer financial incentives such as parking cash out or vanpool subsidies (York and Fabricatore, 2001).

Alternative Literature:

- Up to 1% reduction in VMT (if combined with two other strategies)

Per the Nelson\Nygaard report [2], ride-sharing would fall under the category of a minor TDM program strategy. The report allows a 1% reduction in VMT for projects with at least three minor strategies.

Alternative Literature References:

[2] Nelson\Nygaard, 2005. *Crediting Low-Traffic Developments* (p.12). http://www.montgomeryplanning.org/transportation/documents/TripGenerationAnalysisUsingURBEMIS.pdf

Criteron Planner/Engineers and Fehr & Peers Associates (2001). Index 4D Method. *A Quick-Response Method of Estimating Travel Impacts from Land-Use Changes*. Technical Memorandum prepared for US EPA, October 2001.

Other Literature Reviewed:

None

3.4.4 Implement Subsidized or Discounted Transit Program

Range of Effectiveness: 0.3 – 20.0% commute vehicle miles traveled (VMT) reduction and therefore a 0.3 – 20.0% reduction in commute trip GHG emissions.

Measure Description:

This project will provide subsidized/discounted daily or monthly public transit passes. The project may also provide free transfers between all shuttles and transit to participants. These passes can be partially or wholly subsidized by the employer, school, or development. Many entities use revenue from parking to offset the cost of such a project.

Measure Applicability:

- Urban and suburban context
- Negligible in a rural context
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of project employees eligible
- Transit subsidy amount
- Location of project site: low density suburb, suburban center, or urban location

Mitigation Method:

$$\% \text{ VMT Reduction} = A * B * C$$

Where

A = % reduction in commute vehicle trips (VT) (from [1])

B = % employees eligible

C = Adjustment from commute VT to commute VMT

Detail:

- A:

	Daily Transit Subsidy			
	$0.75	$1.49	$2.98	$5.96
Worksite Setting	**% Reduction in Commute VT**			
Low density suburb	**1.5%**	**3.3%**	**7.9%**	**20.0%***
Suburban center	**3.4%**	**7.3%**	**16.4%**	**20.0%***
Urban location	**6.2%**	**12.9%**	**20.0%***	**20.0%***
* Discounts greater than 20% will be capped, as they exceed levels recommended by TCRP 95 Draft Chapter 19 and other literature.				

- C: 1.0 (see Appendix C for detail)

Assumptions:

Data based upon the following references:

[1] Nelson\Nygaard, 2010. *City of Santa Monica Land Use and Circulation Element EIR Report, Appendix – Santa Monica Luce Trip Reduction Impacts Analysis* (p.401).

[2] Nelson\Nygaard used the following literature sources: VTPI, Todd Litman, *Transportation Elasticities, http://www.vtpi.org/elasticities.pdf.* Comsis Corporation (1993), *Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience*, USDOT and Institute of Transportation Engineers (www.ite.org); www.bts.gov/ntl/DOCS/474.html.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[59]
CO_2e	0.3 - 20% of running
PM	0.3 - 20% of running
CO	0.3 - 20% of running
NOx	0.3 - 20% of running
SO_2	0.3 - 20% of running
ROG	0. 18 - 12% of total

[59] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

Discussion:

This strategy is often part of a Commute Trip Reduction (CTR), another strategy documented separately (see TRT-1 and TRT-2). The Project Applicant should take care not to double count the impacts.

The literature evaluates this strategy in relation to the employer, but keep in mind that this strategy can also be implemented by a school or the development as a whole.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction ($0.75, low density suburb, 20% eligible) = 1.5% * 20% = 0.3%
- High Range % VMT Reduction ($5.96, urban, 100% eligible) = 20% * 100% = 20%

Preferred Literature:

Commute Vehicle Trip Reduction	**Daily Transit Subsidy**			
Worksite Setting	**$0.75**	**$1.49**	**$2.98**	**$5.96**
Low density suburb, rideshare oriented	0.1%	0.2%	0.6%	1.9%
Low density suburb, mode neutral	1.5%	3.3%	7.9%	21.7%*
Low density suburb, transit oriented	2.0%	4.2%	9.9%	23.2%*
Activity center, rideshare oriented	1.1%	2.4%	5.8%	16.5%
Activity center, mode neutral	3.4%	7.3%	16.4%	38.7%*
Activity center, transit oriented	5.2%	10.9%	23.5%*	49.7%*
Regional CBD/Corridor, rideshare oriented	2.2%	4.7%	10.9%	28.3%*
Regional CBD/Corridor, mode neutral	6.2%	12.9%	26.9%*	54.3%*
Regional CBD/Corridor, transit oriented	9.1%	18.1%	35.5%*	64.0%*

* Discounts greater than 20% will be capped, as they exceed levels recommended by *TCRP 95 Draft Chapter 19* and other literature.

Nelson\Nygaard (2010) updated a commute trip reduction table from VTPI Transportation Elasticities to account for inflation since the data was compiled. Data regarding commute vehicle trip reductions was originally from a study conducted by Comsis Corporation and the Institute of Transportation Engineers (ITE).

Alternative Literature:

Alternate:

- 2.4-30.4% commute vehicle trip reduction (VTR)

TCRP 95 Draft Chapter 19 [2] indicates transit subsidies in areas with good transit and restricted parking have a commute VTR of 30.4%; good transit but free parking, a commute VTR of 7.6%; free parking and limited transit 2.4%. Programs with transit subsidies have an average commute VTR of 20.6% compared with an average commute VTR of 13.1% for sites with non-transit fare subsidies.

Alternate:

- 0.03-0.12% annual greenhouse gas (GHG) reduction

Moving Cooler [3] assumed price elasticities of -0.15, -0.2, and -0.3 for lower fares 25%, 33%, and 50%, respectively. *Moving Cooler* assumes average vehicle occupancy of 1.43 and a VMT/trip of 5.12.

Alternative Literature References:

[2] Pratt, Dick. Personal Communication Regarding the Draft of TCRP 95 Traveler Response to Transportation System Changes – Chapter 19 Employer and Institutional TDM Strategies.

[3] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. (Table D.3) http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf

Other Literature Reviewed:

None

3.4.5 Provide End of Trip Facilities

Range of Effectiveness: Grouped strategy (see TRT-1 through TRT-3)

Measure Description:

Non-residential projects will provide "end-of-trip" facilities for bicycle riders including showers, secure bicycle lockers, and changing spaces. End-of-trip facilities encourage the use of bicycling as a viable form of travel to destinations, especially to work. End-of-trip facilities provide the added convenience and security needed to encourage bicycle commuting.

End-of-trip facilities have minimal impacts when implemented alone. This strategy's effectiveness in reducing vehicle miles traveled (VMT) depends heavily on the suite of other transit, pedestrian/bicycle, and demand management measures offered. End-of-trip facilities should be grouped with Commute Trip Reduction (CTR) Programs (TRT-1 through TRT-2).

Measure Applicability:

- Urban, suburban, and rural context
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Alternative Literature:

Alternate:

- 22% increase in bicycle mode share

The bicycle study documents a multivariate analysis of UK National Travel Survey (Wardman et al. 2007) which found significant impacts on bicycling to work. Compared to base bicycle mode share of 5.8% for work trips, outdoor parking would raise the share to 6.3%, indoor secure parking to 6.6%, and indoor parking plus showers to 7.1%. This results in an estimate 22% increase in bicycle mode share ((7.1%-5.8%)/5.8% = 22%). This suggests that such end of trip facilities have an important impact on the decision to bicycle to work. However, these effects represent reductions in VMT no greater than 0.02% (see Appendix C for calculation detail).

Alternate:

- 2 - 5% reduction in commute vehicle trips

The *Transportation Demand Management (TDM) Encyclopedia*, citing Ewing (1993), documents Sacramento's TDM ordinance. The City allows developers to claim trip reduction credits for worksite showers and lockers of 5% in central business districts, 2% within 660 feet of a transit station, and 2% elsewhere.

Alternate:

- 0.625% reduction in VMT

The *Center for Clean Air Policy (CCAP) Guidebook* attributes a 1% to 5% reduction associated with the use of bicycles, which reflects the assumption that their use is typically for shorter trips. Based on the *CCAP Guidebook*, a 2.5% reduction is allocated for all bicycle-related measures and a 1/4 of that for this measure alone. (This information is based on a TIAX review for SMAQMD).

Alternative Literature References:

[1] Pucher J., Dill, J., and Handy, S. *Infrastructure, Programs and Policies to Increase Bicycling: An International Review.* February 2010. (Table 2, pg. S111) http://policy.rutgers.edu/faculty/pucher/Pucher_Dill_Handy10.pdf

[2] Victoria Transportation Policy Institute (VTPI). *TDM Encyclopedia,* http://www.vtpi.org/tdm/tdm9.htm; accessed 3/4/2010; last update 1/25/2010). VTPI citing: Reid Ewing (1993), "TDM, Growth Management, and the Other Four Out of Five Trips," *Transportation Quarterly*, Vol. 47, No. 3, Summer 1993, pp. 343-366.

[3] Center for Clean Air Policy (CCAP), *CCAP Transportation Emission Guidebook*. http://www.ccap.org/safe/guidebook/guide_complete.html; TIAX Results of 2005 Literature Search Conducted by TIAX on behalf of SMAQMD

Other Literature Reviewed:

None

3.4.6 Encourage Telecommuting and Alternative Work Schedules

Range of Effectiveness: 0.07 – 5.50% commute vehicle miles traveled (VMT) reduction and therefore 0.07 – 5.50% reduction in commute trip GHG emissions.

Measure Description:

Encouraging telecommuting and alternative work schedules reduces the number of commute trips and therefore VMT traveled by employees. Alternative work schedules could take the form of staggered starting times, flexible schedules, or compressed work weeks.

Measure Applicability:

- Urban, suburban, and rural context
- Appropriate for retail, office, industrial, and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of employees participating (1 – 25%)
- Strategy implemented: 9-day/80-hour work week, 4-day/40-hour work week, or 1.5 days of telecommuting

Mitigation Method:

% Commute VMT Reduction = Commute

Where

Commute = % reduction in commute VMT (See table below)

	Employee Participation				
	1%	**3%**	**5%**	**10%**	**25%**
	% Reduction in Commute VMT				
9-day/80-hour work week	0.07%	0.21%	0.35%	0.70%	1.75%
4-day/40-hour work week	0.15%	0.45%	0.75%	1.50%	3.75%
telecommuting 1.5 days	0.22%	0.66%	1.10%	2.20%	5.5%
Source: Moving Cooler Technical Appendices, Fehr & Peers Notes: The percentages from Moving Cooler incorporate a discount of 25% for rebound effects. The percentages beyond 1% employee participation are linearly extrapolated.					

Assumptions:

Data based upon the following references:

[1] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. (p. B-54) http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[60]
CO_2e	0.07 – 5.50% of running
PM	0.07 – 5.50% of running
CO	0.07 – 5.50% of running
NOx	0.07 – 5.50% of running
SO_2	0.07 – 5.50% of running
ROG	0.04 – 3.3% of total

Discussion:

This strategy is often part of a Commute Trip Reduction Program, another strategy documented separately (see TRT-1 and TRT-2). The Project Applicant should take care not to double count the impacts.

The employee participation rate should be capped at a maximum of 25%. *Moving Cooler* [1] notes that roughly 50% of a typical workforce could participate in alternative

[60] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

work schedules (based on job requirements) and roughly 50% of those would choose to participate.

The 25% discount for rebound effects is maintained to provide a conservative estimate and support the literature results. The project may consider removing this discount from their calculations if deemed appropriate.

Example:

N/A – no calculations are needed.

Preferred Literature:

- 0.07% - 0.22% reduction in commuting VMT

Moving Cooler [1] estimates that if 1% of employees were to participate in a 9 day/80 hour compressed work week, commuting VMT would be reduced by 0.07%. If 1% of employees were to participate in a 4 day/40 hour compressed work week, commuting VMT would reduce by 0.15%; and 1% of employees participating in telecommuting 1.5 days per week would reduce commuting VMT by 0.22%. These percentages incorporate a discounting of 25% to account for rebound effects (i.e., travel for other purposes during the day while not at the work site). The percentages beyond 1% employee participation are linearly extrapolated (see table above).

Alternative Literature:

Alternate:

- 9-10% reduction in VMT for participating employees

As documented in *TCRP 95 Draft Chapter 19* [2], a Denver federal employer's implementation of compressed work week resulted in a 14-15% reduction in VMT for participating employees. This is equivalent to the 0.15% reduction for each 1% participation cited in the preferred literature above. In the Denver example, there was a 65% participation rate out of a total of 9,000 employees. *TCRP 95* states that the compressed work week experiment has no adverse effect on ride-sharing or transit use. Flexible hours have been shown to work best in the presence of medium or low transit availability.

Alternate:

- 0.5 vehicle trips reduced per employee per week
- 13 – 20 VMT reduced per employee per week

As documented in *TCRP 95 Draft Chapter 19* [2], a study of compressed work week for 2,600 Southern California employees resulted in an average reduction of 0.5 trips per week (per participating employee). Participating employees also reduced their VMT by 13-20 miles per week. This translates to a reduction of between 5% and 10% in commute VMT, and so is lower than the 15% reduction cited for Denver government employees.

Alternative Literature References:

[2] Pratt, Dick. Personal Communication Regarding the Draft of TCRP 95 Traveler Response to Transportation System Changes – Chapter 19 Employer and Institutional TDM Strategies.

Other Literature Reviewed:

None

3.4.7 Implement Commute Trip Reduction Marketing

Range of Effectiveness: 0.8 – 4.0% commute vehicle miles traveled (VMT) reduction and therefore 0.8 – 4.0% reduction in commute trip GHG emissions.

Measure Description:

The project will implement marketing strategies to reduce commute trips. Information sharing and marketing are important components to successful commute trip reduction strategies. Implementing commute trip reduction strategies without a complementary marketing strategy will result in lower VMT reductions. Marketing strategies may include:

- New employee orientation of trip reduction and alternative mode options
- Event promotions
- Publications

CTR marketing is often part of a CTR program, voluntary or mandatory. CTR marketing is discussed separately here to emphasis the importance of not only providing employees with the options and monetary incentives to use alternative forms of transportation, but to clearly and deliberately promote and educate employees of the various options. This will greatly improve the impact of the implemented trip reduction strategies.

Measure Applicability:

- Urban and suburban context
- Negligible in a rural context
- Appropriate for residential, retail, office, industrial and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled
$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of project employees eligible (i.e. percentage of employers choosing to participate)

Mitigation Method:

% Commute VMT Reduction = A * B * C

Where

A = % reduction in commute vehicle trips (from [1])

B = % employees eligible

C = Adjustment from commute VT to commute VMT

Detail:

- A: 4% (per [1])
- C: 1.0 (see Appendix C for detail)

Assumptions:

Data based upon the following references:

[1] Pratt, Dick. Personal communication regarding the *Draft of TCRP 95 Traveler Response to Transportation System Changes – Chapter 19 Employer and Institutional TDM Strategies.* Transit Cooperative Research Program.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[61]
CO_2e	0.8 – 4.0% of running
PM	0.8 – 4.0% of running
CO	0.8 – 4.0% of running
NOx	0.8 – 4.0% of running
SO_2	0.8 – 4.0% of running
ROG	0.5 – 2.4% of total

[61] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

Discussion:

The effectiveness of commute trip reduction marketing in reducing VMT depends on which commute reduction strategies are being promoted. The effectiveness levels provided below should only be applied if other programs are offered concurrently, and represent the total effectiveness of the full suite of measures.

This strategy is often part of a CTR Program, another strategy documented separately (see strategy T# E1). Take care not to double count the impacts.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (20% eligible) = 4% * 20% = 0.8%
- High Range % VMT Reduction (100% eligible) = 4% * 100% = 4.0%

Preferred Literature:

- 4-5% commute vehicle trips reduced with full-scale employer support

TCRP 95 Draft Chapter 19 notes the average empirically-based estimate of reductions in vehicle trips for full-scale, site-specific employer support programs alone is 4-5%. This effectiveness assumes there are alternative commute modes available which have on-going employer support. For a program to receive credit for such outreach and marketing efforts, it should contain guarantees that the program will be maintained permanently, with promotional events delivered regularly and with routine performance monitoring.

Alternative Literature:

- 5-15% reduction in commute vehicle trips
- 3% increase in effectiveness of marketed transportation demand management (TDM) strategies

VTPI [2] notes that providing information on alternative travel modes by employers was one of the most important factors contributing to mode shifting. One study (Shadoff,1993) estimates that marketing increases the effectiveness of other TDM strategies by up to 3%. Given adequate resources, marketing programs may reduce vehicle trips by 5-15%. The 5 – 15% range comes from a variety of case studies across the world. U.S. specific case studies include: 9% reduction in vehicle trips with TravelSmart in Portland (12% reduction in VMT), 4-8% reduction in vehicle trips from four cities with individualized marketing pilot projects from the Federal Transit Administration (FTA). Averaged across the four pilot projects, there was a 6.75% reduction in VMT.

Alternative Literature References:

[2] VTPI, TDM Encyclopedia – TDM Marketing; http://www.vtpi.org/tdm/tdm23.htm; accessed 3/5/2010. Table 7 (citing FTA, 2006)

Other Literature Reviewed:

None

3.4.8 Implement Preferential Parking Permit Program

Range of Effectiveness: Grouped strategy (see TRT-1 through TRT-3)

Measure Description:

The project will provide preferential parking in convenient locations (such as near public transportation or building front doors) in terms of free or reduced parking fees, priority parking, or reserved parking for commuters who carpool, vanpool, ride-share or use alternatively fueled vehicles. The project will provide wide parking spaces to accommodate vanpool vehicles.

The impact of preferential parking permit programs has not been quantified by the literature and is likely to have negligible impacts when implemented alone. This strategy should be grouped with Commute Trip Reduction (CTR) Programs (TRT-1 and TRT-2) as a complementary strategy for encouraging non-single occupant vehicle travel.

Measure Applicability:

- Urban, suburban context
- Appropriate for residential, retail, office, mixed use, and industrial projects

Alternative Literature:

No quantitative results are available. The case study in the literature implemented a preferential parking permit program as a companion strategy to a comprehensive TDM program. Employees who carpooled at least three times a week qualified to use the spaces.

Alternative Literature References:

[1] Transportation Demand Management Institute of the Association for Commuter Transportation. *TDM Case Studies and Commuter Testimonials*. Prepared for the US EPA. 1997. http://www.epa.gov/OMS/stateresources/rellinks/docs/tdmcases.pdf

Other Literature Reviewed:

None

3.4.9 Implement Car-Sharing Program

Range of Effectiveness: 0.4 – 0.7% vehicle miles traveled (VMT) reduction and therefore 0.4 – 0.7% reduction in GHG emissions.

Measure Description:

This project will implement a car-sharing project to allow people to have on-demand access to a shared fleet of vehicles on an as-needed basis. User costs are typically determined through mileage or hourly rates, with deposits and/or annual membership fees. The car-sharing program could be created through a local partnership or through one of many existing car-share companies. Car-sharing programs may be grouped into three general categories: residential- or citywide-based, employer-based, and transit station-based. Transit station-based programs focus on providing the “last-mile” solution and link transit with commuters’ final destinations. Residential-based programs work to substitute entire household based trips. Employer-based programs provide a means for business/day trips for alternative mode commuters and provide a guaranteed ride home option.

Measure Applicability:

- Urban and suburban context
- Negligible in a rural context
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Urban or suburban context

Mitigation Method:

% VMT Reduction = A * B / C

Where

A = % reduction in car-share member annual VMT (from the literature)

B = number of car share members per shared car (from the literature)

C = deployment level based on urban or suburban context

Detail:

- A: 37% *(per [1])*
- B: 20 *(per [2])*
- C:

Project setting	1 shared car per X population
Urban	1,000
Suburban	2,000
Source: *Moving Cooler*	

Assumptions:

Data based upon the following references:

[1] Millard-Ball, Adam. "Car-Sharing: Where and How it Succeeds," (2005) Transit Cooperative Research Program (108). P. 4-22

[2] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. (p. B-52, Table D.3) http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendices_Complete_102209.pdf

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[62]
CO_2e	0.4 – 0.7% of running
PM	0.4 – 0.7% of running
CO	0.4 – 0.7% of running
NOx	0.4 – 0.7% of running
SO_2	0.4 – 0.7% of running
ROG	0.24 – 0.42% of total

[62] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

Discussion:

Variable C in the mitigation method section represents suggested levels of deployment based on the literature. Levels of deployment may vary based on the characteristics of the project site and the needs of the project residents and employees. This variable should be adjusted accordingly.

The methodology for calculation of VMT reduction utilizes *Moving Cooler's* rule of thumb[63] for the estimated number of car share members per vehicle. An estimate of 50% reduction in car-share member annual VMT (from *Moving Cooler*) was high compared to other literature sources, and *TCRP 108's* 37% reduction was used in the calculations instead.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (suburban) = 37% * 20 / 2000 = 0.4%
- High Range % VMT Reduction (urban) = 37% * 20 / 1000 = 0.7%

Preferred Literature:

- 37% reduction in car-share member VMT

The *TCRP 108* [1] report conducted a survey of car-share members in the United States and Canada in 2004. The results of the survey showed that respondents, on average, drove only 63% of the average mileage they previously drove when not car-share members.

Alternative Literature:

Alternate – Residential or Citywide Based:

- 0.05-0.27% reduction in GHG
- 0.33% reduction in VMT in urban areas

Moving Cooler [2] assumed an aggressive deployment of one car per 2,000 inhabitants of medium-density census tracks and of one car per 1,000 inhabitants of high-density census tracks. This strategy assumes providing a subsidy to a public, private, or nonprofit car-sharing organization and providing free or subsidized lease for usage of public street parking. *Moving Cooler* assumed 20 members per shared car and 50% reduction in VMT per equivalent car. The percent reduction calculated assumes a percentage of urban areas are low, medium, and high density, thus resulting in a lower

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▪ [63] See discussion in Alternative Literature section for "rule of thumb" detail.

than expected reduction in VMT assuming an aggressive deployment in medium and high density areas.

Alternate – Transit Station and Employer Based:

- 23-44% reduction in drive-alone mode share
- Average daily VMT reduction of 18 – 23 miles

TCRP 95 Draft Chapter 19 [3] looked at two demonstrations, CarLink I and CarLink II, in the San Francisco Bay Area. CarLink I ran from January to November 1999. It involved 54 individuals and 12 rental cars stationed at the Dublin-Pleasanton BART station. CarLink II ran from July 2001 to June 2002 and involved 107 individuals and 19 rental cars. CarLink II was based in Palo Alto in conjunction with Caltrain commuter rail service and several employers in the Stanford Research Park. Both CarLink demonstrations were primarily targeted for commuters. CarLink I had a 23% increase in rail mode share, a reduction in drive-alone mode share of 44%, and a decrease in Average Daily VMT of 18 miles. CarLink II had a VMT for round-trip commuters decrease of 23 miles per day and a mode share for drive alone decrease of 22.9%.

Alternate:

- 50% reduction in driving for car-share members

A UC Berkeley study of San Francisco's City CarShare [4] found that members drive nearly 50% less after joining. The study also found that when people joined the car-sharing organization, nearly 30% reduced their household vehicle ownership and two-thirds avoided purchasing another car. The UC Berkeley study found that almost 75% of vehicle trips made by car-sharing members were for social trips such as running errands and visiting friends. Only 25% of trips were for commuting to work or for recreation. Most trips were also made outside of peak periods. Therefore, car-sharing may generate limited impact on peak period traffic.

Alternative Literature References:

[3] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. (p. B-52, Table D.3) http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendices_Complete_102209.pdf

[4] Pratt, Dick. *Personal Communication Regarding the Draft of TCRP 95 Traveler Response to Transportation System Changes – Chapter 19 Employer and Institutional TDM Strategies.* Transit Cooperative Research Program.

Cervero, Robert and Yu-Hsin Tsai. *San Francisco City CarShare: Travel-Demand Trends and Second-Year Impacts,* 2005. (Figure 7, p. 35, Table 7, Table 12) http://escholarship.org/uc/item/4f39b7b4

Other Literature Reviewed:

None

3.4.10 Implement a School Pool Program

Range of Effectiveness: 7.2 – 15.8% school vehicle miles traveled (VMT) Reduction and therefore 7.2 – 15.8% reduction in school trip GHG emissions.

Measure Description:

This project will create a ridesharing program for school children. Most school districts provide bussing services to public schools only. SchoolPool helps match parents to transport students to private schools, or to schools where students cannot walk or bike but do not meet the requirements for bussing.

Measure Applicability:

- Urban, suburban, and rural context
- Appropriate for residential and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Degree of implementation of SchoolPool Program(moderate to aggressive)

Mitigation Method:

% VMT Reduction = Families * B

Where

Families = % families that participate (from [1] and [2])

B = adjustments to convert from participation to daily VMT to annual school VMT

Detail:

- Families: 16% (moderate implementation), 35% (aggressive implementation), (from [1] and [2])
- B: 45% (see Appendix C for detail)

Assumptions:

Data based upon the following references:

[1] Transportation Demand Management Institute of the Association for Commuter Transportation. *TDM Case Studies and Commuter Testimonials*. Prepared for the US EPA. 1997. (p. 10, 36-38) http://www.epa.gov/OMS/stateresources/rellinks/docs/tdmcases.pdf

[2] Denver Regional Council of Governments (DRCOG). *Survey of Schoolpool Participants, April 2008.* http://www.drcog.org/index.cfm?page=SchoolPool. Obtained from Schoolpool Coordinator, Mia Bemelen.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[64]
CO_2e	7.2 – 15.8% of running
PM	7.2 – 15.8% of running
CO	7.2 – 15.8% of running
NOx	7.2 – 15.8% of running
SO_2	7.2 – 15.8% of running
ROG	4.3 – 9.5% of total

Discussion:

This strategy reflects the findings from only one case study.

Example:

Sample calculations are provided below:

- Low Range % School VMT Reduction (moderate implementation) = 16% * 45% = 7.2%
- High Range % School VMT Reduction (aggressive implementation) = 35% * 45% = 15.8%

[64] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

Preferred Literature:

- 7,711 – 18,659 daily VMT reduction

As presented in the TDM Case Studies [1] compilation, the SchoolPool program in Denver saved 18,659 VMT per day in 1995, compared with 7,711 daily in 1994 – a 142% increase. The Denver Regional Council of Governments (DRCOG) [2] enrolled approximately 7,000 families and 32 private schools in the program. The DRCOG staff surveyed a school or interested families to collect home location and schedules of the students. The survey also identified prospective drivers. DRCOG then used carpool-matching software and GIS to match families. These match lists were sent to the parents for them to form their own school pools. 16% of families in the database formed carpools. The average carpool carried 3.1 students.

The SchoolPool program is still in effect and surveys are conducted every few years to monitor the effectiveness of the program. The latest survey report received was in 2008. The report showed that the participant database had increased to over 10,000 families, an 18% increase from 2005. 29% of participants used the list to form a school carpool. This percentage was lower than 35% in 2005 but higher than prior to 2005, at 24%. The average number of families in each carpool ranged from 2.1 prior to 2005 to 2.8 in 2008. The average number of carpool days per week was roughly 4.7. The number of school weeks per year was 39. Per discussions with the Schoolpool Coordinator, a main factor of success was establishing a large database. This was achieved by having parents opt-out of the database versus opting-in.

Alternative Literature:

None

Alternative Literature References:

None

Other Literature Reviewed:

None

3.4.11 Provide Employer-Sponsored Vanpool/Shuttle

Range of Effectiveness: 0.3 – 13.4% commute vehicle miles traveled (VMT) reduction and therefore 0.3 – 13.4% reduction in commute trip GHG emissions.

Measure Description:

This project will implement an employer-sponsored vanpool or shuttle. A vanpool will usually service employees' commute to work while a shuttle will service nearby transit stations and surrounding commercial centers. Employer-sponsored vanpool programs entail an employer purchasing or leasing vans for employee use, and often subsidizing the cost of at least program administration, if not more. The driver usually receives personal use of the van, often for a mileage fee. Scheduling is within the employer's purview, and rider charges are normally set on the basis of vehicle and operating cost.

Measure Applicability:

- Urban, suburban, and rural context
- Appropriate for office, industrial, and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled
$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of employees eligible

Mitigation Method:

$$\% \text{ VMT Reduction} = A * B * C$$

Where

A = % shift in vanpool mode share of commute trips (from [1])

B = % employees eligible

C = adjustments from vanpool mode share to commute VMT

Detail:

- A: 2-20% annual reduction in vehicle mode share (*from [1]*)
  - Low range: low degree of implementation, smaller employers
  - High range: high degree of implementation, larger employers
- C: 0.67 (See Appendix C for detail)

Assumptions:

Data based upon the following references:

[1] TCRP Report 95. *Chapter 5: Vanpools and Buspools - Traveler Response to Transportation System Changes.* http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_95c5.pdf. (p.5-8)

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[65]
CO_2e	0.3 – 13.4% of running
PM	0.3 – 13.4% of running
CO	0.3 – 13.4% of running
NOx	0.3 – 13.4% of running
SO_2	0.3 – 13.4% of running
ROG	0.18 – 8.0% of total

Discussion:

Vanpools are generally more successful with the largest of employers, as large employee counts create the best opportunities for employees to find a suitable number of travel companions to form a vanpool. In the San Francisco Bay Area several large companies (such as Google, Apple, and Genentech) provide regional bus transportation for their employees. No specific studies of these large buspools were identified in the literature. However, the GenenBus serves as a key element of the overall commute trip reduction (CTR) program for Genentech, as discussed in the CTR Program – Required strategy.

This strategy is often part of a CTR Program, another strategy documented separately (see strategy T# E1). Take care not to double count the impacts.

Example:

Sample calculations are provided below:

[65] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

- Low Range % VMT Reduction (low implementation/small employer, 20% eligible) = 2% * 20% * 0.67 = 0.3%
- High Range % VMT Reduction (high implementation/large employer, 100% eligible) = 20% * 100% * 0.67 = 13.4%

Preferred Literature:

- 2-20% vanpool mode share

TCRP Report 95 [1] notes that vanpools can capture 2 to 20% mode share. This range can be attributed to differences in programs, access to high-occupancy vehicle (HOV) lanes, and geographic range. The *TCRP Report* highlights a case study of the 3M Corporation, which with the implementation of a vanpooling program saw drive alone mode share decrease by 10 percentage points and vanpooling mode share increase to 7.8 percent. The *TCRP Report* notes most vanpools programs do best where one-way trip lengths exceed 20 miles, where work schedules are fixed and regular, where employer size is sufficient to allow matching of 5 to 12 people from the same residential area, where public transit is inadequate, and were some congestion or parking problems exist.

Alternative Literature:

In *TDM Case Studies* [2], a case study of Kaiser Permanente Hospital has shown their employer-sponsored shuttle service eliminated 380,100 miles per month, or nearly 4 million miles of travel per year, and four tons of smog precursors annually.

Alternative Literature References:

[2] Transportation Demand Management Institute of the Association for Commuter Transportation. *TDM Case Studies and Commuter Testimonials*. Prepared for the US EPA. 1997. http://www.epa.gov/OMS/stateresources/rellinks/docs/tdmcases.pdf

Other Literature Reviewed:

None

3.4.12 Implement Bike-Sharing Programs

Range of Effectiveness: Grouped strategy (see SDT-5 and LUT-9)

Measure Description:

This project will establish a bike sharing program. Stations should be at regular intervals throughout the project site. The number of bike-share kiosks throughout the project area should vary depending on the density of the project and surrounding area. Paris' bike-share program places a station every few blocks throughout the city (approximately 28 bike stations/square mile). Bike-station density should increase around commercial and transit hubs.

Bike sharing programs have minimal impacts when implemented alone. This strategy's effectiveness is heavily dependent on the location and context. Bike-sharing programs have worked well in densely populated areas (examples in Barcelona, London, Lyon, and Paris) with existing infrastructure for bicycling. Bike sharing programs should be combined with **Bike Lane Street Design (SDT-5)** and **Improve Design of Development (LUT-9)**.

Taking evidence from the literature, a 135-300% increase in bicycling (of which roughly 7% are shifting from vehicle travel) results in a negligible impact (around 0.03% vehicle miles traveled (VMT) reduction (see Appendix C for calculations)).

Measure Applicability:

- Urban and suburban-center context only
- Negligible in a rural context
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Alternative Literature:

Alternate:

The International Review [1] found bike mode share increases:

- from 0.75% in 2005 to 1.76% in 2007 in Barcelona (Romero, 2008) (135% increase)
- From 1% in 2001 to 2.5% in 2007 in Paris (Nadal, 2007; City of Paris, 2007) (150% increase)
- From 0.5% in 1995 to 2% in 2006 in Lyon (Bonnette, 2007; Velo'V, 2009) (300% increase)

London [2] is the only study that reports the breakdown of the prior mode In London: 6% of users reported shifting from driving, 34% from transit, 23% said they would not have travelled (Noland and Ishaque, 2006). Additionally, 68% of the bike trips were for leisure or recreation. Companion strategies included concurrent improvements in bicycle facilities.

The London program was implemented west of Central London in a densely populated area, mainly residential, with several employment centers. A relatively well developed bike network existed, including over 1,000 bike racks. The program implemented 25 locker stations with 70 bikes total.

Alternate:

- 1/3 vehicle trip reduced per day per bicycle (1,000 vehicle trips reduced per day in Lyon)

The Bike Share Opportunities [3] report looks at two case studies of bike-sharing implementation in France. In Lyon, the 3,000 bike-share system shifts 1,000 car trips to bicycle each day. Surveys indicate that 7% of the bike share trips would have otherwise been made by car. Lyon saw a 44% increase in bicycle riding within the first year of their program while Paris saw a 70% increase in bicycle riding and a 5% reduction in car use and congestion within the first year and a half of their program. The Bike Share Opportunities report found that population density is an important part of a successful program. Paris' bike share subscription rates range between 6% and 9% of the total population. This equates to an average of 75,000 rentals per day. The effectiveness of bike share programs at sub-city scales are not addressed in the literature.

Alternative Literature References:

[1] Pucher J., Dill, J., and Handy, S. Infrastructure, Programs and Policies to Increase Bicycling: An International Review. February 2010. (Table 4)

[2] Noland, R.B., Ishaque, M.M., 2006. "Smart Bicycles in an urban area: Evaluation of a pilot scheme in London." *Journal of Public Transportation*. 9(5), 71-95. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.117.8173&rep=rep1&type=pdf#page=76

[3] NYC Department of City Planning, *Bike-Share Opportunities in New York City,* 2009. (p. 11, 14, 24, 68) http://www.nyc.gov/html/dcp/html/transportation/td_bike_share.shtml

Other Literature Reviewed:

None

3.4.13 Implement School Bus Program

Measure Effectiveness Range: 38 – 63% School VMT Reduction and therefore 38 – 63% reduction in school trip GHG emissions[66]

Measure Description:

The project will work with the school district to restore or expand school bus services in the project area and local community.

Measure Applicability:

- Urban, suburban, and rural context
- Appropriate for residential and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of families expected to use/using school bus program

Mitigation Method:

$$\% \text{ VMT Reduction} = A * B$$

Where

A = % families expected to use/using school bus program

B = adjustments to convert from participation to school day VMT to annual school VMT

[66] Transit vehicles may also result in increases in emissions that are associated with electricity production or fuel use. The Project Applicant should consider these potential additional emissions when estimating mitigation for these measures.

Detail:

- A: a typical range of 50 – 84% (see discussion section)
- B: 75% (see Appendix C for detail)

Assumptions:

Data based upon the following references:

[1] JD Franz Research, Inc.; *Lamorinda School Bus Program, 2003 Parent Survey, Final Report;* January 2004; obtained from Juliet Hansen, Program Manager. (p. 5)

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[67]
CO_2e	38 – 63% of running
PM	38 – 63% of running
CO	38 – 63% of running
NOx	38 – 63% of running
SO_2	38 – 63% of running
ROG	23 – 38% of total

Discussion:

The literature presents a high range of effectiveness showing 84% participation by families. 50% is an estimated low range assuming the project has a minimum utilization goal. Note that the literature presents results from a single case study.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (50% participation) = 50% * 75% = 38%
- High Range % VMT Reduction (85% participation) = 84% * 75% = 63%

Preferred Literature:

- 84% penetration rate
- 2,451 – 2,677 daily vehicle trips reduced
- 441,180 – 481,860 annual vehicle trips reduced

[67] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

The Lamorinda School Bus Program was implemented to reduce traffic congestion in the communities of Lafayette, Orinda, and Moraga, California. In 2003, a parent survey was conducted to determine the extent to which the program diverted or eliminated vehicle trips. This survey covered a representative sample of all parents (not just those signed up for the school bus program). The range of morning trips prevented is 1,266 to 1,382; the range of afternoon trips prevented is 1,185 to 1,295. Annualized, the estimated total trip prevention is between 441,180 to 481,860. 83% of parents surveyed reported that their child usually rides the bus to school in the morning. 84% usually rode the bus back home in the afternoons. The data came from surveys and the results are unique to the location and extent of the program. The report did not indicate the number of school buses in operation during the time of the survey.

Alternative Literature:

None

Alternative Literature References:

None

Other Literature Reviewed:

None

3.4.14 Price Workplace Parking

Range of Effectiveness: 0.1 – 19.7% commute vehicle miles traveled (VMT) reduction and therefore 0.1 -19.7% reduction in commute trip GHG emissions.

Measure Description:

The project will implement workplace parking pricing at its employment centers. This may include: explicitly charging for parking for its employees, implementing above market rate pricing, validating parking only for invited guests, not providing employee parking and transportation allowances, and educating employees about available alternatives.

Though similar to the Employee Parking "Cash-Out" strategy, this strategy focuses on implementing market rate and above market rate pricing to provide a price signal for employees to consider alternative modes for their work commute.

Measure Applicability:

- Urban and suburban context
- Negligible impact in a rural context
- Appropriate for retail, office, industrial, and mixed-use projects
- Reductions applied only if complementary strategies are in place:
    - Residential parking permits and market rate public on-street parking - to prevent spill-over parking
    - Unbundled parking - is not required but provides a market signal to employers to transfer over the, now explicit, cost of parking to the employees. In addition, unbundling parking provides a price with which employers can utilize as a means of establishing workplace parking prices.

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Location of project site: low density suburb, suburban center, or urban location
- Daily parking charge ($1 - $6)
- Percentage of employees subject to priced parking

Mitigation Method:

% VMT Reduction = A * B

Where

A = Percentage reduction in commute VMT (from [1] and [2])

B = Percent of employees subject to priced parking

Detail:

- A:

Project Location	Daily Parking Charge			
	$1	$2	$3	$6
Low density suburb	0.5%	1.2%	1.9%	2.8%
Suburban center	1.8%	3.7%	5.4%	6.8%
Urban Location	6.9%	12.5%	16.8%	19.7%
Moving Cooler, VTPI, Fehr & Peers. Note: 2009 dollars.				

Assumptions:

Data based upon the following references:

[1] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. (Table 5.13, Table D.3) http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendices_Complete_102209.pdf

[2] VTPI, Todd Litman, *Transportation Elasticities,*(Table 15) *http://www.vtpi.org/elasticities.pdf*.

Comsis Corporation (1993), *Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience*, USDOT and Institute of Transportation Engineers (www.ite.org); www.bts.gov/ntl/DOCS/474.html.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[68]
CO_2e	0.1 – 19.7% of running
PM	0.1 – 19.7% of running
CO	0.1 – 19.7% of running
NOx	0.1 – 19.7% of running
SO_2	0.1 – 19.7% of running
ROG	0.06 – 11.8% of total

Discussion:

Priced parking can result in parking spillover concerns. The highest VMT reductions should be given only with complementary strategies such as parking time limits or neighborhood parking permits are in place in surrounding areas.

Example:

Sample calculations are provided below:

- Low Range % Commute VMT Reduction (low density suburb, $1/day, 20% priced) = 0.5% * 20% = 0.1%
- High Range % Commute VMT Reduction (urban, $6/day, 100% priced) = 19.7% * 100% = 19.7%

Preferred Literature:

The table above (variable A) was calculated using the percent commute VMT reduction from *Moving Cooler* (0.5% - 6.9% reduction for $1/day parking charge). The percentage reductions for $2 - $6 / day parking charges were extrapolated by multiplying the *Moving Cooler* percentages with the ratios from the VTPI table below (percentage increases). For example, to obtain a percent VMT reduction for a $6/day parking charge for a low density suburb, 0.5% * ((36.1%-6.5%) /6.5%) = 2.3%. The methodology was utilized to capture the non-linear effect of parking charges on trip reduction (VTPI) while maintaining a conservative estimate of percent reductions (*Moving Cooler*).

Preferred:

- 0.5-6.9% reduction in commuting VMT
- 0.44-2.07% reduction in greenhouse gas (GHG) emissions

[68] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

Moving Cooler Technical Appendices indicate that increasing employee parking costs $1 per day ($0.50 per vehicle for carpool and free for vanpools) can reduce GHG between 0.44% and 2.07% and reduce commuting VMT between 0.5% and 6.9%. The reduction in GHG varies based on how extensive the implementation of the program is. The reduction in commuting VMT differs for type of urban area as shown in the table below. Please note that these numbers are independent of results for employee parking cash-out strategy (discussed in its own fact sheet).

		Percent Change in Commuting VMT					
Strategy	Description	Large Metropolitan (higher transit use)	Large Metropolitan (lower transit use)	Medium Metro (higher)	Medium Metro (lower)	Small Metro (higher)	Small Metro (lower)
Parking Charges	Parking charge of $1/day	6.9%	0.9%	1.8%	0.5%	1.3%	0.5%
Source: *Moving Cooler*							

Preferred:

Commute Vehicle trip reduction	**Daily Parking Charges**			
Worksite Setting	**$0.75**	**$1.49**	**$2.98**	**$5.96**
Suburb	6.5%	15.1%	25.3%*	36.1%*
Suburban Center	12.3%	25.1%*	37.0%*	46.8%*
Central Business District	17.5%	31.8%*	42.6%*	50.0%*
Source: VTPI [2]				

* Discounts greater than 20% should be capped, as they exceed levels recommended by *TCRP 95* and other literature.

The reduction in commute trips varies by parking fee and worksite setting [2]. For daily parking fees between $1.49 and $5.96, worksites set in low-density suburbs could decrease vehicle trips by 6.5-36.1%, worksites set in activity centers could decrease vehicle trips by 12.3-46.8%, and worksites set in regional central business districts could decrease vehicles by 17.5-50%. (Note that adjusted parking fees (from 1993 dollars to 2009 dollars) were used. Adjustments were taken from the *Santa Monica General Plan EIR Report, Appendix*, Nelson\Nygaard).

Alternative Literature:

Alternate:

- 1 percentage point reduction in auto mode share
- 12.3% reduction in commute vehicle trips

TCRP 95 Draft Chapter 19 [4] found that an increase of $8 per month in employee parking charges was necessary to decrease employee SOV mode split rates by one percentage point. *TCRP 95* compared 82 sites with TDM programs and found that programs with parking fees have an average commute vehicle trip reduction of 24.6%, compared with 12.3% for sites with free parking.

Alternate:

- 1% reduction in VMT ($1 per day charge)
- 2.6% reduction in VMT ($3 per day charge)

The Deakin, et al. report [5] for the California Air Resources Board (CARB) analyzed transportation pricing measures for the Los Angeles, Bay Area, San Diego, and Sacramento metropolitan areas.

Alternative Literature References:

[4] Pratt, Dick. Personal Communication Regarding the Draft of TCRP 95 Traveler Response to Transportation System Changes – Chapter 19 Employer and Institutional TDM Strategies. (Table 19-9)

[5] Deakin, E., Harvey, G., Pozdena, R., and Yarema, G., 1996. *Transportation Pricing Strategies for California: An Assessment of Congestion, Emissions, Energy and Equity Impacts.* Final Report. Prepared for California Air Resources Board (CARB), Sacramento, CA (Table 7.2)

Other Literature Reviewed:

None

3.4.15 Implement Employee Parking "Cash-Out"

Range of Effectiveness: 0.6 – 7.7% commute vehicle miles traveled (VMT) reduction and therefore 0.6 – 7.7% reduction in commute trip GHG emissions

Measure Description:

The project will require employers to offer employee parking "cash-out." The term "cash-out" is used to describe the employer providing employees with a choice of forgoing their current subsidized/free parking for a cash payment equivalent to the cost of the parking space to the employer.

Measure Applicability:

- Urban and suburban context
- Not applicable in a rural context
- Appropriate for retail, office, industrial, and mixed-use projects
- Reductions applied only if complementary strategies are in place:
    - Residential parking permits and market rate public on-street parking -to prevent spill-over parking
    - Unbundled parking - is not required but provides a market signal to employers to forgo paying for parking spaces and "cash-out" the employee instead. In addition, unbundling parking provides a price with which employers can utilize as a means of establishing "cash-out" prices.

Baseline Method:

See introduction section.

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of employees eligible
- Location of project site: low density suburb, suburban center, or urban location

Mitigation Method:

$$\% \text{ VMT Reduction} = A * B$$

Where

A = % reduction in commute VMT (from the literature)

B = % of employees eligible

Detail:

- A: Change in Commute VMT: 3.0% (low density suburb), 4.5% (suburban center), 7.7% (urban) change in commute VMT (source: Moving Cooler)

Assumptions:

Data based upon the following references:

- Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. (Table 5.13, Table D.3) http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[69]
CO_2e	0.6 – 7.7% of running
PM	0.6 – 7.7% of running
CO	0.6 – 7.7% of running
NOx	0.6 – 7.7% of running
SO_2	0.6 – 7.7% of running
ROG	0.36 – 4.62% of running

Discussion:

Please note that these estimates are independent of results for workplace parking pricing strategy (see strategy number T# E5 for more information).

If work site parking is not unbundled, employers cannot utilize this unbundled price as a means of establishing “cash-out” prices. The table below shows typical costs for parking facilities in large urban and suburban areas in the US. This can be utilized as a reference point for establishing reasonable “cash-out” prices. Note that the table does not include external costs to parking such as added congestion, lost opportunity cost of land devoted to parking, and greenhouse gas (GHG) emissions.

	Structured (urban)	Surface (suburban)
Land (Annualized)	$1,089	$215
Construction (Annualized)	$2,171	$326

[69] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

O & M Costs	$575	$345
Annual Total	$3,835	$885
Monthly Costs	$320	$74
Source: VTPI, *Transportation Costs and Benefit Analysis II – Parking Costs*, April 2010 (p.5.4-10)		

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (low density suburb and 20% eligible) = 3% * 0.2 = 0.6%
- High Range % VMT Reduction (urban and 100% eligible) = 7.7% * 1 = 7.7%

Preferred Literature:

- 0.44% - 2.07% reduction in GHG emissions
- 3.0% - 7.7% reduction in commute VMT

Moving Cooler Technical Appendices indicate that reimbursing “cash-out” participants $1/day can reduce GHG between 0.44% and 2.07% and reduce commuting VMT between 3.0% and 7.7%. The reduction in GHG varies based on how extensive the implementation of the program is. The reduction in commuting VMT differs for type of urban area is shown in the table below.

		Percent Change in Commuting VMT					
Strategy	Description	Large Metropolitan (higher transit use)	Large Metropolitan (lower transit use)	Medium Metro (higher)	Medium Metro (lower)	Small Metro (higher)	Small Metro (lower)
Parking Cash-Out	Subsidy of $1/day	7.7%	3.7%	4.5%	3.0%	4.0%	3.0%

Alternative Literature:

Alternate:

- 2-6% reduction in vehicle trips

VTPI used synthesis data to determine parking cash out could reduce commute vehicle trips by 10-30%. VTPI estimates that the portion of vehicle travel affected by parking cash-out would be about 20% and therefore there would be only about a 2-6% total reduction in vehicle trips attributed to parking cash-out.

Alternate:

- 12% reduction in VMT per year per employee
- 64% increase in carpooling
- 50% increase in transit mode share
- 39% increase in pedestrian/bike share

Shoup looked at eight California firms that complied with California's 1992 parking cash-out law, applicable to employers of 50 or more persons in regions that do not meet the state's clean air standards. To comply, a firm must offer commuters the option to choose a cash payment equal to any parking subsidy offered. Six of companies went beyond compliance and subsidized one or more alternatives to parking (more than the parking subsidy price). The eight companies ranged in size between 120 and 300 employees, and were located in downtown Los Angeles, Century City, Santa Monica, and West Hollywood. Shoup states that an average of 12% fewer VMT per year per employee is equivalent to removing one of every eight cars driven to work off the road.

Alternative Literature Notes:

Litman, T., 2009. "Win-Win Emission Reduction Strategies." Victoria Transport Policy Institute. Website: http://www.vtpi.org/wwclimate.pdf. Accessed March 2010. (p. 5)

Donald Shoup, "Evaluating the Effects of Cashing Out Employer-Paid Parking: Eight Case Studies." *Transport Policy*, Vol. 4, No. 4, October 1997, pp. 201-216. (Table 1, p. 204)

Other Literature Reviewed:

None

3.5 Transit System Improvements

3.5.1 Provide a Bus Rapid Transit System

Range of Effectiveness: 0.02 – 3.2% vehicle miles traveled (VMT) reduction and therefore 0.02 – 3% reduction in GHG emissions.

Measure Description:

The project will provide a Bus Rapid Transit (BRT) system with design features for high quality and cost-effective transit service. These include:

- Grade-separated right-of-way, including bus only lanes (for buses, emergency vehicles, and sometimes taxis), and other Transit Priority measures. Some systems use guideways which automatically steer the bus on portions of the route.
- Frequent, high-capacity service
- High-quality vehicles that are easy to board, quiet, clean, and comfortable to ride.
- Pre-paid fare collection to minimize boarding delays.
- Integrated fare systems, allowing free or discounted transfers between routes and modes.
- Convenient user information and marketing programs.
- High quality bus stations with Transit Oriented Development in nearby areas.
- Modal integration, with BRT service coordinated with walking and cycling facilities, taxi services, intercity bus, rail transit, and other transportation services.

BRT systems vary significantly in the level of travel efficiency offered above and beyond “identity” features and BRT branding. The following effectiveness ranges represent general guidelines. Each proposed BRT should be evaluated specifically based on its characteristics in terms of time savings, cost, efficiency, and way-finding advantages. These types of features encourage people to use public transit and therefore reduce VMT.

Measure Applicability:

- Urban and suburban context
- Negligible in a rural context. Other measures are more appropriate to rural areas, such as express bus service to urban activity centers with park-and-ride lots at system-efficient rural access points.
- Appropriate for specific or general plans

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Existing transit mode share
- Percentage of lines serving Project converting to BRT

The following are optional inputs. Average (default) values are included in the calculations but can be updated to project specificity if desired. Please see Appendix C for calculation detail:

- Average vehicle occupancy

Mitigation Method:

% VMT Reduction = Riders * Mode * Lines * D

Where

Riders = % increase in transit ridership on BRT line (28% from [1])
Mode = Existing transit mode share (see table below)
Lines = Percentage of lines serving project converting to BRT
D = Adjustments from transit ridership increase to VMT (0.67, see Appendix C)

Project setting	Transit mode share
Suburban	1.3%
Urban	4%
Urban Center	17%
Source: NHTS, 2001 http://www.dot.ca.gov/hq/tsip/tab/documents/travelsurveys/Final2001_StwTravelSurveyWkdayRpt.pdf (Urban – MTC, SACOG. Suburban – SCAG, SANDAG, Fresno County.) Urban Center from San Francisco County Transportation Authority Countywide Transportation Plan, 2000.	

- D: 0.67 (see Appendix C for detail)

Assumptions:

Data based upon the following references:

[1] FTA, August 2005. "Las Vegas Metropolitan Area Express BRT Demonstration Project", NTD, http://www.ntdprogram.gov/ntdprogram/cs?action=showRegionAgencies&region=9

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[70]
CO_2e	0.02 – 3.2% of running
PM	0.02 – 3.2% of running
CO	0.02 – 3.2% of running
NOx	0.02 – 3.2% of running
SO_2	0.02 – 3.2% of running
ROG	0.012 – 1.9% of total

Discussion:

Increases in transit ridership due to shifts from other lines do not need to be addressed since it is already incorporated in the literature.

In general, transit operational strategies alone are not enough for a large modal shift [2], as evidenced by the low range in VMT reductions. Through case study analysis, the TCRP report [2] observed that strategies that focused solely on improving level of service or quality of transit were unsuccessful at achieving a significant shift. Strategies that reduce the attractiveness of vehicle travel should be implemented in combination to attract a larger shift in transit ridership. The three following factors directly impact the attractiveness of vehicle travel: urban expressway capacity, urban core density, and downtown parking availability.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (suburban,10% of lines) = 28% * 1.3% * 10% * 0.67 = 0.02%

[70] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

- High Range % VMT Reduction (urban, 100% of lines) = 28% * 17% * 100% * 0.67 = 3.2%

Preferred Literature:

- 28% increase in transit ridership in the existing corridor

The FTA study [1] looks at the implementation of the Las Vegas BRT system. The BRT supplemented an existing route along a 7.5 mile corridor. The existing route was scaled back. Total ridership on the corridor (both routes combined) increased 61,704 monthly riders, 28% increase on the existing corridor and 1.4% increase in system ridership. The route represented an increase in 2.1% of system service miles provided.

Alternative Literature:

Alternate:

- 27-84% increase in total transit ridership

Various bus rapid transit systems obtained the following total transit ridership growth: Vancouver 96B (30%), Las Vegas Max (35-40%), Boston Silver Line (84%), Los Angeles (27-42%), and Oakland (66%). VTPI [3] obtained the BRT data from BC Transit's unpublished research. The effectiveness of a BRT strategy depends largely on the land uses the BRT serves and their design and density.

Alternate:

- 50% increase in weekly transit ridership
- 60 – 80% shorter travel time compared to vehicle trip

The Martin Luther King, Jr. East Busway in Pennsylvania opened in 1983 as a separate roadway exclusively for public buses. The busway was 6.8 miles long with six stations. Ridership has grown from 20,000 to 30,000 weekday riders over 10 years. The busway saves commuters significant time compared with driving: 12 minutes versus 30-45 minutes in the AM or an hour in the PM [4].

Alternative Literature References:

[2] Transit Cooperative Research Program. TCRP 27 – Building Transit Ridership: An Exploration of Transit's Market Share and the Public Policies That Influence It (p.47-48). 1997. [cited in discussion section above]

[3] TDM Encyclopedia; Victoria Transport Policy Institute (2010). Bus Rapid Transit; (http://www.vtpi.org/tdm/tdm120.htm); updated 1/25/2010; accessed 3/3/2010.

[4] Transportation Demand Management Institute of the Association for Commuter Transportation. *TDM Case Studies and Commuter Testimonials*. Prepared for the US EPA. 1997. (p.55-56) http://www.epa.gov/OMS/stateresources/rellinks/docs/tdmcases.pdf

3.5.2 Implement Transit Access Improvements

Range of Effectiveness: Grouped strategy. [See TST-3 and TST-4]

Measure Description:

This project will improve access to transit facilities through sidewalk/ crosswalk safety enhancements and bus shelter improvements. The benefits of Transit Access Improvements alone have not been quantified and should be grouped with Transit Network Expansion (TST-3) and Transit Service Frequency and Speed (TST-4).

Measure Applicability:

- Urban, suburban context
- Appropriate for residential, retail, office, mixed use, and industrial projects

Alternative Literature:

No literature was identified that specifically looks at the quantitative impact of improving transit facilities as a standalone strategy.

Alternative Literature References:

None

Other Literature Reviewed:

None

3.5.3 Expand Transit Network

Range of Effectiveness: 0.1 – 8.2% vehicle miles travelled (VMT) reduction and therefore 0.1 – 8.2% reduction in GHG emissions[71]

Measure Description:

The project will expand the local transit network by adding or modifying existing transit service to enhance the service near the project site. This will encourage the use of transit and therefore reduce VMT.

Measure Applicability:

- Urban and suburban context
- May be applicable in a rural context but no literature documentation available (effectiveness will be case specific and should be based on specific assessment of levels of services and origins/destinations served)
- Appropriate for specific or general plans

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage increase transit network coverage
- Existing transit mode share
- Project location: urban center, urban, or suburban

[71] Transit vehicles may also result in increases in emissions that are associated with electricity production or fuel use. The Project Applicant should consider these potential additional emissions when estimating mitigation for these measures.

The following are optional inputs. Average (default) values are included in the calculations but can be updated to project specificity if desired. Please see Appendix C for calculation detail:

- Average vehicle occupancy

Mitigation Method:

% VMT Reduction = Coverage * B * Mode * D

Where

Coverage = % increase in transit network coverage
B = elasticity of transit ridership with respect to service coverage (see Table below)
Mode = existing transit mode share
D = adjustments from transit ridership increase to VMT (0.67, from Appendix C)

B:

Project setting	Elasticity
Suburban	1.01
Urban	0.72
Urban Center	0.65
Source: TCRP 95, Chapter 10	

Mode: Provide existing transit mode share for project or utilize the following averages

Project setting	Transit mode share
Suburban	1.3%
Urban	4%
Urban Center	17%
Source: NHTS, 2001http://www.dot.ca.gov/hq/tsip/tab/documents/travelsurveys/Final2001_StwTravelSurveyWkdayRpt.pdf (Urban – MTC, SACOG. Suburban – SCAG, SANDAG, Fresno County.) Urban Center from San Francisco County Transportation Authority Countywide Transportation Plan, 2000.	

Assumptions:

Data based upon the following references:

[1] Transit Cooperative Research Program. TCRP Report 95 Traveler Response to System Changes – Chapter 10: Bus Routing and Coverage. 2004. (p. 10-8 to 10-10)

Emission Reduction Ranges and Variables:

Pollut0ant	Category Emissions Reductions[72]
CO_2e	0.1 – 8.2% of running
PM	0.1 – 8.2% of running
CO	0.1 – 8.2% of running
NOx	0.1 – 8.2% of running
SO_2	0.1 – 8.2% of running
ROG	0.06 – 4.9% of total

Discussion:

In general, transit operational strategies alone are not enough for a large modal shift [2], as evidenced by the low range in VMT reductions. Through case study analysis, the TCRP report [2] observed that strategies that focused solely on improving level of service or quality of transit were unsuccessful at achieving a significant shift. Strategies that reduce the attractiveness of vehicle travel should be implemented in combination to attract a larger shift in transit ridership. The three following factors directly impact the attractiveness of vehicle travel: urban expressway capacity, urban core density, and downtown parking availability.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (10% expansion, suburban) = 10% * 1.01 * 1.3% * .67 = 0.1%
- High Range % VMT Reduction (100% expansion, urban) = 100% * 0.72 * 17% * .67 = 8.2%

The low and high ranges are estimates and may vary based on the characteristics of the project.

[72] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

Preferred Literature:

- 0.65 = elasticity of transit ridership with respect to service coverage/expansion (in radial routes to central business districts)
- 0.72 = elasticity of transit ridership with respect to service coverage/expansion (in central city routes)
- 1.01 = elasticity of transit ridership with respect to service coverage/expansion (in suburban routes)

TCRP 95 Chapter 10 [1] documents the results of system-wide service expansions in San Diego. The least sensitivity to service expansion came from central business districts while the largest impacts came from suburban routes. Suburban locations, with traditionally low transit service, tend to have greater ridership increases compared to urban locations which already have established transit systems. In general, there is greater opportunity in suburban locations.

Alternative Literature:

- -0.06 = elasticity of VMT with respect to transit revenue miles

Growing Cooler [3] modeled the impact of various urban variables (including transit revenue miles and transit passenger miles) on VMT, using data from 84 urban areas around the U.S.

Alternative Literature References:

[2] Transit Cooperative Research Program. TCRP 27 – Building Transit Ridership: An Exploration of Transit's Market Share and the Public Policies That Influence It (p.47-48). 1997. [cited in discussion section above]

[3] Ewing, et al, 2008. Growing Cooler – The Evidence on Urban Development and Climate Change. Urban Land Institute.

3.5.4 Increase Transit Service Frequency/Speed

Range of Effectiveness: 0.02 – 2.5% vehicle miles traveled (VMT) reduction and therefore 0.02 – 2.5% reduction in GHG emissions[73]

Measure Description:

This project will reduce transit-passenger travel time through more reduced headways and increased speed and reliability. This makes transit service more attractive and may result in a mode shift from auto to transit which reduces VMT.

Measure Applicability:

- Urban and suburban context
- May be applicable in a rural context but no literature documentation available (effectiveness will be case specific and should be based on specific assessment of levels of services and origins/destinations served)
- Appropriate for specific or general plans

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage reduction in headways (increase in frequency)
- Level of implementation
- Project setting: urban center, urban, suburban
- Existing transit mode share

[73] Transit vehicles may also result in increases in emissions that are associated with electricity production or fuel use. The Project Applicant should consider these potential additional emissions when estimating mitigation for these measures.

The following are optional inputs. Average (default) values are included in the calculations but can be updated to project-specific values if desired. Please see Appendix C for calculation detail:

- Average vehicle occupancy

Mitigation Method:

% VMT Reduction = Headway * B * C * Mode * E

Where

Headway = % reduction in headways
B = elasticity of transit ridership with respect to increased frequency of service (from [1])
C = adjustment for level of implementation
Mode = existing transit mode share
E = adjustments from transit ridership increase to VMT

Detail:

- Headway: reasonable ranges from 15 – 80%
- B:

Setting	Elasticity
Urban	0.32
Suburban	0.36
Source: TCRP Report 95 Chapter 9	

- C:

Level of implementation = number of lines improved / total number of lines serving project	Adjustment
<50%	50%
>=50%	85%
Fehr & Peers, 2010.	

- Mode: Provide existing transit mode share for project or utilize the following averages

Project setting	Transit mode share
Suburban	1.3%
Urban	4%
Urban Center	17%
Source: NHTS, 2001http://www.dot.ca.gov/hq/tsip/tab/documents/travelsurveys/Final2001_StwTravelSurveyWkdayRpt.pdf (Urban – MTC, SACOG. Suburban – SCAG, SANDAG, Fresno County.)	

Urban Center from San Francisco County Transportation Authority Countywide Transportation Plan, 2000.

- E: 0.67 (see Appendix C for detail)

Assumptions:

Data based upon the following references:

[1] Transit Cooperative Research Program. TCRP Report 95 Traveler Response to System Changes – Chapter 9: Transit Scheduling and Frequency (p. 9-14)

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[74]
CO_2e	0.02 – 2.5% % of running
PM	0.02 – 2.5% % of running
CO	0.02 – 2.5% % of running
NOx	0.02 – 2.5% % of running
SO_2	0.02 – 2.5% % of running
ROG	0.01 – 1.5% % of total

Discussion:

Reasonable ranges for reductions were calculated assuming existing 30-minute headways reduced to 25 minutes and 5 minutes to establish the estimated low and high reductions, respectively.

The level of implementation adjustment is used to take into account increases in transit ridership due to shifts from other lines. If increases in frequency are only applied to a percentage of the lines serving the project, then we conservatively estimate that 50% of the transit ridership increase is a shift from the existing lines. If frequency increases are applied to a majority of the lines serving the project, we conservatively assume at least some of the transit ridership (15%) comes from existing riders.

In general, transit operational strategies alone are not enough for a large modal shift [2], as evidenced by the low range in VMT reductions. Through case study analysis, the TCRP report [2] observed that strategies that focused solely on improving level of service or quality of transit were unsuccessful at achieving a significant shift. Strategies that reduce the attractiveness of vehicle travel should be implemented in combination to attract a larger shift in transit ridership. The three following factors directly impact the

[74] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

attractiveness of vehicle travel: urban expressway capacity, urban core density, and downtown parking availability.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (15% reduction in headways, suburban, <50% implementation) = 15% * 0.36 * 50% * 1.3% *0.67 = 0.02%
- High Range % VMT Reduction (80% reduction in headways, urban, >50% implementation) = 80% * 0.32 * 85% * 17% * 0.67 = 2.5%

Preferred Literature:

- 0.32 = elasticity of transit ridership with respect to transit service (urban)
- 0.36 – 0.38 = elasticity of transit ridership with respect to transit service (suburban)

TCRP 95 Chapter 9 [1] documents the results of frequency changes in Dallas. Increases in frequency are more sensitive in a suburban environment. Suburban locations, with traditionally low transit service, tend to have greater ridership increases compared to urban locations which already have established transit systems. In general, there is greater opportunity in suburban locations

Alternative Literature:

- 0.5 = elasticity of transit ridership with respect to increased frequency of service
- 1.5 to 2.3% increase in annual transit trips due to increased frequency of service
- 0.4-0.5 = elasticity of ridership with respect to increased operational speed
- 4% - 15% increase in annual transit trips due to increased operational speed
- 0.03-0.09% annual GHG reduction (for bus service expansion, increased frequency, and increased operational speed)

For increased frequency of service strategy, *Moving Cooler* [3] looked at three levels of service increases, 3%, 3.5% and 4.67% increases in service, resulting in a 1.5 – 2.3% increase in annual transit trips. For increased speed and reliability, Moving Cooler looked at three levels of speed/reliability increases. Improving travel speed by 10% assumed implementing signal prioritization, limited stop service, etc. over 5 years. Improving travel speed by 15% assumed all above strategies plus signal synchronization and intersection reconfiguration over 5 years. Improving travel speed by 30% assumed all above strategies and an improved reliability by 40%, integrated fare system, and implementation of BRT where appropriate. *Moving Cooler* calculates estimated 0.04-0.14% annual GHG reductions in combination with bus service expansion strategy.

Alternative Literature References:

[2] Transit Cooperative Research Program. TCRP 27 – Building Transit Ridership: An Exploration of Transit's Market Share and the Public Policies That Influence It (p.47-48). 1997. [cited in discussion section]

[3] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. (p B-32, B-33, Table D.3) http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendices_Complete_102209.pdf

3.5.5 Provide Bike Parking Near Transit

Range of Effectiveness: Grouped strategy. [See TST-3 and TST-4]

Measure Description:

Provide short-term and long-term bicycle parking near rail stations, transit stops, and freeway access points. The benefits of Station Bike Parking have no quantified impacts as a standalone strategy and should be grouped with Transit Network Expansion (TST-3) and Increase Transit Service Frequency and Speed (TST-4) to encourage multi-modal use in the area and provide ease of access to nearby transit for bicyclists.

Measure Applicability:

- Urban, suburban context
- Appropriate for residential, retail, office, mixed use, and industrial projects

Alternative Literature:

No literature was identified that specifically looks at the quantitative impact of including transit station bike parking.

Alternative Literature References:

None

Other Literature Reviewed:

None

3.5.6 Provide Local Shuttles

Range of Effectiveness: Grouped strategy. [See TST-4 and TST-5]

Measure Description:

The project will provide local shuttle service through coordination with the local transit operator or private contractor. The local shuttles will provide service to transit hubs, commercial centers, and residential areas. The benefits of Local Shuttles alone have not been quantified and should be grouped with Transit Network Expansion (TST-4) and Transit Service Frequency and Speed (TST-5) to solve the “first mile/last mile” problem. In addition, many of the CommuteTrip Reduction Programs (Section 2.4, TRP 1-13) also included local shuttles.

Measure Applicability:

- Urban, suburban context
- Appropriate for large residential, retail, office, mixed use, and industrial projects

Alternative Literature:

No literature was identified to support the effectiveness of this strategy alone.

Alternative Literature References:

None

Other Literature Reviewed:

None

3.6 Road Pricing/Management

3.6.1 Implement Area or Cordon Pricing

Range of Effectiveness: 7.9 – 22.0% vehicle miles traveled (VMT) reduction and therefore 7.9 – 22.0% reduction in GHG emissions.

Measure Description:

This project will implement a cordon pricing scheme. The pricing scheme will set a cordon (boundary) around a specified area to charge a toll to enter the area by vehicle. The cordon location is usually the boundary of a central business district (CBD) or urban center, but could also apply to substantial development projects with limited points of access, such as the proposed Treasure Island development in San Francisco. The cordon toll may be static/constant, applied only during peak periods, or be variable, with higher prices during congested peak periods. The toll price can be based on a fixed schedule or be dynamic, responding to real-time congestion levels. It is critical to have an existing, high quality transit infrastructure for the implementation of this strategy to reach a significant level of effectiveness. The pricing signals will only cause mode shifts if alternative modes of travel are available and reliable.

Measure Applicability:

- Central business district or urban center only

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage increase in pricing for passenger vehicles to cross cordon
- Peak period variable price or static all-day pricing (London scheme)

The following are optional inputs. Average (default) values are included in the calculations but can be updated to project-specific values if desired. Please see Appendix C for calculation detail:

- % (due to pricing) route shift, time-of-day shift, HOV shift, trip reduction, shift to transit/walk/bike

Mitigation Method:

% VMT Reduction = Cordon$ * B * C

Where

Cordon$ = % increase in pricing for passenger vehicles to cross cordon

B = Elasticity of VMT with respect to price (from [1])

C = Adjustment for % of VMT impacted by congestion pricing and mode shifts

Detail:

- Cordon$: reasonable range of 100 – 500% (See Appendix C for detail))
- B: 0.45 [1]
- C:

Cordon pricing scheme	Adjustment
Peak-period variable pricing	8.8%
Static all-day pricing	21%
Source: See Appendix C for detail	

Assumptions:

Data based upon the following references:

[1] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. (p. B-13, B-14) http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf

- Referencing: VTPI, *Transportation Elasticities: How Prices and Other Factors Affect Travel Behavior.* July 2008. www.vtpi.org

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[75]
CO_2e	7.9 - 22.0% of running
PM	7.9 - 22.0% of running
CO	7.9 - 22.0% of running
NOx	7.9 - 22.0% of running
SO_2	7.9 - 22.0% of running
ROG	4.7 – 13.2% of total

Discussion:

The amount of pricing will vary on a case-by-case basis. The 100 – 500% increase is an estimated range of increases and should be adjusted to reflect the specificities of the pricing scheme implemented. Take care in calculating the percentage increase in price if baseline is $0.00. An upper limit of 500% may be a good check point. If baseline is zero, the Project Applicant may want to conduct calculations with a low baseline such as $1.00.

These calculations assume that the project is within the area cordon, essentially assuming that 100% of project trips will be affected. See Appendix C to make appropriate adjustments.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (100% increase in price, peak period pricing) = 100% * 0.45 * 8.8% = 4.0%
- High Range % VMT Reduction (500% increase in price, all-day pricing) = 500% * 0.45 * 21% = 47.3% = 22% (established maximum based on literature)

Preferred Literature:

- -0.45 VMT elasticity with regard to pricing
- 0.04-0.08% greenhouse gas (GHG) reduction

Moving Cooler [1] assumes an average of 3% of regional VMT would cross the CBD cordon. A VMT reduction of 20% was estimated to require an average of 65 cents/mile applied to all congested VMT in the CBD, major employment, and retail centers. The

[75] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

range in GHG reductions is attributed to the range of implementation and start date. *Moving Cooler* reports an elasticity range from -0.15 to -0.47 from VTPI. *Moving Cool*er utilizes a stronger elasticity (0.45) to represent greater impact cordon pricing will have on users compared to other pricing strategies.

Alternative Literature:

- 6.5-14.0% reduction in carbon emissions
- 16-22% reduction in vehicles
- 6-9% increase in transit use

The Center for Clean Air Policy (CCAP) [2] cites two case studies in Europe, one in London and one in Stockholm, which show vehicle reductions of 16% and 22%, respectively. London's fee reduced CO_2 by 6.5%. Stockholm's program reduced injuries by 10%, increased transit use by 6-9%, and reduced carbon emissions by 14% in the central city within months of implementation.

Alternative Literature References:

[2] Center for Clean Air Policy (CCAP), *Short-term Efficiency Measures.* (p. 1) http://www.ccap.org/docs/resources/715/Short-Term%20Travel%20Efficiency%20 Measures%20cut%20GHGs%209%2009%20final.pdf

CCAP cites Transport for London. *Central London Congestion Charging: Impacts Monitoring*, *Sixth Annual Report*. July 2008 http://www.tfl.gov.uk/assets/downloads/sixth-annual-impacts-monitoring-report-2008-07.pdf (p. 6) and Leslie Abboud and Jenny Clevstrom, "Stockholm's Syndrome," August 29, 2006, *Wall Street Journal.*http://transportation.northwestern.edu/mahmassani/Media/WSJ_8.06.pdf (p. 2)

Other Literature Reviewed:

None

3.6.2 Improve Traffic Flow

Range of Effectiveness: 0 - 45% reduction in GHG emissions

Measure Description:

The project will implement improvements to smooth traffic flow, reduce idling, eliminate bottlenecks, and management speed. Strategies may include signalization improvements to reduce delay, incident management to increase response time to breakdowns and collisions, Intelligent Transportation Systems (ITS) to provide real-time information regarding road conditions and directions, and speed management to reduce high free-flow speeds.

This measure does not take credit for any reduction in GHG emissions associated with changes to non-project traffic VMT. If Project Applicant wants to take credit for this benefit, the non-project traffic VMT would also need to be covered in the baseline conditions.

Measure Applicability:

- Urban, suburban, and rural context

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Average base-year travel speed (miles per hour (mph)) on implemented roads (congested[76] condition)

[76] A roadway is considered “congested” if operating at Level of Service (LOS) E or F

- Future travel speed (mph) on implemented roads for both a) congested and b) free-flow[77] condition
- Total vehicle miles traveled (VMT) on implemented roadways
- Total project-generated VMT

Mitigation Method:

$$\% \ CO_2 \text{ Emissions Reduction} = 1 - \frac{\text{Project GHG Emission}_{\text{post strategy}}}{\text{Project GHG emission}_{\text{baseline}}}$$

Where

Project GHG emission$_{\text{post strategy}}$ = EF$_{\text{running}}$ after strategy implementation * project VMT
Project GHG emission$_{\text{baseline}}$ = EF$_{\text{running}}$ before strategy implementation * project VMT
EF$_{\text{running}}$ = emission factor for running emissions [from table presented under "Detail" below]

Detail:

mph	Grams of CO_2 / mile	
	congested	Free-flow
5	1,110	823
10	715	512
15	524	368
20	424	297
25	371	262
30	343	247
35	330	244
40	324	249
45	323	259
50	325	273
55	328	289
60	332	306
65	339	325
70	353	347
75	377	375
80	420	416
85	497	478
Source: Barth, 2008, Fehr & Peers [1]		

[77] A roadway is considered "free flow" if operating at LOS D or better

By only including the project VMT portion, the reduction is typically on scale with the percentage of cost for traffic improvements and full reduction calculated for project VMT should be used. However, if the project cost is a greater share than their contribution to the VMT on the road, than the project and non-project VMT should be calculated and the percent reduction should be multiplied by the percent cost allocation. The GHG emission reductions associated with non-project VMT (if applicable) would be calculated as follows:

Metric Tonnes GHG reduced due to improving non-Project traffic flow = % Cost Allocation * Non-Project VMT * ($EF_{congested}$ – $EF_{freeflow}$) / (1,000,000 gram/MT)

Where:

Non-Project VMT = portion of non-project VMT that the Project's cost share impacts

$EF_{congested}$ = emissions for congested road in g/VMT

$EF_{freeflow}$ = emissions for freeflow road in g/VMT

Assumptions:

Data based upon the following references:

[1] Barth and Boriboonsomsin, "Real World CO_2 Impacts of Traffic Congestion", *Transportation Research Record, Journal of the Transportation Research Board,* No. 2058, Transportation Research Board, National Academy of Science, 2008.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[78]
CO_2e	0 - 45% of running
PM	0 - 45% of running
CO	0 - 45% of running

[78] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

NOx	0 - 45% of running
SO_2	0 - 45% of running
ROG	0 - 27% of total

Discussion:

Care must be taken when estimating effectiveness since significantly improving traffic flow essentially lowers the cost and delay involved in travel, which under certain circumstances may induce additional VMT. [See Appendix C for a discussion on induced travel.]

The range of effectiveness presented above is a very rough estimate as emissions reductions will be highly dependent on the level of implementation and degree of congestion on the existing roadways. In addition, the low range of effectiveness was stated at 0% to highlight the potential of induced travel negating benefits achieved from this strategy.

Example:

Sample calculations are provided below:

- Signal timing coordination implementation:
  - Existing congested speeds of 25 mph
  - Conditions post-implementation: would improve to 25 mph free flow speed
  - Proposed project daily traffic generation is 200,000 VMT
  - Project CO_2 Emissions$_{baseline}$ = (371 g CO_2/mile) * (200,000 VMT daily) * (1 MT / 1 x 10^6 g) = 74 MT of CO_2 daily
  - Project CO_2 Emissions$_{post\ strategy}$ = (262 g CO_2/mile) * (200,000 VMT daily) * (1 MT / 1 x 10^6 g) = 52.4 MT of CO_2 daily
  - Percent CO_2emissions reduction = 1- (52.4 MT/ 74 MT) = 29%
- Speed management technique:
  - Existing free-flow speeds of 75 mph
  - Conditions post-implementation: reduce to 55 mph free flow speed
  - Proposed project daily traffic generation is 200,000 VMT
  - Project CO_2 Emissions$_{baseline}$ = (375 g CO_2/mile) * (200,000 VMT daily) * (1 MT / 1 x 10^6 g) = 75 MT of CO_2 daily
  - Project CO_2 Emissions$_{post\ strategy}$ = (289 g CO_2/mile) * (200,000 VMT daily) * (1 MT / 1 x 10^6 g) = 58 MT of CO_2 daily
  - Percent CO_2emissions reduction= 1 – (58 tons/ 75 tons) = 23%

Preferred Literature:

- 7 – 12% reduction in CO_2 emissions

This study [1] examined traffic conditions in Southern California using energy and emissions modeling and calculated the impacts of 1) congestion mitigation strategies to smooth traffic flow, 2) speed management techniques to reduce high free-flow speeds, and 3) suppression techniques to eliminate acceleration/deceleration associated with stop-and-go traffic. Using typical conditions on Southern California freeways, the strategies could reduce emissions by 7 to 12 percent.

The table (in the mitigation method section) was calculated using the CO_2 emissions equation from the report:

$$\ln (y) = b_0 + b_1 * x + b_2 * x^2 + b_3 * x^3 + b_4 * x^4$$

where

y = CO_2 emission in grams / mile
x = average trip speed in miles per hour (mph)

The coefficients for b_i were based off of Table 1 of the report, which then provides an equation for both congested conditions (real-world) and free-flow (steady-state) conditions.

Alternative Literature:

- 4 - 13% reduction in fuel consumption

The FHWA study [2] looks at various case studies of traffic flow improvements. In Los Angeles, a new traffic control signal system was estimated to reduce signal delays by 44%, vehicle stops by 41%, and fuel consumption by 13%. In Virginia, a study of retiming signal systems estimated reductions of stops by 25%, travel time by 10%, and fuel consumption by 4%. In California, optimization of 3,172 traffic signals through 1988 (through California's Fuel Efficient Traffic Signal Management program) documented an average reduction in vehicle stops of 16% and in fuel use of 8.6%. The 4-13% reduction in fuel consumption applies only to that vehicular travel directly benefited by the traffic flow improvements, specifically the VMT within the corridor in which the ITS is implemented and only during the times of day that would otherwise be congested without ITS. For example, signal coordination along an arterial normally congested in peak commute hours would produce a 4-13% reduction in fuel consumption only for the VMT occurring along that arterial during weekday commute hours.

Alternate:

- Up to 0.02% *increase* in greenhouse gas (GHG) emissions

Moving Cooler [3] estimates that bottleneck relief will result in an increase in GHG emissions during the 40-year period, 2010 to 2050. In the short term, however, improved roadway conditions may improve congestion and delay, and thus reduce fuel consumption. VMT and GHG emissions are projected to increase after 2030 as induced demand begins to consume the roadway capacity. The study estimates a maximum increase of 0.02% in GHG emissions.

Alternative Literature References:

[2] FHWA, *Strategies to Reduce Greenhouse Gas Emissions from Transportation Sources*. http://www.fhwa.dot.gov/environment/glob_c5.pdf.

[3] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf

Other Literature Reviewed:

None

3.6.3 Required Project Contributions to Transportation Infrastructure Improvement Projects

Range of Effectiveness: Grouped strategy. [See RPT-2 and TST-1 through 7]

Measure Description:

The project should contribute to traffic-flow improvements or other multi-modal infrastructure projects that reduce emissions and are not considered as substantially growth inducing. The local transportation agency should be consulted for specific needs.

Larger projects may be required to contribute a proportionate share to the development and/or continuation of a regional transit system. Contributions may consist of dedicated right-of-way, capital improvements, easements, etc. The local transportation agency should be consulted for specific needs.

Refer to Traffic Flow Improvements (RPT-2) or the Transit System Improvements (TST-1 through 7) strategies for a range of effectiveness in these categories. The benefits of Required Contributions may only be quantified when grouped with related improvements.

Measure Applicability:

- Urban, suburban, and rural context
- Appropriate for residential, retail, office, mixed use, and industrial projects

Alternative Literature:

Although no literature discusses project contributions as a standalone measure, this strategy is a supporting strategy for most operations and infrastructure projects listed in this report.

Other Literature Reviewed:

None

3.6.4 Install Park-and-Ride Lots

Range of Effectiveness: Grouped strategy. [See RPT-1, TRT-11, TRT-3, and TST-1 through 6]

Measure Description:

This project will install park-and-ride lots near transit stops and High Occupancy Vehicle (HOV) lanes. Park-and-ride lots also facilitate car- and vanpooling. Refer to Implement Area or Cordon Pricing (RPT-1), Employer-Sponsored Vanpool/Shuttle (TRT-11), Ride Share Program (TRT-3), or the Transit System Improvement strategies (TST-1 through 6) for ranges of effectiveness within these categories. The benefits of Park-and-Ride Lots are minimal as a stand-alone strategy and should be grouped with any or all of the above listed strategies to encourage carpooling, vanpooling, ride-sharing, and transit usage.

Measure Applicability:

- Suburban and rural context
- Appropriate for residential, retail, office, mixed use, and industrial projects

Alternative Literature:

Alternate:

- 0.1 – 0.5% vehicle miles traveled (VMT) reduction

A 2005 FHWA [1] study found that regional VMT in metropolitan areas may be reduced between 0.1 to 0.5% (citing Apogee Research, Inc., 1994). The reduction potential of this strategy may be limited because it reduces the trip length but not vehicle trips.

Alternate:

- 0.50% VMT reduction per day

Washington State Department of Transportation (WSDOT) [2] notes the above number applies to countywide interstates and arterials.

Alternative Literature References:

[1] FHWA. Transportation and Global Climate Change: A Review and Analysis of the Literature – Chapter 5: Strategies to Reduce Greenhouse Gas Emissions from Transportation Sources. http://www.fhwa.dot.gov/environment/glob_c5.pdf

[2] Washington State Department of Transportation. *Cost Effectiveness of Park-and-Ride Lots in the Puget Sound Area.* http://www.wsdot.wa.gov/research/reports/fullreports/094.1.pdf

Other Literature Reviewed:

None

3.7 Vehicles

3.7.1 Electrify Loading Docks and/or Require Idling-Reduction Systems

Range of Effectiveness: 26-71% reduction in TRU idling GHG emissions

Measure Description:

Heavy-duty trucks transporting produce or other refrigerated goods will idle at truck loading docks and during layovers or rest periods so that the truck engine can continue to power the cab cooling elements. Idling requires fuel use and results in GHG emissions.

The Project Applicant should implement an enforcement and education program that will ensure compliance with this measure. This includes posting signs regarding idling restrictions as well as recording engine meter times upon entering and exiting the facility.

Measure Applicability:

- Truck refrigeration units (TRU)

Inputs:

The following information needs to be provided by the Project Applicant:

- Electricity provider for the Project
- Horsepower of TRU
- Hours of operation

Baseline Method:

$$\text{GHG emission} = \frac{CO_2\ \text{Exhaust}}{\text{Activity} \times \text{AvgHP} \times \text{LF}} \times \text{Hp} \times \text{Hr} \times \text{C} \times \text{LF}$$

Where:

GHG emission = MT CO_2e

CO_2 Exhaust = Statewide daily CO_2 emission from TRU for the relevant horsepower tier (tons/day). Obtained from OFFROAD2007.

Activity = Statewide daily average TRU operating hours for the relevant horsepower tier (hours/day). Obtained from OFFROAD2007.

AvgHP = Average TRU horsepower for the relevant horsepower tier (HP). Obtained from OFFROAD2007.

Hp = Horsepower of TRU.

Hr = Hours of operation.

C = Unit conversion factor

LF = Load factor of TRU for the relevant horsepower tier (dimensionless). Obtained from OFFROAD 2007.

Note that this method assumes the load factor of the TRU is same as the default in OFFROAD2007.

Mitigation Method:

Electrify loading docks

TRUs will be plugged into electric loading dock instead of left idling. The indirect GHG emission from electricity generation is:

$$\text{GHG emission} = \text{Utility} \times \text{Hp} \times \text{LF} \times \text{Hr} \times \text{C}$$

Where:

GHG emissions = MT CO_2e
Utility = Carbon intensity of Local Utility (CO_2e/kWh)
Hp = Horsepower of TRU.
LF = Load factor of TRU for the relevant horsepower tier (dimensionless). Obtained from OFFROAD2007.
Hr = Hours of operation.
C = Unit conversion factor

GHG Reduction %[79] $= 1 - \dfrac{\text{Utility} \times \text{C}}{\text{EF} \times 10^{-6}}$

Idling Reduction

Emissions from reduced TRU idling periods are calculated using the same methodology for the baseline scenario, but with the shorter hours of operation.

$$\text{GHG Reduction \%} = 1 - \frac{\text{time}_{\text{mitigated}}}{\text{time}_{\text{baseline}}}$$

Electrify loading docks

Power Utility	TRU Horsepower (HP)	Idling Emission Reductions[80]
LADW&P	< 15	26.3%
	< 25	26.3%
	< 50	35.8%

[79] This assumes energy from engine losses are the same.
[80] This reduction percentage applies to all GHG and criteria pollutant idling emissions.

PG&E	< 15	72.9%
	< 25	72.9%
	< 50	76.3%
SCE	< 15	61.8%
	< 25	61.8%
	< 50	66.7%
SDGE	< 15	53.5%
	< 25	53.5%
	< 50	59.5%
SMUD	< 15	67.0%
	< 25	67.0%
	< 50	71.2%

Idling Reduction

Emission reduction from shorter idling period is same as the percentage reduction in idling time.

Discussion:

The output from OFFROAD2007 shows the same emissions within each horsepower tier regardless of the year modeled. Therefore, the emission reduction is dependent on the location of the Project and horsepower of the TRU only.

Assumptions:

Data based upon the following references:

- California Air Resources Board. Off-road Emissions Inventory. OFFROAD2007. Available online at: http://www.arb.ca.gov/msei/offroad/offroad.htm
- California Climate Action Registry Reporting Online Tool. 2006 PUP Reports. Available online at: https://www.climateregistry.org/CARROT/public/reports.aspx

Preferred Literature:

The electrification of truck loading docks can allow properly equipped trucks to take advantage of external power and completely eliminate the need for idling. Trucks would need to be equipped with internal wiring, inverter, system, and a heating, ventilation, and air conditioning (HVAC) system. Under this mitigation measure, the direct emissions from fuel combustion are completely displaced by indirect emissions from the CO_2 generated during electricity production. The amount of electricity required depends on the type of truck and refrigeration elements; this data could be determined from manufacturer specifications. The total kilowatt-hours required should be multiplied by the carbon-intensity factor of the local utility provider in order to calculate the amount of indirect CO_2 emissions. To take credit for this mitigation measure, the Project Applicant would need to provide detailed evidence supporting a calculation of the emissions reductions.

Alternative Literature:

None

Other Literature Reviewed:

1. USEPA. 2002. Green Transport Partnership, A Glance at Clean Freight Strategies: Idle Reduction. Available online at: http://nepis.epa.gov/Adobe/PDF/P1000S9K.PDF
2. ATRI. 2009. Research Results: Demonstration of Integrated Mobile Idle Reduction Solutions. Available online at: http://www.atri-online.org/research/results/ATRI1pagesummaryMIRTDemo.pdf

None

3.7.2 Utilize Alternative Fueled Vehicles

Range of Effectiveness: Reduction in GHG emissions varies depending on vehicle type, year, and associated fuel economy.

Measure Description:

When construction equipment is powered by alternative fuels such as biodiesel (B20), liquefied natural gas (LNG), or compressed natural gas (CNG) rather than conventional petroleum diesel or gasoline, GHG emissions from fuel combustion may be reduced.

Measure Applicability:

- Vehicles

Inputs:

The following information needs to be provided by the Project Applicant:

- Vehicle category
- Traveling speed (mph)
- Number of trips and trip length, or Vehicle Miles Traveled (VMT)
- Fuel economy (mpg) or Fuel consumption

Baseline Method:

$$\text{Baseline } CO_2 \text{ Emission} = EF \times \frac{1}{FE} \times VMT \times C$$

Where:

Baseline CO_2 Emission = MT of CO_2
EF = CO_2 emission factor, from CCAR General Reporting Protocol (g/gallon)
VMT = Vehicle miles traveled (VMT) = T x L
FE = Fuel economy (mpg)
C = Unit conversion factor

$$\text{Baseline } N_2O/CH_4 \text{ Emission} = EF \times VMT \times C$$

Where:

Baseline N_2O/CH_4 Emission = MT of N_2O or CH_4
EF = N_2O or CH_4 emission factor, from CCAR General Reporting Protocol (g/mile)
VMT = Vehicle miles traveled (VMT) = T x L
T = Number of one-way trips
L = One-way trip length
FC = Fuel consumption (gallon) = VMT/FE

FE = Fuel economy (mpg)
C = Unit conversion factor

The total baseline GHG emission is the sum of the emissions of CO_2, N_2O and CH_4, adjusted by their global warming potentials (GWP):

Baseline GHG Emission

= Baseline CO_2 Emission + Baseline N_2O Emission $\times$ 310 +Baseline CH_4 Emission $\times$ 21

Where:

Baseline GHG Emission = MT of CO_2e
310 = GWP of N_2O
21 = GWP of CH_4

Mitigation Method:

Mitigated emissions from using alternative fuel is calculated using the same methodology before, but using emission factors for the alternative fuel, and fuel consumption calculated as follows:

$$GHGemissions = \frac{1}{FE} \times ER \times VMT \times EF_{CO2} + VMT \times EF_{N20} + VMT \times EF_{CH4}$$

Where:

ER = Energy ratio from US Department of Energy (see table below)
EF = Emission Factor for pollutant
VMT = Vehicle miles traveled (VMT)
FE = Fuel economy (mpg)

Fuel	Energy Ratio: Amount of fuel needed to provide same energy as			
	1 gallon of Gasoline		1 gallon of Diesel	
Gasoline	1	gal	1.13	gal
#2 Diesel	0.88	gal	1	gal
B20	0.92	gal	1.01	gal
CNG	126.67	ft^3	143.14	ft^3
LNG	1.56	gal	1.77	gal
LPC	1.37	gal	1.55	gal

Emission reductions can be calculated as:

$$\text{Reduction} = 1 - \frac{\text{Mitigated Emission}}{\text{Running Emission}}$$

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	Range Not Quantified[81]
PM	Range Not Quantified
CO	Range Not Quantified
NOx	Range Not Quantified
SO_2	Range Not Quantified
ROG	Range Not Quantified

Discussion:

Using the methodology described above, only the running emission is considered. A hypothetical scenario for a gasoline fueled light duty automobile in 2015 is illustrated below. The CO_2 emission factor from motor gasoline in CCAR 2009 is 8.81 kg/gallon. Assuming the automobile makes two trips of 60 mile each per day, and using the current passenger car fuel economy of 27.5 mpg under the CAFE standards, then the annual baseline CO_2 emission from the automobile is:

$$8.81 \times \frac{2 \times 60 \times 365}{27.5} \times 10^{-3} = 14.0 \text{ MT/year}$$

Where 10^{-3} is the conversion factor from kilograms to MT.

Using the most recent N_2O emission factor of 0.0079 g/mile in CCAR 2009 for gasoline passenger cars, the annual baseline N_2O emission from the automobile is:

$$0.0079 \times 2 \times 365 \times 60 \times 10^{-6} = 0.000346 \text{ MT/year}$$

[81] The emissions reductions varies and depends on vehicle type, year, and the associated fuel economy. The methodology above describes how to calculate the expected GHG emissions reduction assuming the required input parameters are known.

Similarly, using the same formula with the most recent CH_4 emission factor of 0.0147 g/mile in CCAR 2009 for gasoline passenger cars, the annual baseline CH_4 emission from the automobile is calculated to be 0.000644 MT/year.

Thus, the total baseline GHG emission for the automobile is:

$$14.0 + 0.000346 \times 310 + 0.000644 \times 21 = 14.1 \text{ MT/year}$$

If compressed natural gas (CNG) is used as alternative fuel, the CNG consumption for the same VMT is:

$$\frac{2 \times 60 \times 365}{27.5} \times 126.67 = 201{,}751 \text{ ft}^3$$

Using the same formula as for the baseline scenario but with emission factors of CNG and the CNG consumption, the mitigated GHG emission can be calculated as shown in the table below

Pollutant	Emission (MT/yr)
CO_2	11.0
N_2O	0.0022
CH_4	0.0323
CO_2e	12.4

Therefore, the emission reduction is:

$$1 - \frac{12.4}{14.0} = 11.4\%$$

Notice that in the baseline scenario, N_2O and CH_4 only make up <1% of the total GHG emissions, but actually increase for the mitigated scenario and contribute to >10% of total GHG emissions.

Assumptions:

Data based upon the following references:

- California Climate Action Registry (CCAR). 2009. General Reporting Protocol. Version 3.1. Available online at: http://www.climateregistry.org/tools/protocols/general-reporting-protocol.html

- US Department of Energy. 2010. Alternative and Advanced Fuels – Fuel Properties. Available online at: http://www.afdc.energy.gov/afdc/fuels/properties.html

Preferred Literature:

The amount of emissions avoided from using alternative fuel vehicles can be calculated using emission factors from the California Climate Action Registry (CCAR) General Reporting Protocol [1]. Multiplying this factor by the fuel consumption or vehicle miles traveled (VMT) gives the direct emissions of CO_2 and N_2O /CH_4, respectively. Fuel consumption and VMT can be calculated interchangeably with the fuel economy (mpg). The total GHG emission is the sum of the emissions from the three chemicals multiplied by their respective global warming potential (GWP).

Assuming the same VMT, the amount of alternative fuel required to run the same vehicle fleet can be calculated by multiplying gasoline/diesel fuel consumption by the equivalent-energy ratio obtained from the US Department of Energy [2]. Using the alternative fuel consumption and the emission factors for the alternative fuel from CCAR, the mitigated GHG emissions can be calculated. The GHG emissions reduction associated with this mitigation measure is therefore the difference in emissions from these two scenarios.

Alternative Literature:

None

Notes:

[1] California Climate Action Registry (CCAR). 2009. General Reporting Protocol. Version 3.1. Available online at: http://www.climateregistry.org/tools/protocols/general-reporting-protocol.html
[2] US Department of Energy. 2010. Alternative and Advanced Fuels – Fuel Properties. Available online at: http://www.afdc.energy.gov/afdc/fuels/properties.html

Other Literature Reviewed:

None

3.7.3 Utilize Electric or Hybrid Vehicles

Range of Effectiveness: 0.4 - 20.3% reduction in GHG emissions

Measure Description:

When vehicles are powered by grid electricity rather than fossil fuel, direct GHG emissions from fuel combustion are replaced with indirect GHG emissions associated with the electricity used to power the vehicles. When vehicles are powered by hybrid-electric drives, GHG emissions from fuel combustion are reduced.

Measure Applicability:

- Vehicles

Inputs:

The following information needs to be provided by the Project Applicant:

- Vehicle category
- Traveling speed (mph)
- Number of trips and trip length, or Vehicle Miles Traveled (VMT)
- Fuel economy (mpg)

Baseline Method:

$$\text{Baseline Emission} = EF \times (1 - R) \times VMT \times C$$

Where:

Baseline Emission = MT of Pollutant
EF = Running emission factor for pollutant at traveling speed, from EMFAC.
VMT = Vehicle miles traveled (VMT)
R = Additional reduction in EF due to regulation (see Table 1)
C = Unit conversion factor

Mitigation Method:

<u>Fully Electric Vehicle</u>

Vehicle will run solely on electricity. The indirect GHG emission from electricity generation is:

$$\text{Mitigated Emission} = \text{Utility} \times \frac{1}{FE} \times VMT \times ER \times C$$

Where:

Mitigated Emission = MT of CO_2e
Utility = Carbon intensity of Local Utility (CO_2e/kWh)
VMT = Vehicle miles traveled (VMT)
ER = Energy Ratio = 33.4 kWh/gallon-gasoline or 37.7 kWh/gallon-diesel
FE = Fuel Economy (mpg)
C = Unit conversion factor

Power Utility	Carbon-Intensity (lbs CO_2e/MWh)
LADW&P	1,238
PG&E	456
SCE	641
SDGE	781
SMUD	555

Criteria pollutant emissions will be 100% reduced for equipment running solely on electricity.

Hybrid-Electric Vehicle

The Project Applicant has to determine the fuel consumption reduced from using the hybrid-electric vehicle. The emission reductions for all pollutants are the same as the fuel reduction.

Emission reductions can be calculated as:

$$\text{GHG Reduction\%} = 1 - \frac{\text{Mitigated Emission}}{\text{Running Emission}}$$

Emission Reduction Ranges and Variables:

See Table VT-3.1 below.

Discussion:

Using the methodology described above, only the running emission is considered. A hypothetical scenario for a gasoline fueled light duty automobile with catalytic converter in 2015 is illustrated below. The running CO_2 emission factor at 30 mph from an EMFAC run of the Sacramento county with temperature of 60F and relative humidity of 45% is 336.1 g/mile. From Table VT-3.1, there will be an additional reduction of 9.1% for the emission factor in 2015 due to Pavley standard. Assuming the automobile makes two trips of 60 mile each per day, then annual baseline emission from the automobile is:

$$336.1\times(100\%-9.1\%)\times 2\times 365\times 60\times 10^{-6}=13.4\ \text{MT/year}$$

Where 10^{-6} is the conversion factor from grams to MT. Assuming the current passenger car fuel economy of 27.5 mpg under the CAFE standards, and using the carbon-intensity factor for PG&E, the electric provider for the Sacramento region, the mitigated emission from replacing the automobile described above with electric vehicle would be:

$$\left(456\times\frac{2\times 365\times 60}{27.5}\times 33.4\times\frac{1}{2{,}204\times 10^{3}}\right)=11.0\ \text{MT/year}$$

Therefore, the emission reduction is:

$$1-\frac{11.0}{13.4}=17.9\%$$

Assumptions:

Data based upon the following references:

- California Air Resources Board. EMFAC2007. Available online at: http://www.arb.ca.gov/msei/onroad/latest_version.htm
- California Climate Action Registry (CCAR). 2009. General Reporting Protocol. Version 3.1. Available online at: http://www.climateregistry.org/tools/protocols/general-reporting-protocol.html
- California Climate Action Registry Reporting Online Tool. 2006 PUP Reports. Available online at: https://www.climateregistry.org/CARROT/public/reports.aspx
- US Department of Energy. 2010. Alternative and Advanced Fuels – Fuel Properties. Available online at: http://www.afdc.energy.gov/afdc/fuels/properties.html

Preferred Literature:

The amount of emissions avoided from using electric and hybrid vehicles can be calculated using CARB's EMFAC model, which provides state-wide and regional running emission factors for a variety of on-road vehicles in units of grams per mile [1]. Multiplying this factor by the vehicle miles traveled (VMT) gives the direct emissions. For criteria pollutant, emissions can be assumed to be 100% reduced from running on electricity. For GHG, assuming the same VMT, the electricity required to run the same vehicle fleet can be calculated by dividing by the fuel economy (mph) and multiplying the gasoline-electric energy ratio obtained from the US Department of Energy [2]. Multiplying this value by the carbon-intensity factor of the local utility gives the amount of indirect GHG emissions associated with electric vehicles. The GHG emissions reduction associated with this mitigation measure is therefore the difference in emissions from these two scenarios.

Alternative Literature:

None

Notes:

[1] California Air Resources Board. EMFAC2007. Available online at: http://www.arb.ca.gov/msei/onroad/latest_version.htm
[2] US Department of Energy. 2010. Alternative and Advanced Fuels – Fuel Properties. Available online at: http://www.afdc.energy.gov/afdc/fuels/properties.html

Other Literature Reviewed:

None

Table VT-3.1
Reduction in EMFAC Running Emission Factor from New Regulations

Year	Vehicle Class	Reduction	Pollutant	Regulation
2010	LDA/LDT/MDV	0.4%	CO_2	Pavley Standard
2011	LDA/LDT/MDV	1.6%	CO_2	Pavley Standard
2012	LDA/LDT/MDV	3.5%	CO_2	Pavley Standard
2013	LDA/LDT/MDV	5.3%	CO_2	Pavley Standard
2014	LDA/LDT/MDV	7.1%	CO_2	Pavley Standard
2015	LDA/LDT/MDV	9.1%	CO_2	Pavley Standard
2016	LDA/LDT/MDV	11.0%	CO_2	Pavley Standard
2017	LDA/LDT/MDV	13.1%	CO_2	Pavley Standard
2018	LDA/LDT/MDV	15.5%	CO_2	Pavley Standard
2019	LDA/LDT/MDV	17.9%	CO_2	Pavley Standard
2020	LDA/LDT/MDV	20.3%	CO_2	Pavley Standard
2011	Other Buses	21.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	School Bus	19.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	MHDDT Agriculture	17.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	MHDDT CA International Registration Plan	4.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	MHDDT Instate	6.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	MHDDT Out-of-state	4.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	HHDDT Agriculture	23.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	HHDDT CA International Registration Plan	1.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	HHDDT Non-neighboring Out-of-state	0.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	HHDDT Neighboring Out-of-state	2.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	HHDDT Singleunit	10.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	HHDDT Tractor	9.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	Other Buses	25.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	Power Take Off	28.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	School Bus	45.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	MHDDT Agriculture	20.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	MHDDT CA International Registration Plan	12.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	MHDDT Instate	11.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles

Year	Vehicle Class	Reduction	Pollutant	Regulation
				Regulation
2012	MHDDT Out-of-state	12.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT Agriculture	29.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT CA International Registration Plan	8.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT Non-neighboring Out-of-state	15.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT Neighboring Out-of-state	15.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT Drayage at Other Facilities	9.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT Drayage in Bay Area	9.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT Drayage near South Coast	7.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT Singleunit	14.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT Tractor	13.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	Other Buses	45.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	Power Take Off	57.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	School Bus	68.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	MHDDT Agriculture	31.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	MHDDT CA International Registration Plan	55.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	MHDDT Instate	64.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	MHDDT Out-of-state	55.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT Agriculture	48.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT CA International Registration Plan	60.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT Non-neighboring Out-of-state	50.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT Neighboring Out-of-state	63.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT Drayage at Other Facilities	67.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT Drayage in Bay Area	65.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT Drayage near South Coast	51.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2013	HHDDT Singleunit	66.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT Tractor	69.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	Other Buses	53.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	Power Take Off	63.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	School Bus	71.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	MHDDT Agriculture	33.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	MHDDT CA International Registration Plan	65.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	MHDDT Instate	77.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	MHDDT Out-of-state	65.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	MHDDT Utility	0.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT Agriculture	52.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT CA International Registration Plan	63.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT Non-neighboring Out-of-state	46.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT Neighboring Out-of-state	64.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT Singleunit	79.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT Tractor	79.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT Utility	4.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	Other Buses	49.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	Power Take Off	61.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	School Bus	71.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	MHDDT Agriculture	34.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	MHDDT CA International Registration Plan	60.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	MHDDT Instate	74.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	MHDDT Out-of-state	60.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	MHDDT Utility	0.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2015	HHDDT Agriculture	53.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT CA International Registration Plan	55.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT Non-neighboring Out-of-state	37.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT Neighboring Out-of-state	55.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT Singleunit	77.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT Tractor	76.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT Utility	4.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	Other Buses	43.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	Power Take Off	75.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	School Bus	70.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	MHDDT Agriculture	32.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	MHDDT CA International Registration Plan	56.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	MHDDT Instate	73.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	MHDDT Out-of-state	56.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	MHDDT Utility	0.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT Agriculture	51.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT CA International Registration Plan	45.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT Non-neighboring Out-of-state	27.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT Neighboring Out-of-state	46.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT Singleunit	75.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT Tractor	73.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT Utility	4.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	Other Buses	36.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	Power Take Off	71.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	School Bus	67.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2017	MHDDT Agriculture	55.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	MHDDT CA International Registration Plan	52.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	MHDDT Instate	70.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	MHDDT Out-of-state	52.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	MHDDT Utility	0.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT Agriculture	58.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT CA International Registration Plan	37.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT Non-neighboring Out-of-state	18.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT Neighboring Out-of-state	37.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT Singleunit	73.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT Tractor	70.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT Utility	3.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	Other Buses	31.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	Power Take Off	67.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	School Bus	74.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	MHDDT Agriculture	53.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	MHDDT CA International Registration Plan	47.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	MHDDT Instate	68.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	MHDDT Out-of-state	47.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	MHDDT Utility	0.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	HHDDT Agriculture	55.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	HHDDT CA International Registration Plan	30.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	HHDDT Non-neighboring Out-of-state	11.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	HHDDT Neighboring Out-of-state	30.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	HHDDT Singleunit	72.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2018	HHDDT Tractor	67.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	HHDDT Utility	3.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	Other Buses	27.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	Power Take Off	76.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	School Bus	73.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	MHDDT Agriculture	53.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	MHDDT CA International Registration Plan	42.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	MHDDT Instate	65.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	MHDDT Out-of-state	42.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	MHDDT Utility	0.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT Agriculture	54.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT CA International Registration Plan	24.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT Non-neighboring Out-of-state	5.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT Neighboring Out-of-state	24.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT Singleunit	69.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT Tractor	64.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT Utility	3.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	Other Buses	23.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	Power Take Off	74.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	School Bus	71.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	MHDDT Agriculture	52.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	MHDDT CA International Registration Plan	37.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	MHDDT Instate	60.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	MHDDT Out-of-state	37.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	MHDDT Utility	0.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2020	HHDDT Agriculture	52.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	HHDDT CA International Registration Plan	19.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	HHDDT Non-neighboring Out-of-state	3.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	HHDDT Neighboring Out-of-state	20.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	HHDDT Singleunit	66.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	HHDDT Tractor	61.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	HHDDT Utility	2.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	Other Buses	21.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	Power Take Off	79.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	School Bus	68.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	MHDDT Agriculture	51.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	MHDDT CA International Registration Plan	33.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	MHDDT Instate	57.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	MHDDT Out-of-state	33.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	MHDDT Utility	5.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Agriculture	50.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT CA International Registration Plan	16.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Non-neighboring Out-of-state	3.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Neighboring Out-of-state	16.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Drayage at Other Facilities	10.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Drayage in Bay Area	9.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Drayage near South Coast	9.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Singleunit	64.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Tractor	59.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Utility	5.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2022	Other Buses	20.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	Power Take Off	79.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	School Bus	66.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	MHDDT Agriculture	50.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	MHDDT CA International Registration Plan	28.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	MHDDT Instate	53.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	MHDDT Out-of-state	28.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	MHDDT Utility	6.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Agriculture	49.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT CA International Registration Plan	13.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Non-neighboring Out-of-state	1.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Neighboring Out-of-state	14.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Drayage at Other Facilities	10.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Drayage in Bay Area	8.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Drayage near South Coast	8.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Singleunit	61.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Tractor	55.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Utility	5.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	Other Buses	18.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	Power Take Off	74.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	School Bus	64.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	MHDDT Agriculture	79.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	MHDDT CA International Registration Plan	23.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	MHDDT Instate	48.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	MHDDT Out-of-state	23.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2023	MHDDT Utility	7.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Agriculture	68.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT CA International Registration Plan	11.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Non-neighboring Out-of-state	1.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Neighboring Out-of-state	11.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Drayage at Other Facilities	9.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Drayage in Bay Area	8.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Drayage near South Coast	8.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Singleunit	56.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Tractor	51.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Utility	4.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	Other Buses	15.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	Power Take Off	68.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	School Bus	61.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	MHDDT Agriculture	77.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	MHDDT CA International Registration Plan	20.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	MHDDT Instate	43.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	MHDDT Out-of-state	20.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	MHDDT Utility	5.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Agriculture	65.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT CA International Registration Plan	9.1%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Non-neighboring Out-of-state	0.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Neighboring Out-of-state	9.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Drayage at Other Facilities	9.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Drayage in Bay Area	7.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2024	HHDDT Drayage near South Coast	7.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Singleunit	50.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Tractor	46.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Utility	3.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	Other Buses	13.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	Power Take Off	62.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	School Bus	58.2%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	MHDDT Agriculture	75.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	MHDDT CA International Registration Plan	15.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	MHDDT Instate	37.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	MHDDT Out-of-state	15.3%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	MHDDT Utility	3.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Agriculture	62.7%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT CA International Registration Plan	6.8%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Non-neighboring Out-of-state	0.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Neighboring Out-of-state	7.0%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Drayage at Other Facilities	8.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Drayage in Bay Area	7.5%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Drayage near South Coast	7.6%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Singleunit	44.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Tractor	42.9%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Utility	2.4%	PM2.5	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	MHDDT CA International Registration Plan	1.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	MHDDT Instate	2.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	MHDDT Out-of-state	1.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2011	HHDDT CA International Registration Plan	0.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	HHDDT Non-neighboring Out-of-state	0.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	HHDDT Neighboring Out-of-state	1.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	HHDDT Singleunit	4.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2011	HHDDT Tractor	3.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	Power Take Off	13.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	School Bus	2.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	MHDDT CA International Registration Plan	1.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	MHDDT Instate	2.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	MHDDT Out-of-state	1.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT CA International Registration Plan	0.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT Non-neighboring Out-of-state	0.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT Neighboring Out-of-state	0.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT Singleunit	3.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2012	HHDDT Tractor	3.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	Other Buses	18.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	Power Take Off	34.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	School Bus	4.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	MHDDT Agriculture	5.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	MHDDT CA International Registration Plan	12.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	MHDDT Instate	25.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	MHDDT Out-of-state	12.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT Agriculture	10.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT CA International Registration Plan	8.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT Non-neighboring Out-of-state	1.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2013	HHDDT Neighboring Out-of-state	8.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT Singleunit	33.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2013	HHDDT Tractor	28.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	Other Buses	40.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	Power Take Off	37.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	School Bus	6.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	MHDDT Agriculture	9.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	MHDDT CA International Registration Plan	22.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	MHDDT Instate	34.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	MHDDT Out-of-state	22.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	MHDDT Utility	0.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT Agriculture	17.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT CA International Registration Plan	13.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT Non-neighboring Out-of-state	4.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT Neighboring Out-of-state	14.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT Singleunit	45.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT Tractor	36.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2014	HHDDT Utility	1.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	Other Buses	52.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	Power Take Off	33.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	School Bus	6.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	MHDDT Agriculture	18.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	MHDDT CA International Registration Plan	20.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	MHDDT Instate	31.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	MHDDT Out-of-state	20.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2015	MHDDT Utility	0.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT Agriculture	27.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT CA International Registration Plan	11.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT Non-neighboring Out-of-state	2.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT Neighboring Out-of-state	12.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT Singleunit	42.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT Tractor	34.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2015	HHDDT Utility	1.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	Other Buses	54.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	Power Take Off	43.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	School Bus	4.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	MHDDT Agriculture	19.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	MHDDT CA International Registration Plan	22.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	MHDDT Instate	32.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	MHDDT Out-of-state	22.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	MHDDT Utility	0.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT Agriculture	29.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT CA International Registration Plan	11.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT Non-neighboring Out-of-state	3.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT Neighboring Out-of-state	13.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT Singleunit	43.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT Tractor	35.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2016	HHDDT Utility	1.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	Other Buses	59.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	Power Take Off	38.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2017	MHDDT Agriculture	43.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	MHDDT CA International Registration Plan	27.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	MHDDT Instate	35.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	MHDDT Out-of-state	27.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	MHDDT Utility	1.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT Agriculture	45.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT CA International Registration Plan	14.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT Non-neighboring Out-of-state	7.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT Neighboring Out-of-state	17.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT Singleunit	46.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT Tractor	38.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2017	HHDDT Utility	1.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	Other Buses	56.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	Power Take Off	32.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	School Bus	7.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	MHDDT Agriculture	41.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	MHDDT CA International Registration Plan	26.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	MHDDT Instate	41.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	MHDDT Out-of-state	26.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	MHDDT Utility	1.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	HHDDT Agriculture	42.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	HHDDT CA International Registration Plan	15.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	HHDDT Non-neighboring Out-of-state	4.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	HHDDT Neighboring Out-of-state	16.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	HHDDT Singleunit	51.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2018	HHDDT Tractor	43.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2018	HHDDT Utility	1.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	Other Buses	52.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	Power Take Off	38.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	School Bus	6.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	MHDDT Agriculture	40.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	MHDDT CA International Registration Plan	22.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	MHDDT Instate	38.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	MHDDT Out-of-state	22.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	MHDDT Utility	1.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT Agriculture	40.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT CA International Registration Plan	12.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT Non-neighboring Out-of-state	2.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT Neighboring Out-of-state	13.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT Singleunit	48.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT Tractor	41.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2019	HHDDT Utility	1.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	Other Buses	49.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	Power Take Off	41.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	School Bus	5.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	MHDDT Agriculture	38.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	MHDDT CA International Registration Plan	19.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	MHDDT Instate	34.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	MHDDT Out-of-state	19.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	MHDDT Utility	1.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2020	HHDDT Agriculture	38.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	HHDDT CA International Registration Plan	9.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	HHDDT Non-neighboring Out-of-state	1.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	HHDDT Neighboring Out-of-state	10.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	HHDDT Singleunit	45.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	HHDDT Tractor	39.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2020	HHDDT Utility	1.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	Other Buses	48.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	Power Take Off	51.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	School Bus	4.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	MHDDT Agriculture	38.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	MHDDT CA International Registration Plan	21.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	MHDDT Instate	41.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	MHDDT Out-of-state	21.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	MHDDT Utility	33.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Agriculture	37.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT CA International Registration Plan	9.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Non-neighboring Out-of-state	1.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Neighboring Out-of-state	9.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Drayage at Other Facilities	40.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Drayage in Bay Area	41.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Drayage near South Coast	39.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Singleunit	54.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Tractor	45.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2021	HHDDT Utility	21.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2022	Other Buses	48.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	Power Take Off	60.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	School Bus	3.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	MHDDT Agriculture	40.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	MHDDT CA International Registration Plan	20.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	MHDDT Instate	41.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	MHDDT Out-of-state	20.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	MHDDT Utility	28.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Agriculture	40.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT CA International Registration Plan	8.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Non-neighboring Out-of-state	1.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Neighboring Out-of-state	9.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Drayage at Other Facilities	39.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Drayage in Bay Area	40.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Drayage near South Coast	39.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Singleunit	54.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Tractor	45.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2022	HHDDT Utility	18.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	Other Buses	47.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	Power Take Off	54.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	School Bus	2.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	MHDDT Agriculture	65.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	MHDDT CA International Registration Plan	18.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	MHDDT Instate	39.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	MHDDT Out-of-state	18.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2023	MHDDT Utility	25.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Agriculture	59.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT CA International Registration Plan	7.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Non-neighboring Out-of-state	1.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Neighboring Out-of-state	8.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Drayage at Other Facilities	38.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Drayage in Bay Area	39.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Drayage near South Coast	38.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Singleunit	52.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Tractor	44.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2023	HHDDT Utility	16.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	Other Buses	43.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	Power Take Off	47.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	School Bus	1.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	MHDDT Agriculture	63.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	MHDDT CA International Registration Plan	15.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	MHDDT Instate	33.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	MHDDT Out-of-state	15.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	MHDDT Utility	19.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Agriculture	56.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT CA International Registration Plan	6.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Non-neighboring Out-of-state	0.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Neighboring Out-of-state	6.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Drayage at Other Facilities	38.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Drayage in Bay Area	39.4%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation

Year	Vehicle Class	Reduction	Pollutant	Regulation
2024	HHDDT Drayage near South Coast	37.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Singleunit	47.2%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Tractor	39.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2024	HHDDT Utility	13.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	Other Buses	39.0%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	Power Take Off	39.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	School Bus	1.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	MHDDT Agriculture	61.1%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	MHDDT CA International Registration Plan	11.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	MHDDT Instate	28.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	MHDDT Out-of-state	11.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	MHDDT Utility	13.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Agriculture	53.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT CA International Registration Plan	4.6%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Non-neighboring Out-of-state	0.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Neighboring Out-of-state	4.8%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Drayage at Other Facilities	37.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Drayage in Bay Area	38.9%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Drayage near South Coast	37.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Singleunit	41.5%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Tractor	35.7%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation
2025	HHDDT Utility	10.3%	NOx	On-Road Heavy-Duty Diesel Vehicles Regulation

4.0 Water

4.1 Water Supply

4.1.1 Use Reclaimed Water

Range of Effectiveness: Up to 40% in Northern California and up to 81% in Southern California

Measure Description:

California water supplies come from ground water, surface water, and from reservoirs, typically fed from snow melt. Some sources of water are transported over long distances, and sometimes over terrain to reach the point of consumption. Transporting water can require a significant amount of electricity. In addition, treating water to potable standards can also require substantial amounts of energy. Reclaimed water is water reused after wastewater treatment for non-potable uses instead of returning the water to the environment. This is different than gray water, which has not been through wastewater treatment. Reclaimed non-potable water requires significantly less energy to collect, treat, and redistribute water to the point of local areas of non-potable water consumption. Since less energy is required to provide reclaimed water, fewer GHGs will be associated with reclaimed water use compared to the average California water supply use.

This measure describes how to calculate GHG savings from using reclaimed water instead of new potable water supplies for outdoor water uses or other non-potable water uses. The baseline scenario document outlines average Northern and Southern California electricity-use water factors, and assumes that all water is treated to potable standards.

Measure Applicability:

- Non-potable water use

Inputs:

The following information needs to be provided by the Project Applicant:

- Reclaimed water use (million gallons)
- Total non-potable water use (million gallons)

Baseline Method:

$$\text{GHG emissions} = \text{Water}_{\text{non-potable total}} \times \text{Electricity}_{\text{baseline}} \times \text{Utility}$$

Where:

GHG emissions = MT CO_2e
$\text{Water}_{\text{non-potable total}}$ = Total volume of non-potable water used (million gallons)
Provided by Applicant
$\text{Electricity}_{\text{baseline}}$ = Electricity required to supply, treat, and distribute water (kWh/million gallons)
Northern California Average: 3,500 kWh/million gallons
Southern California Average: 11,111 kWh/million gallons
Utility = Carbon intensity of Local Utility (CO_2e/kWh)

Mitigation Method:

A million gallons of reclaimed water would use an average of 2,100 kWh electricity per million gallons of water (range of 1,200 to 3,000 kWh). Therefore the percent reduction in GHG emissions associated with implementing reclaimed water usage is:

$$\text{GHG emission reduction} = \frac{\text{Water}_{\text{reclaimed}}}{\text{Water}_{\text{non-potable total}}} \times \frac{\text{Electricity}_{\text{baseline}} - \text{Electricity}_{\text{reclaimed}}}{\text{Electricity}_{\text{baseline}}}$$

Where:

GHG emission reduction = Percentage reduction in GHG emissions for non-potable water use.
$\text{Water}_{\text{reclaimed}}$ = Total volume of reclaimed water used (million gallons)
Provided by Applicant
$\text{Water}_{\text{non-potable total}}$ = Total volume of non-potable water used (million gallons)
Provided by Applicant
$\text{Electricity}_{\text{reclaimed}}$ = Electricity required to treat and distribute reclaimed water (2,100 kWh/million gallons)
$\text{Electricity}_{\text{baseline}}$ = Electricity required to supply and distribute water
Northern California Average: 3,500 kWh/million gallons
Southern California Average: 11,111 kWh/million gallons

Therefore, for projects in Northern California, the reduction in GHG emissions is:

$$\text{GHG emission reduction} = \frac{\text{Water}_{\text{reclaimed}}}{\text{Water}_{\text{non-potable total}}} \times \frac{(3{,}500 - 2{,}100)}{3{,}500} = \frac{\text{Water}_{\text{reclaimed}}}{\text{Water}_{\text{non-potable total}}} \times 0.40$$

And for projects in Southern California, the reduction in GHG emissions is:

$$\text{GHG emission reduction} = \frac{\text{Water}_{\text{reclaimed}}}{\text{Water}_{\text{non-potable total}}} \times \frac{(11{,}111 - 2{,}100)}{11{,}111} = \frac{\text{Water}_{\text{reclaimed}}}{\text{Water}_{\text{non-potable total}}} \times 0.81$$

As shown in these equations, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	N. California: Up to 40% if assuming 100% reclaimed water S. California: Up to 81% if assuming 100% reclaimed water Percent reduction would scale down linearly as the percent reclaimed water decreases.
All other pollutants	Not quantified[82]

Discussion:

If the Project Applicant uses 100 million gallons of non-potable water for a project in Northern California, they would calculate baseline emissions as described in the baseline methodologies document. If the applicant then selects to mitigate water by committing to using 40 million gallons of reclaimed water in place of the usual water source, the applicant would reduce the amount of GHG emissions associated with outdoor water use by 16%

$$\text{GHG Emission Reduced} = \frac{40}{100} \times 0.40 = 0.16 \text{ or } 16\%$$

Assumptions:

Data based upon the following reference:

[1] CEC. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. Available online at: http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF

Preferred Literature:

GHG emissions from the mitigated scenario should be calculated based on the 2006 CEC report, which presents regional baseline electricity-use water factors and a factor of 1,200-3,000 kWh per million gallons for reclaimed water. GHG emissions are calculated by multiplying the amount of water (million gallons) by the electricity-use water factor (kWh per million gallons) by the carbon-intensity of the local utility (CO_2e per kWh). The GHG emissions reductions associated with this mitigation measure are

[82] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

associated with the difference between the baseline potable water electricity-use water factor and the mitigated scenario.

Alternative Literature:

None

Other Literature Reviewed:

None

4.1.2 Use Gray Water

Range of Effectiveness: Up to 100% of outdoor water GHG emissions if outdoor water use is replaced completely with graywater

Measure Description:

California water supplies come from ground water, surface water, and from reservoirs, typically fed from snow melt. Some sources of water are transported over long distances, and sometimes over terrain to reach the point of consumption. Transporting water can require a significant amount of electricity. In addition, treating water to potable standards can also require substantial amounts of energy. Untreated wastewater generated from bathtubs, showers, bathroom wash basins, and clothes washing machines is known as graywater and is collected and distributed onsite for irrigation of landscape and mulch. Since graywater does not require treatment or energy to redistribute it onsite, there are negligible GHG emissions associated with the use of graywater.

This measure describes how to calculate GHG savings from using graywater instead of new potable water supplies for landscape irrigation and other outdoor uses. The baseline scenario document outlines average Northern and Southern California electricity-use water factors, and assumes that all water is non-potable.

Measure Applicability:

- Outdoor water use

Inputs:

The following information needs to be provided by the Project Applicant:

- Graywater use[83] (million gallons), or:
  - Type of graywater system, which must be compliant with the California Plumbing Code, and
  - Number of residents in homes with compliant graywater systems
- Total outdoor water use (million gallons)

Baseline Method:

$$\text{GHG emissions} = \text{Water}_{\text{outdoor total}} \times \text{Electricity}_{\text{baseline}} \times \text{Utility}$$

[83] Note that this is the amount of graywater used, which may be less than the amount of graywater generated. A project may generate and collect more graywater than is needed for landscape irrigation. The Project Applicant should only take credit for the amount of potable water which is displaced by graywater. The amount of landscape irrigation water demand (graywater demand) is calculated according to the methodology described in WUW-3 and the baseline methodologies document.

Where:

GHG emissions = MT CO_2e
$Water_{outdoor\ total}$ = Total volume of outdoor water used (million gallons)
Provided by Applicant
$Electricity_{baseline}$ = Electricity required to supply, treat, and distribute water (kWh/million gallons)
Northern California Average: 3,500 kWh/million gallons
Southern California Average: 11,111 kWh/million gallons
Utility = Carbon intensity of Local Utility (CO_2e/kWh)

Mitigation Method:

If the Project Applicant cannot provide the total amount of graywater used, the graywater use can be calculated based on the following equation:

$Water_{graywater}$ =

$$\left[\left(25 \times Residents_{graywater\text{-}sbw}\right) + \left(15 \times Residents_{graywater\text{-}laundry}\right)\right] \frac{gallons}{day} \times \frac{365\ days}{year} \times \frac{1\ million\ gallons}{10^6\ gallons}$$

Where:

$Water_{graywater}$ = Total volume of graywater used (million gallons).
$Residents_{graywater\text{-}sbw}$ = Total number of residents in homes with graywater systems based on graywater generated from showers, bathtubs, and wash basins
25 = gallons per day per residential occupant from showers, bathtubs, and washbasins [1]
$Residents_{graywater\text{-}laundry}$ = Total number of residents in homes with graywater systems based on graywater generated from laundry machines
15 = gallons per day per residential occupant from laundry machines [1]

The percent reduction in GHG emissions associated with implementing graywater usage is therefore:

$$\text{GHG emission reduction} = \frac{Water_{graywater}}{Water_{oudoor\ total}} \times \frac{Electricity_{baseline} - Electricity_{graywater}}{Electricity_{baseline}}$$

Where:

GHG emission reduction = Percentage reduction in GHG emissions for outdoor water use.
$Water_{graywater}$ = Total volume of graywater used (million gallons)
Provided by Applicant or calculated using equation above
$Water_{outdoor\ total}$ = Total volume of outdoor water used (million gallons)
Provided by Applicant

Electricity$_{graywater}$ = Electricity required to distribute graywater (0 kWh/million gallons)[84]
Electricity$_{baseline}$ = Electricity required to supply, treat, and distribute water
Northern California Average: 3,500 kWh/million gallons [2]
Southern California Average: 11,111 kWh/million gallons [2]

Therefore, for projects in Northern California, the reduction in GHG emissions is:

$$\text{GHG emission reduction} = \frac{\text{Water}_{\text{graywater}}}{\text{Water}_{\text{outdoor total}}} \times \frac{(3{,}500 - 0)}{3{,}500} = \frac{\text{Water}_{\text{graywater}}}{\text{Water}_{\text{outdoor total}}}$$

And for projects in Southern California, the reduction in GHG emissions is:

$$\text{GHG emission reduction} = \frac{\text{Water}_{\text{graywater}}}{\text{Water}_{\text{outdoor total}}} \times \frac{(11{,}111 - 0)}{11{,}111} = \frac{\text{Water}_{\text{graywater}}}{\text{Water}_{\text{outdoor total}}}$$

As shown in these equations, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	N. California: Up to 100% if assuming 100% graywater S. California: Up to 100% if assuming 100% graywater Percent reduction would scale down linearly as the percent reclaimed water decreases.
All other pollutants	Not Quantified[85]

Discussion:

If the Project Applicant uses 100 million gallons of water for outdoor uses in a project in Northern California, they would calculate baseline emissions as described above and in the baseline methodologies document. If the Project Applicant then selects to mitigate water by committing to establishing graywater systems based on graywater recovery from laundry machines in 500 homes with an average of 3 people in each home, the amount of graywater used is then:

[84] In some cases the distribution of graywater will require some amount of electricity; for example, graywater generated at residences and pumped to a nearby park. In those cases, Electricity$_{graywater}$ will be non-zero.
[85] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

$Water_{graywater}$ =

$$[(25\times 0)+(15\times 500\times 3)]\frac{\text{gallons}}{\text{day}}\times\frac{365\text{ days}}{\text{year}}\times\frac{1\text{ million gallons}}{10^6\text{ gallons}} = 8.2 \text{ million gallons}$$

Then the Project Applicant would reduce the amount of GHG emissions associated with outdoor water use by 8.2%

$$\text{GHG Emission Reduced} = \frac{8.2}{100} = 0.082 \text{ or } 8.2\%$$

Assumptions:

Data based upon the following references:

[1] 2007 CPC, Title 24, Part 5, Chapter 16A, Part I – Nonpotable Water Reuse Systems. Available online at: http://www.hcd.ca.gov/codes/shl/2007CPC_Graywater_Complete_2-2-10.pdf

[2] CEC. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December. Available online at: http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF

Preferred Literature:

Assuming a compliant graywater system is installed, Part 1606A.0 of the California Plumbing Code (CPC) estimates 25 gallons per day per residential occupant of graywater generation from showers, bathtubs, and wash basins, and 15 gallons per day per residential occupant of graywater discharge from laundry machines. Electricity and CO_2 savings from using graywater are determined by comparing to the emissions that would have been associated with the water use if the graywater demand had instead been supplied by potable water. The baseline emissions should be calculated based on the 2006 CEC methodology. A development may generate and collect more graywater than is needed for landscape irrigation. A Project Applicant should only take credit for emissions reductions associated with the amount of potable water which is displaced by graywater. The amount of landscape irrigation water demand (graywater demand) is calculated according to the methodology described in the baseline methodologies document and WUW-3.

Alternative Literature:

None

Other Literature Reviewed:

[3] Arizona Department of Environmental Quality. 2009. Using Gray Water at Home Brochure. Available online at: http://www.azdeq.gov/environ/water/permits/download/graybro.pdf

[4] Arizona Department of Water Resources. Technologies – Irrigation, Rainwater Harvesting, Gray Water Reuse and Artificial Turf. Available online at: http://www.azwater.gov/AzDWR/StatewidePlanning/Conservation2/Technologies/Tech%20pages%20templates/LandscapeIrrigation.htm. Accessed February 2010.

[5] AAC, Title 18, Chapter 9, Article 7. Direct Reuse of Reclaimed Water. Available online at: http://www.azsos.gov/public_services/title_18/18-09.pdf

[6] Oasis Design. Graywater Information Central. Available online at: http://www.graywater.net/. Accessed February 2010.

4.1.3 Use Locally Sourced Water Supply

Range of Effectiveness: 0 – 60% for Northern and Central California, 11 – 75% for Southern California

Measure Description:

California water supplies come from ground water, surface water, and from reservoirs, typically fed from snow melt. Some sources of water are transported over long distances, and sometimes over terrain to reach the point of consumption. Transporting water can require a significant amount of electricity. Using locally-sourced water or water from less energy-intensive sources reduces the electricity and indirect CO_2 emissions associated with water supply and transport.

This measure describes how to calculate GHG savings from using local or less energy-intensive water sources instead of water from the typical mix of Northern and Southern California sources. According to the 2006 CEC report [1], water in Northern California (which also includes the Central Coast and San Joaquin Valley for this study) is primarily supplied by deliveries from the State Water Project and groundwater, and to a lesser extent is supplied by the gravity-dominated systems of Hetch Hetchy and the Mokelumne Aqueduct. In contrast, water imported from the State Water Project is Southern California's dominant water source. The baseline scenario uses average Northern and Southern California electricity intensity factors as reported in 2006 CEC and detailed in the Baseline Method below.

Measure Applicability:

- Indoor (potable) and outdoor (non-potable) water use

Inputs:

- Total potable and non-potable water use (million gallons)

Baseline Method:

$$\text{GHG emissions} = \text{Water}_{baseline} \times \text{Electricity}_{baseline} \times \text{Utility}$$

Where:

GHG emissions = MT CO_2e

$\text{Water}_{baseline}$ = Total volume of water used (million gallons)
Provided by Applicant

$\text{Electricity}_{baseline}$ = Electricity required to supply, treat, and distribute water (and for indoor uses, the electricity required to treat the resulting wastewater) (kWh/million gallons)
Indoor Uses:
Northern California Average: 5,411 kWh/million gallons [1]
Southern California Average: 13,022 kWh/million gallons [1]

Outdoor Uses:

Northern California Average: 3,500 kWh/million gallons [1]

Southern California Average: 11,111 kWh/million gallons [1]

Utility = Carbon intensity of Local Utility (CO_2e/kWh)

Mitigation Method:

Table WSW-3.1 shows that water from local or nearby groundwater basins, nearby surface water, and gravity-dominated systems have smaller energy-intensity factors than the average Northern and Southern California energy-intensity factors. The Project Applicant should use Table WSW-3.1 to identify the outdoor and indoor electricity intensity factors associated with the Project's water source(s). The GHG emission reduction is then calculated as follows:

$$\text{GHG emission reduction} = \frac{\text{Water}_{\text{mitigated}}}{\text{Water}_{\text{baseline}}} \times \frac{\text{Electricity}_{\text{baseline}} - \text{Electricity}_{\text{mitigated}}}{\text{Electricity}_{\text{baseline}}}$$

Where:

GHG emission reduction = Percentage reduction in GHG emissions for water use

$Water_{mitigated}$ = Volume of water to be supplied from the mitigated (local or less energy-intensive) source

Provided by Applicant

$Water_{baseline}$ = Total volume of water used (million gallons)

Provided by Applicant

$Electricity_{mitigated}$ = Electricity required to distribute water for Project from mitigated (local or less-energy intensive) source

$Electricity_{baseline}$ = Baseline electricity required to supply, treat, and distribute water (and for indoor uses, the electricity required to treat the resulting wastewater) (kWh/million gallons)

Indoor Uses:

Northern California Average: 5,411 kWh/million gallons [1]

Southern California Average: 13,022 kWh/million gallons [1]

Outdoor Uses:

Northern California Average: 3,500 kWh/million gallons [1]

Southern California Average: 11,111 kWh/million gallons [1]

As shown in these equations, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	Assuming 100% of water is sourced locally: Indoor Uses: • 0-40% reduction for Northern and Central California • 11-64% reduction for Southern California Outdoor Uses: • 0-60% reduction for Northern and Central California • 12-75% reduction for Southern California
All other pollutants	Not Quantified[86]

Discussion:

Assume a Project is located in Southern California within the Chino Basin and has a total indoor water demand of 100 million gallons. Assume 70 million gallons will be sourced from a water district which obtains its water from the typical Southern California water sources. Therefore, for these 70 million gallons the baseline outdoor water electricity-intensity factor for Southern California is used. Assume that the Project Applicant chooses to mitigate the Project by sourcing the remaining 30 million gallons from the Chino Basin. The expected GHG emission reduction is then:

$$\text{GHG Emission Reduced} = \frac{30}{100} \times \frac{11{,}111 - 4{,}298}{11{,}111} = 0.18 \text{ or } 18\%$$

Assumptions:

Data based upon the following reference:

[1] CEC. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December. Available online at: http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF

86 Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

[2]CEC. 2005. California's Water-Energy Relationship. Final Staff Report. CEC 700-2005-011-SF. Available online at: http://www.energy.ca.gov/2005publications/CEC-700-2005-011/CEC-700-2005-011-SF.PDF
[3]NRDC. 2004. Energy Down the Drain: The Hidden Costs of California's Water Supply. Prepared by NRDC and the Pacific Institute. Available online at: http://www.nrdc.org/water/conservation/edrain/edrain.pdf

Preferred Literature:

Electricity and CO_2 savings from using locally-sourced water or water from sources which require below-average electricity intensities for supply and conveyance (such as gravity-dominated systems or local groundwater basins that are not very deep) are determined by comparing to the emissions that would have occurred if the water had instead been conveyed from typical water sources for the region. According to the 2005 and 2006 CEC reports [1,2], the typical mix of water sources in Northern and Central California is the State Water Project, groundwater, and gravity-dominated systems such as Hetch Hetchy and the Mokelumne Aqueduct. The majority of water in Southern California is supplied by imports from the State Water Project and the Colorado River Aqueduct. Examples of mitigated electricity-intensity factors are shown in Table WSW-3.1 and are based on data provided in 2006 CEC [1], 2005 CEC [2], and 2004 NRDC [3]. GHG emissions are calculated by multiplying the amount of water (million gallons) by the electricity-use water factor (kWh per million gallons) by the carbon-intensity of the local utility (CO_2e per kWh). The GHG emissions reductions associated with this mitigation measure are associated with the difference between the baseline water electricity-intensity factor and the mitigated electricity-intensity factor.

Alternative Literature:

None

Other Literature Reviewed:

None

Table WSW-3.1

Energy Intensity of Water Use (kWh/MG) by Region

REGION	WATER USE SEGMENT							
	Supply & Conveyance[1]		Treatment[1]	Distribution[1]	*OUTDOOR TOTAL (NON-POTABLE)*[2]	Wastewater Treatment[1]	*INDOOR TOTAL (POTABLE)*[3]
Northern California	SWP to Bay Area *surface water*	3,150	111	1,272	***4,533***	1,911	***6,444***
	Hetch Hetchy to Bay Area *gravity dominated*	0	111	1,272	***1,383***	1,911	***3,294***
	Mokelumne Aqueduct to Bay Area *gravity dominated*	160	111	1,272	***1,543***	1,911	***3,454***
Central California	SWP to Central Coast *surface water*	3,150	111	1,272	***4,533***	1,911	***6,444***
	SWP to San Joaquin Valley *surface water*	1,510	111	1,272	***2,893***	1,911	***4,804***
	San Joaquin River Basin & Central Coast[4] *groundwater*	896	111	1,272	***2,279***	1,911	***4,190***
	Tulare Lake Basin[4] *groundwater*	537	111	1,272	***1,920***	1,911	***3,831***
	Fresno and Kings Counties (Westlands WD)[4] *groundwater*	2,271	111	1,272	***3,654***	1,911	***5,565***
Southern California	SWP to L.A. Basin *surface water*	8,325	111	1,272	***9,708***	1,911	***11,619***
	Colorado River Aqueduct to L.A. Basin *surface water*	6,140	111	1,272	***7,523***	1,911	***9,434***
	Chino Basin[5] *groundwater*	2,915	111	1,272	***4,298***	1,911	***6,209***
	Los Angeles[4] *groundwater*	1,780	111	1,272	***3,163***	1,911	***5,074***
	San Diego County (Sweetwater WD)[4] *groundwater*	1,433	111	1,272	***2,816***	1,911	***4,727***
	San Diego County (Yuima WD)[4]	2,029	111	1,272	***3,412***	1,911	***5,323***

REGION	WATER USE SEGMENT							
	Supply & Conveyance[1]		Treatment[1]	Distribution[1]	*OUTDOOR TOTAL (NON-POTABLE)[2]*	Wastewater Treatment[1]	*INDOOR TOTAL (POTABLE)[3]*
	groundwater						
State-wide	Local / Intrabasin	120	111	1,272	***1,503***	1,911	***3,414***
	Groundwater	4.45 kWh / MG / foot of well depth	111	1,272	***TBC***	1,911	***TBC***
	Ocean Desalination	13,800	111	1,272	***15,183***	1,911	***17,094***
	Brackish Water Desalination	3,230	111	1,272	***4,613***	1,911	***6,524***

Abbreviations:

CEC - California Energy Commission
kWh - kilowatt hour
MG - million gallons
NRDC - Natural Resources Defense Council
SWP - State Water Project
TBC - to be calculated based on well depth
WD - Water District

Notes:

1. Treatment, Distribution, and Wastewater Treatment electricity-intensity factors from 2006 CEC. Supply & Conveyance electricity-intensity factors from 2006 CEC unless otherwise noted.
2. Outdoor (Non-Potable) electricity-intensity factor is the sum of the Supply & Conveyance, Treatment, and Distribution electricity-intensity factors.
3. Indoor (Potable) electricity-intensity factor is the sum of the Supply & Conveyance, Treatment, Distribution, and Wastewater Treatment electricity-intensity factors.
4. Supply & Conveyance electricity-intensity factor from 2004 NRDC.
5. Supply & Conveyance electricity-intensity factor from 2005 CEC.

Sources:

CEC. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December. Available at: http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF

CEC. 2005. California's Water-Energy Relationship. Final Staff Report. CEC 700-2005-011-SF. Available online at: http://www.energy.ca.gov/2005publications/CEC-700-2005-011/CEC-700-2005-011-SF.PDF

NRDC. 2004. Energy Down the Drain: The Hidden Costs of California's Water Supply. Prepared by NRDC and the Pacific Institute. Available online at: http://www.nrdc.org/water/conservation/edrain/edrain.pdf

4.2 Water Use

4.2.1 Install Low-Flow Water Fixtures

Range of Effectiveness: 20% of GHG emissions associated with indoor Residential water use; 17-31% of GHG emissions associated with Non-Residential indoor water use.

Measure Description:

Water use contributes to GHG emissions indirectly, via the production of the electricity that is used to pump, treat, and distribute the water. Installing low-flow or high-efficiency water fixtures in buildings reduces water demand, energy demand, and associated indirect GHG emissions.

This measure describes how to calculate GHG savings from installing low-flow water toilets, urinals, showerheads, or faucets, or high-efficiency clothes washers and dishwashers in residential and commercial buildings. To take credit for this mitigation measure, the Project Applicant must know the total expected indoor water demand before and after installation of low-flow or high-efficiency water fixtures. If expected water demand after implementation of the mitigation measure is not known, it can be calculated based on the information provided below. Water flow rates presented here in Tables WUW-1.1 and WUW-1.3 are based on technical specifications in the California Code of Regulations Title 20 (Appliance Efficiency Regulations) [2], Title 24 (California Green Building Standards Code) [1] and ENERGY STAR [5-8]. Indoor water end-uses for residential and commercial buildings presented here in Tables WUW-1.1 and WUW-1.2 are based on data provided in a 2003 report by the Pacific Institute for Studies in Development, Environment, and Security [3]. This report incorporates data from the most comprehensive end-use survey available to date, the 1999 Residential End Uses of Water survey published by the American Water Works Association [4], as well as California-specific population, water, and appliance data. California-specific data includes local utility water use and market penetration rates of low-flow and high-efficiency water fixtures.

The baseline scenario document describes the method to calculate baseline GHG emissions. It provides average Northern and Southern California electricity-use water factors and assumes that all water is treated to potable standards.

The percent reduction in GHG emissions is calculated based on the baseline scenario water use and the percent reduction in indoor water use achieved from a Project Applicant's commitment to installing low-flow and high-efficiency water fixtures. Table WUW-1.4 lists the estimated percent reductions in GHG emissions by water fixture and land use. The sum of all percent reductions applicable to the Project gives the overall percent reduction in GHG emissions expected from this mitigation measure. The details of these calculations are described below.

Measure Applicability:

- Indoor water use
- To meet CEQA enforcement requirements, the Project Applicant should only take credit for this mitigation measure if the clothes washers and dishwashers are supplied by the Project Applicant/builder.

Inputs:

The following information needs to be provided by the Project Applicant:

- Total expected indoor water demand, without installation of low-flow or high-efficiency fixtures (million gallons), AND
- Total expected indoor water demand, after installation of low-flow or high-efficiency fixtures (million gallons), OR
- Commitment to low-flow or high-efficiency water fixtures (toilets, showerheads, sink faucets, dishwashers, clothes washers, or all of the above)

Baseline Method:

$$\text{GHG emissions} = \text{Water}_{\text{baseline}} \times \text{Electricity} \times \text{Utility}$$

Where:

GHG emissions = MT CO_2e

$\text{Water}_{\text{baseline}}$ = Total expected indoor water demand, without installation of low-flow and high-efficiency fixtures (million gallons)
Provided by Applicant

Electricity = Electricity required to supply, treat, and distribute water and the resulting wastewater (kWh/million gallons)
Northern California Average: 5,411 kWh/million gallons
Southern California Average: 13,022 kWh/million gallons

Utility = Carbon intensity of Local Utility (CO_2e/kWh)

Mitigation Method:

Since this mitigation method does not change the electricity intensity factor (kWh/million gallons) associated with the supply, treatment, and distribution of the water, the percent reduction in GHG emissions is dependent only on the change in water consumption.

The Project Applicant can choose to compute the percent reduction in GHG emissions in one of three ways:

Method A

The Project Applicant can use Table WUW-1.4 to calculate the overall percent reduction in GHG emissions from committing to installing certain low-flow or high-efficiency water fixtures. The Project Applicant may commit to installing fixtures based on three standards: the California Green Building Standards Code (CGBSC) mandatory requirements, the CGBSC voluntary standards, or the ENERGY STAR standards. Table WUW-1.4 presents the percent reductions in GHG emissions for each of these three standards based on water fixture type (toilet, showerhead, clothes washer, etc) and land use type (residential, office, restaurant, etc). Note that in Table WUW-1.4, it is assumed that a Project Applicant commits to installing low-flow or high-efficiency fixtures for 100% of an end-use category (i.e. either 0% or 100% of toilets will be low-flow, either 0% or 100% of clothes washers will be high-efficiency, etc). The total percent reduction in GHG emissions expected from this mitigation measure is then simply the sum of all of the individual percent reductions:

$$\text{GHG emission reduction} = \sum \text{PercentReduction}_{\text{Fixture}}$$

Where:

GHG emission reduction = Percentage reduction in GHG emissions for indoor water use.
$\text{PercentReduction}_{\text{Fixture}}$ = Percent reduction in GHG emissions from each individual water fixture (i.e. toilet, bathroom faucet, dishwasher, etc.)
Provided in Table WUW-1.4

Method B

If the Project Applicant can provide detailed and substantial evidence to support a calculation of $\text{Water}_{\text{mitigated}}$, then that value can be used to calculate the percent GHG emission reduction using the following equation:

$$\text{GHG emission reduction} = \frac{\text{Water}_{\text{baseline}} - \text{Water}_{\text{mitigated}}}{\text{Water}_{\text{baseline}}}$$

Where:

GHG emission reduction = Percentage reduction in GHG emissions for indoor water use.
$\text{Water}_{\text{baseline}}$ = Total expected indoor water demand, without installation of low-flow and high-efficiency fixtures (million gallons)
Provided by Applicant
$\text{Water}_{\text{mitigated}}$ = Total calculated indoor water demand, after installation of low-flow and high-efficiency fixtures (million gallons)
Provided by Applicant or calculated using equations below

As shown in this equation, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions.

Method C

The Project Applicant may choose to install fixtures which exceed the requirements of the California Green Building Standards Code but have different flow rates than those specified in the Tables WUW-1.1 and WUW-1.3. To take credit for this mitigation measure, the Project Applicant would need to calculate the percent reduction in GHG emissions using the equations below. In these equations, it is assumed that a Project Applicant commits to installing low-flow or high-efficiency fixtures for 100% of an end-use category (i.e. either 0% or 100% of toilets will be low-flow, either 0% or 100% of clothes washers will be high-efficiency, etc). More complicated equations are necessary to account for less than 100% commitment in one or more end-use categories.

$$Water_{mitigated} = \sum EndUseWater_{mitigated}$$

End-Uses are toilets, urinals, showerheads, bathroom faucets, kitchen faucets, dishwashers, clothes washers, and leaks and other.

Where,

$$EndUseWater_{mitigated} = EndUse_{PercentIndoor} \times Water_{baseline} \times \frac{EndUseFlowRate_{mitigated}}{EndUseFlowRate_{unmitigated}}$$

$EndUse_{PercentIndoor}$ = % of Indoor Water Use for that end-use
Provided in Table WUW-1.1 for Residential Buildings
Provided in Table WUW-1.1 for Non-Residential Buildings

$Water_{baseline}$ = Total expected indoor water demand, without installation of low-flow and high-efficiency fixtures (million gallons)
Provided by Applicant

$EndUseFlowRate_{baseline}$ = Baseline current California standard water flow rate for that end-use
Provided in Table WUW-1.1 for Residential Buildings
Provided in Table WUW-1.3 for Non-Residential Buildings

$EndUseFlowRate_{mitigated}$ = Mitigated water flow rate for that end use
Provided by Applicant, supported by manufacturer specification or technical sheets

For the Leak, Other end use and all end-uses where the Project Applicant makes no commitment to installing low-flow or high-efficiency water fixtures, $EndUseFlowRate_{mitigated} = EndUseFlowRate_{unmitigated}$, so then $EndUseWater_{mitigated} = EndUse_{PercentIndoor} \times Water_{baseline}$.

Then the percent reduction in GHG emissions is calculated as follows:

$$\text{GHG emission reduction} = \frac{Water_{baseline} - Water_{mitigated}}{Water_{baseline}}$$

Where:

GHG emission reduction = Percentage reduction in GHG emissions for indoor water use.

$Water_{baseline}$ = Total expected indoor water demand, without installation of low-flow and high-efficiency fixtures (million gallons)
Provided by Applicant

$Water_{mitigated}$ = Total calculated indoor water demand, after installation of low-flow and high-efficiency fixtures (million gallons)
Calculated by Applicant using equation above

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	Estimated 20% reduction for residential buildings, assuming the Project Applicant commits to installing 100% of fixtures with the lowest flow rates presented in Table WUW-1.1. Estimated 17-31% reduction for non-residential buildings, assuming the Project Applicant commits to installing 100% of fixtures with the lowest flow rates presented in Table WUW-1.3.
All other pollutants	Not Quantified[87]

Discussion:

In this example, assume that a Project Applicant commits to installing the following:

For residences:

- 2010 CGBSC Mandatory Requirements for toilet, showerhead, bathroom faucet, and kitchen faucet
- ENERGY STAR residential standard dishwasher

For hotel:

- 2010 CGBSC Voluntary Standards for toilet, urinal, showerhead, bathroom faucet, and kitchen faucet
- ENERGY STAR top-loading clothes washer
- ENERGY STAR commercial dishwasher (high temp, under counter)

Using Method A, the following equation is employed:

$$\text{GHG emission reduction} = \sum \text{PercentReduction}_{\text{Fixture}}$$

[87] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

From Table WUW-1.4, the percent reduction in GHG emissions associated with indoor water use is then:

For residences:

$$6.6\% + 4.4\% + 5.7\% + 3.3\% + 0.2\% = 20.2\%$$

For hotel:

$$13.8\% + 5.4\% + 1.2\% + 0.8\% + 1.9\% + 6.4\% + 1.5\% = 31.0\%$$

Assumptions:

Data based upon the following references:

[1] CCR Title 24, Part 11. 2010. Draft California Green Building Standards Code. Available online at: http://www.documents.dgs.ca.gov/bsc/documents/2010/Draft-2010-CALGreenCode.pdf
[2] CCR Title 20, Division 2, Chapter 4, Article 4, Section 1605. Appliance Efficiency Regulations.
[3] Gleick, P.H.; Haasz, D.; Henges-Jeck, C.; Srinivasan, V.; Cushing, K.K.; Mann, A. 2003. Waste Not, Want Not: The Potential for Urban Water Conservation in California. Published by the Pacific Institute for Studies in Development, Environment, and Security. Full report available online at: http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf. Appendices available online at: http://www.pacinst.org/reports/urban_usage/appendices.htm
[4] Mayer, P.W.; DeOreo, W.B.; Opitz, E.M.; Kiefer, J.C.; Davis, W.Y.; Dziegielewski, B.; Nelson, J.O. 1999. Residential End Uses of Water. Published by the American Water Works Association Research Foundation.
[5] USEPA. ENERGY STAR: Clothes Washers Key Product Criteria. Available online at: http://www.energystar.gov/index.cfm?c=clotheswash.pr_crit_clothes_washers
[6] USEPA. ENERGY STAR: Commercial Clothes Washers for Consumers. Available online at: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CCW
[7] USEPA. ENERGY STAR: Dishwashers Key Product Criteria. Available online at: http://www.energystar.gov/index.cfm?c=dishwash.pr_crit_dishwashers
[8] USEPA. ENERGY STAR Commercial Dishwashers Savings Calculator. Available online at: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COH

Preferred Literature:

For the baseline scenario, the California Green Building Standards Code [1] specifies baseline water flow rates for toilets, showerheads, urinals, bathroom faucets, and kitchen faucets. The California Appliance Efficiency Regulation (Title 20) [2] specifies baseline water flow rates for residential and commercial dishwashers and clothes washers. For the mitigated scenario, the 2010 CGBSC also specifies water flow rates for toilets, showerheads, urinals, bathroom faucets, and kitchen faucets which become mandatory in 2011, additional voluntary flow rates for these same fixtures, and voluntary flow rates for commercial dishwashers and clothes washers. In addition, ENERGY STAR-certified residential and commercial dishwashers and clothes washers have mitigated water flow rates [5-8].

Alternative Literature:

None

Other Literature Reviewed:

[9] USEPA. Water Sense: Product Factsheets and Final Specifications. Available online at: http://www.epa.gov/watersense/products/index.html. Accessed February 2010.

USEPA WaterSense labeled products include toilets, bathroom sink faucets, and flushing urinals, and are certified to meet USEPA's standards for improved water efficiency. While WaterSense models do perform with greater water efficiency than federal standard models, they are not more efficient than the models required in California starting in 2011 due to the 2010 CGBSC. Furthermore, WaterSense models are compared to federal standard models and calculations would need to be adjusted to account for differences in California standards. USEPA reports that toilets, bathroom faucets, and showers account for 30%, 15%, and 17% of indoor household water use, respectively. USEPA reports that WaterSense toilets use 20% less water than the federal standard model, while WaterSense bathroom faucets use 30% less water. Federal standard showerheads use 2.5 gallons of water per minute while the WaterSense models use 2.0 gallons of water per minute, which is equivalent to the 2010 CGBSC Mandatory Requirement. Further, federal standard flushing urinal models use 1.0 gallons per flush, while WaterSense models uses 0.5 gallons per flush, which is equivalent to the 2010 CGBSC Mandatory Requirement.

Table WUW-1.1
Reduction in Water use from Low-flow or High-efficiency Residential Water Fixtures

Fixture	% of Indoor Water Use[1]	Water Flow Rate				
		Baseline Current California Standard[2]	Mitigated 2010 California Green Building Standards Code (Mandatory in 2011)[3]	Mitigated 2010 California Green Building Standards Code (Voluntary)[4]	Mitigated ENERGY STAR[5]	Unit
Toilet	33%	1.6	1.28	--	--	gallons/flush
Showerhead	22%	2.5	2.0	--	--	gallons/minute @ 60 psi
Bathroom Faucet	18%	2.2	1.5	--	--	gallons/minute @ 60 psi
Kitchen Faucet		2.2	1.8	--	--	gallons/minute @ 60 psi
Standard Dishwasher	1%	6.5	--	5.8	5.0	gallons/cycle
Compact Dishwasher		4.5	--	--	3.5	gallons/cycle
Top-loading Clothes Washer	14%	6.0	--	--	6.0	gallons/cycle/ cubic foot
Front-loading Clothes Washer		6.0	--	--	6.0	gallons/cycle/ cubic foot
Leaks, Other	12%	--	--	--	--	--

Notes:

1. Indoor household end use of water 2000 estimates from Figure 2-4c of the Pacific Institute report.
2. Baseline water flow rates for toilets, showerheads, bathroom faucets, and kitchen faucets are from the 2010 California Green Building Standards Code. Baseline water flow rates for dishwashers and clothes washers are from CCR Title 20, Division 2, Chapter 4, Article 4, Section 1605.2 (Appliance Efficiency Regulations for appliances sold in California).
3. Mitigated water flow rates for toilets, showerheads, bathroom faucets, and kitchen faucets are voluntary in 2010 and mandatory starting January 1, 2011.
4. Mitigated water flow rates for dishwashers and clothes washers are voluntary.
5. In some cases, the 2011 ENERGY STAR dishwasher and clothes washer models have lower flow rates than the 2010 California Green Building Standards Code. Using these ENERGY STAR models results in an additional mitigation beyond what is recommended by the 2010 California Green Building Standards Code.

Table WUW-1.2
Percent Indoor Water Use by End-Use in Non-Residential Buildings

End-Use	OFFICE		HOTEL		RESTAURANT		GROCERY STORE		NON-GROCERY RETAIL STORES		K-12 SCHOOL		OTHER SCHOOL	
	Total[1]	Indoor[2]	Total[1]	Indoor[2]	Total[1]	Indoor[2]	Total[1]	Indoor[2]	Total[1]	Indoor[2]	Total[1]	Indoor[2]	Total[1]	Indoor[2]
Restroom	26%	--	51%	--	34%	--	17%	--	26%	--	20%	--	20%	--
Toilets (72% of Restroom)	--	48%	--	46%	--	27%	--	26%	--	46%	--	51%	--	37%
Urinals (17% of Restroom)	--	11%	--	11%	--	6%	--	6%	--	11%	--	12%	--	9%
Faucets (4% of Restroom)	--	3%	--	3%	--	1%	--	1%	--	3%	--	3%	--	2%
Showers (7% of Restroom)	--	5%	--	4%	--	3%	--	2%	--	4%	--	5%	--	4%
Kitchen	3%	--	10%	--	46%	--	9%	--	4%	--	2%	--	1%	--
Faucets (57% of Kitchen)	--	4%	--	7%	--	29%	--	11%	--	6%	--	4%	--	1%
Dishwashers (24% of Kitchen)	--	2%	--	3%	--	12%	--	5%	--	2%	--	2%	--	1%
Ice Making (19% of Kitchen)	--	1%	--	2%	--	10%	--	4%	--	2%	--	1%	--	0%
Laundry	0%	0%	14%	18%	0%	0%	0%	0%	0%	0%	0%	0%	1%	3%
Other	10%	26%	5%	6%	12%	13%	22%	46%	11%	27%	6%	21%	17%	44%
Landscaping	38%	--	10%	--	6%	--	3%	--	38%	--	72%	--	61%	--
Cooling	23%	--	10%	--	2%	--	49%	--	21%	--	unknown	--	unknown	--
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Notes:

1. Water end-use data from Figures E-1, E-2, E-5, E-6, E-7, E-8, and E-9 of Appendix E of the Pacific Institute report.

2. Indoor end-use data calculated based on the total water use data for the relevant building category and Figure 4-3 and Figure 4-4 of the Pacific Institute report. Figure 4-3 shows the breakdown of restroom water use by end-use in the commercial & industry sector. Figure 4-4 shows the breakdown of kitchen water use by end-use in the commercial & industry sector; it was assumed that all end-uses except dishwashing and ice making are associated with faucet water use.

Table WUW-1.3
Reduction in Water use from Low-flow or High-efficiency Non-Residential Water Fixtures

Fixture	Water Flow Rate				
	Baseline Current California Standard[1]	Mitigated 2010 California Green Building Standards Code (Mandatory in 2011)[2]	Mitigated 2010 California Green Building Standards Code (Voluntary)[3]	Mitigated ENERGY STAR[4]	Unit
Toilet	1.6	1.28	1.12	--	gallons/flush
Urinal	1.0	0.5	0.5	--	gallons/flush
Showerhead	2.5	2.0	1.8	--	gallons/minute @ 60 psi
Bathroom Faucet	0.5	0.4	0.35	--	gallons/minute @ 60 psi
Kitchen Faucet	2.2	1.8	1.6	--	gallons/minute @ 60 psi
Dishwasher: High Temp, Under Counter	1.98	--	0.90	1.00	gallons/rack
Dishwasher: High Temp, Door	1.44	--	0.95	0.95	gallons/rack
Dishwasher: High Temp, Single Tank Conveyor	1.13	--	0.70	0.70	gallons/rack
Dishwasher: High Temp, Multi Tank Conveyor	1.10	--	0.70	0.54	gallons/rack
Dishwasher: Low Temp, Under Counter	1.95	--	0.98	1.70	gallons/rack
Dishwasher: Low Temp, Door	1.85	--	1.16	1.18	gallons/rack
Dishwasher: Low Temp, Single Tank Conveyor	1.23	--	0.62	0.79	gallons/rack
Dishwasher: Low Temp, Multi Tank Conveyor	0.99	--	0.62	0.54	gallons/rack
Top-loading Clothes Washer	9.5	--	8.6	6.0	gallons/cycle/ cubic foot
Front-loading Clothes Washer	9.5	--	8.6	6.0	gallons/cycle/ cubic foot

Notes:

1. Baseline water flow rates for toilets, showerheads, bathroom faucets, and kitchen faucets are from the 2010 California Green Building Standards Code. Baseline water flow rates for dishwashers are from the ENERGY STAR Commercial Dishwasher Calculator. Baseline water flow rates for clothes washers are from CCR Title 20, Division 2, Chapter 4, Article 4, Section 1605.2 (Appliance Efficiency Regulations for appliances sold in California).

2. These mitigated water flow rates for toilets, showerheads, bathroom faucets, and kitchen faucets are voluntary in 2010 and mandatory starting January 1, 2011.

3. These mitigated water flow rates for toilets, showerheads, bathroom faucets, and kitchen faucets are voluntary and represent the maximum recommended flow rate in order to achieve an overall 30% reduction in water use. Mitigated water flow rates for dishwashers and clothes washers are also voluntary. The range of values shown here represents different types of commercial dishwashers (high-temperature or chemical; conveyor, door, or undercounter models). See Appendix A5 of the 2010 California Green Building Standards Code for details.

4. In some cases, the ENERGY STAR dishwasher and clothes washer models have lower flow rates than the 2010 California Green Building Standards Code. Using these ENERGY STAR models results in an additional mitigation beyond what is recommended by the 2010 California Green Building Standards Code. See the following ENERGY STAR website for details: http://www.energystar.gov/index.cfm?c=comm_dishwashers.pr_crit_comm_dishwashers

Table WUW-1.4

Percent Reductions in GHG emissions from Installing Low-Flow or High-Efficiency Water Fixtures

FIXTURE	LAND USE							
	RESIDENTIAL	OFFICE	HOTEL	RESTAURANT	GROCERY STORE	NON-GROCERY RETAIL STORE	K-12 SCHOOL	OTHER SCHOOL
2010 California Green Building Standards Code (Mandatory Requirements starting in 2011):								
Toilet	6.6%	9.6%	9.2%	5.3%	5.1%	9.1%	10.3%	7.4%
Urinal	N/A	5.7%	5.4%	3.1%	3.0%	5.4%	6.1%	4.4%
Showerhead	4.4%	0.9%	0.9%	0.5%	0.5%	0.9%	1.0%	0.7%
Bathroom Faucet	5.7%	0.5%	0.5%	0.3%	0.3%	0.5%	0.6%	0.4%
Kitchen Faucet	3.3%	0.8%	1.3%	5.2%	1.9%	1.0%	0.7%	0.3%
2010 California Green Building Standards Code (Voluntary Standards):								
Toilet	N/A	14.4%	13.8%	8.0%	7.7%	13.7%	15.4%	11.1%
Urinal	N/A	5.7%	5.4%	3.1%	3.0%	5.4%	6.1%	4.4%
Showerhead	N/A	1.3%	1.2%	0.7%	0.7%	1.2%	1.4%	1.0%
Bathroom Faucet	N/A	0.8%	0.8%	0.4%	0.4%	0.8%	0.9%	0.6%
Kitchen Faucet	N/A	1.2%	1.9%	7.8%	2.9%	1.5%	1.1%	0.4%
Top-Loading Clothes Washer	N/A	N/A	1.8%	N/A	N/A	N/A	N/A	0.3%

FIXTURE	LAND USE							
	RESIDENTIAL	OFFICE	HOTEL	RESTAURANT	GROCERY STORE	NON-GROCERY RETAIL STORE	K-12 SCHOOL	OTHER SCHOOL
Front-Loading Clothes Washer	N/A	N/A	1.8%	N/A	N/A	N/A	N/A	0.3%
Residential Standard Dishwasher	0.1%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Residential Compact Dishwasher	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Commercial Dishwasher: High Temp, Under Counter	N/A	1.0%	1.6%	6.5%	2.5%	1.3%	0.9%	0.3%
Commercial Dishwasher: High Temp, Door	N/A	0.6%	1.0%	4.1%	1.5%	0.8%	0.6%	0.2%
Commercial Dishwasher: High Temp, Single Tank Conveyor	N/A	0.7%	1.1%	4.6%	1.7%	0.9%	0.7%	0.2%
Commercial Dishwasher: High Temp, Multi Tank Conveyor	N/A	0.7%	1.1%	4.4%	1.6%	0.9%	0.6%	0.2%
Commercial Dishwasher: Low Temp, Under Counter	N/A	0.9%	1.5%	6.0%	2.2%	1.2%	0.9%	0.3%
Commercial Dishwasher: Low Temp, Door	N/A	0.7%	1.1%	4.5%	1.7%	0.9%	0.6%	0.2%
Commercial Dishwasher: Low Temp, Single Tank Conveyor	N/A	0.9%	1.5%	6.0%	2.2%	1.2%	0.9%	0.3%

FIXTURE	LAND USE							
	RESIDENTIAL	OFFICE	HOTEL	RESTAURANT	GROCERY STORE	NON-GROCERY RETAIL STORE	K-12 SCHOOL	OTHER SCHOOL
Commercial Dishwasher: Low Temp, Multi Tank Conveyor	N/A	0.7%	1.1%	4.5%	1.7%	0.9%	0.6%	0.2%
ENERGY STAR Standards:								
Top-Loading Clothes Washer	N/A	N/A	6.4%	N/A	N/A	N/A	N/A	0.9%
Front-Loading Clothes Washer	N/A	N/A	6.4%	N/A	N/A	N/A	N/A	0.9%
Residential Standard Dishwasher	0.2%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Residential Compact Dishwasher	0.2%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Commercial Dishwasher: High Temp, Under Counter	N/A	0.9%	1.5%	5.9%	2.2%	1.2%	0.8%	0.3%
Commercial Dishwasher: High Temp, Door	N/A	0.6%	1.0%	4.1%	1.5%	0.8%	0.6%	0.2%
Commercial Dishwasher: High Temp, Single Tank Conveyor	N/A	0.7%	1.1%	4.6%	1.7%	0.9%	0.7%	0.2%
Commercial Dishwasher: High Temp, Multi Tank Conveyor	N/A	0.9%	1.5%	6.1%	2.3%	1.2%	0.9%	0.3%
Commercial Dishwasher: Low Temp, Under Counter	N/A	0.2%	0.4%	1.5%	0.6%	0.3%	0.2%	0.1%

FIXTURE	LAND USE							
	RESIDENTIAL	OFFICE	HOTEL	RESTAURANT	GROCERY STORE	NON-GROCERY RETAIL STORE	K-12 SCHOOL	OTHER SCHOOL
Commercial Dishwasher: Low Temp, Door	N/A	0.7%	1.1%	4.3%	1.6%	0.8%	0.6%	0.2%
Commercial Dishwasher: Low Temp, Single Tank Conveyor	N/A	0.7%	1.1%	4.3%	1.6%	0.8%	0.6%	0.2%
Commercial Dishwasher: Low Temp, Multi Tank Conveyor	N/A	0.8%	1.4%	5.5%	2.0%	1.1%	0.8%	0.3%

Notes:

N/A indicates that either (a) an improved standard does not exist, or (b) the percent of indoor water use for that fixture and land use is typically zero. For example, (a) the ENERGY STAR standard for residential clothes washers is the same as the baseline current California standard, and (b) no water is expected to be used for laundry (clothes washers) in the Office land use.

4.2.2 Adopt a Water Conservation Strategy

Range of Effectiveness: Varies depending on Project Applicant and strategies selected. It is equal to the Percent Reduction in water commitment.

Measure Description:

Water use contributes to GHG emissions indirectly, via the production of the electricity that is used to pump, treat, and distribute the water. Reducing water use reduces energy demand and associated indirect GHG emissions.

This mitigation measure describes how to calculate GHG emissions reductions from a Water Conservation Strategy which achieves X% reduction in water use (where X% is the specific percentage reduction in water use committed to by the Project Applicant). The steps taken to achieve this X% reduction in water use can vary in nature and may incorporate technologies which have not yet been established at the time this document was written. In order to take credit for this mitigation measure, the Project Applicant would need to provide detailed and substantial evidence supporting the percent reduction in water use.

The expected percent reduction is applied to the baseline water use, calculated according to the baseline methodology document. The energy-intensity factor associated with water conveyance, treatment, and distribution is provided in the 2006 CEC report [1].

This measure may incorporate other mitigation measures (WUW-1 through 6) of this document. As such, if this measure is used, the other measures cannot be used. These measures can be consulted to assist in determining methods of quantification and typical ranges of effectiveness.

Measure Applicability:

- Indoor and/or Outdoor water use

Inputs:

The following information needs to be provided by the Project Applicant:

- Total expected water demand, without implementation of Water Conservation Strategy (million gallons)
- Percent reduction in water use after implementation of Water Conservation Strategy (%)

Baseline Method:

$$\text{GHG emissions} = \text{Water}_{\text{baseline}} \times \text{Electricity} \times \text{Utility}$$

Where:

GHG emissions = MT CO_2e

$Water_{baseline}$ = Total expected water demand, without implementation of Water Conservation Strategy (million gallons)

Provided by Applicant

Electricity = Electricity required to supply, treat, and distribute water (and for indoor uses, the electricity required to treat the wastewater) (kWh/million gallons)

Northern California Avg (outdoor uses): 3,500 kWh/million gallons [1]

Northern California Avg (indoor uses): 5,411 kWh/million gallons [1]

Southern California Avg (outdoor uses): 11,111 kWh/million gallons [1]

Southern California Avg (indoor uses): 13,022 kWh/million gallons [1]

Utility = Carbon intensity of Local Utility (CO_2e/kWh)

If there are percent reductions associated with both indoor and outdoor water use, the GHG emissions from indoor and outdoor water use should be calculated separately and then summed. Thus,

$$\text{Total GHG emissions} = \text{GHG emissions}_{indoor} + \text{GHG emissions}_{outdoor}$$

Mitigation Method:

Since this mitigation method does not change the electricity intensity factor (kWh/million gallons) associated with the supply and distribution of the water, the percent reduction in GHG emissions is dependent only on the change in water consumption:

$$\text{GHG emission reduction} = \text{PercentReduction}$$

Where:

GHG emission reduction = Percentage reduction in GHG emissions for water use.

PercentReduction = Expected percent reduction in water use after implementation of Water Conservation Strategy (%)

Provided by Applicant

As shown in these equations, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	To be determined by Applicant

All other pollutants	Not Quantified[88]

Discussion:

The percent reduction in GHG emissions is equivalent to the percent reduction in indoor and outdoor water usage. Therefore, if a Project Applicant implements a Water Conservation Strategy which achieves a 10% reduction in water use, the GHG emissions associated with water use are reduced by 10%.

Assumptions:

Data based upon the following reference:

[1] CEC. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. Available online at: http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF

Preferred Literature:

2006 CEC report

Alternative Literature:

None

Other Literature Reviewed:

None

[88] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

4.2.3 Design Water-Efficient Landscapes

Range of Effectiveness: 0 – 70% reduction in GHG emissions from outdoor water use

Measure Description:

Water use contributes to GHG emissions indirectly, via the production of the electricity that is used to pump, treat, and distribute the water. Designing water-efficient landscapes for a project site reduces water consumption and the associated indirect GHG emissions. Examples of measures which a Project Applicant should consider when designing landscapes are reducing lawn sizes, planting vegetation with minimal water needs such as California native species, choosing vegetation appropriate for the climate of the project site, and choosing complimentary plants with similar water needs or which can provide each other with shade and/or water.

This measure describes how to calculate GHG savings from residential and commercial landscape plantings which have decreased watering demands compared to standard California landscape plantings. The methodology for calculating water demand presented here is based on the California Department of Water Resources (CDWR) 2009 Model Water Efficient Landscape Ordinance [1] and the CDWR 2000 report: "A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California: The Landscape Coefficient Method and WUCOLS III" ("WUCOLS") [2].

By January 1, 2010, all local water agencies were required to adopt the CDWR Model Water Efficient Landscape Ordinance or develop their own local ordinance which is at least as effective at conserving water as the Model Ordinance. Some local agencies have published or are in the process of developing local ordinances.[89] A Project Applicant may choose to use the methodology presented in a local ordinance to demonstrate a percent reduction in water use and GHG emissions; however, the calculations will be similar to the methodology presented in the CDWR Model Ordinance and re-described here.

Measure Applicability:

- Outdoor water use

Inputs:

The following information needs to be provided by the Project Applicant:

[89] List of local water agencies and a description of their plans to either adopt the CDWR Model Ordinance or develop their own ordinance: ftp://ftp.water.ca.gov/Model-Water-Efficient-Landscape-Ordinance/Local-Ordinances/

- Water$_{baseline}$, to be calculated by the Project Applicant using the methodology described below
- Water$_{mitigated}$, to be calculated by the Project Applicant using the methodology described below

Baseline Method:

The Project's baseline water use is the Maximum Applied Water Allowance (MAWA) described in the Model Water Efficient Landscape Ordinance:

$$MAWA = ET_0 \times 0.62 \times [(0.7 \times LA) + (0.3 \times SLA)]$$

Where:

MAWA	=	Maximum Applied Water Allowance (gallons per year)
ET_0	=	Annual Reference Evapotranspiration[90] from Appendix A of the Model Water Efficient Landscape Ordinance (inches per year)
0.7	=	ET Adjustment Factor (ETAF)
LA	=	Landscape Area[91] includes Special Landscape Area[92] (square feet)
0.62	=	Conversion factor (to gallons per square foot)
SLA	=	Portion of the landscape area identified as Special Landscape Area (square feet)
0.3	=	the additional ET Adjustment Factor for Special Landscape Area

Then the baseline GHG emissions are calculated as follows:

$$GHG\ emissions = MAWA \times Electricity \times Utility$$

Where:

GHG emissions = MT CO_2e

Electricity = Electricity required to supply, treat, and distribute water (kWh/million gallons)

Northern California Average (outdoor uses): 3,500 kWh/million gallons

Southern California Average (outdoor uses): 11,111 kWh/million gallons

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[90] Evapotranspiration is water lost to the atmosphere due to evaporation from soil and transpiration from plant leaves. For a more detailed definition, see this California Irrigation Management Information System (CIMIS) website:
http://wwwcimis.water.ca.gov/cimis/infoEtoOverview.jsp;jsessionid=91682943559928B8A9A243D2A2665E19

[91] § 491 Definitions in Model Water Efficient Landscape Ordinance: "Landscape Area (LA) means all the planting areas, turf areas, and water features in a landscape design plan subject to the Maximum Applied Water Allowance calculation. The landscape area does not include footprints of buildings or structures, sidewalks, driveways, parking lots, decks, patios, gravel or stone walks, other pervious or non-pervious hardscapes, and other non-irrigated areas designed for non-development (e.g., open spaces and existing native vegetation)."

[92] § 491 Definitions in Model Water Efficient Landscape Ordinance: "Special Landscape Area (SLA) means an area of the landscape dedicated solely to edible plants, areas irrigated with recycled water, water features using recycled water and areas dedicated to active play such as parks, sports fields, golf courses, and where turf provides a playing surface."

Utility = Carbon intensity of Local Utility (CO_2e/kWh)

Mitigation Method:

Since this mitigation method does not change the electricity intensity factor (kWh/million gallons) associated with the supply, treatment, and distribution of the water, the percent reduction in GHG emissions is dependent only on the change in water consumption.

The Project's mitigated water use is the Estimated Total Water Use (ETWU) described in the Model Water Efficient Landscape Ordinance:

$$ETWU = ET0 \times 0.62 \times \left(\frac{PF \times HA}{IE} + SLA \right)$$

Where:

ETWU	=	Estimated total water use (gallons per year)
ET_0	=	Annual Reference Evapotranspiration from Appendix A of the Model Water Efficient Landscape Ordinance (inches per year)
PF	=	Plant Factor from WUCOLS[93] see Table WUW-3.1 for examples and WUCOLS for a complete list of values
HA	=	Hydrozone Area[94] (square feet)
SLA	=	Special Landscape Area (square feet)
0.62	=	Conversion factor (to gallons per square foot)
IE	=	Irrigation Efficiency[95] (minimum 0.71)

Then the percent reduction in GHG emissions is calculated as follows:

$$\text{GHG emission reduction} = \frac{MAWA - ETWU}{MAWA}$$

[93] § 491 Definitions in Model Water Efficient Landscape Ordinance: "Plant Factor (PF)" is a factor, when multiplied by ET_0, estimates the amount of water needed by plants." The Model Water Efficient Landscape Ordinance indicates that PF is 0-0.3 for low water use plants, 0.4-0.6 for moderate water use plants, and 0.7-1.0 for high water use plants. PF is equivalent to the "species factor" (k_s) in WUCOLS. See Table A above for examples of low, moderate, and high water use plants from WUCOLS. For a complete list of PF (k_s) values, see the species evaluation list in WUCOLS.

[94] § 491 Definitions in Model Water Efficient Landscape Ordinance: "Hydrozone means a portion of the landscaped area having plants with similar water needs. A hydrozone may be irrigated or non-irrigated."

[95] § 491 Definitions in Model Water Efficient Landscape Ordinance: "Irrigation Efficiency (IE) means the measurement of the amount of water beneficially used divided by the amount of water applied. Irrigation efficiency is derived from measurements and estimates of irrigation system characteristics and management practices. The minimum average irrigation efficiency for purposes of the ordinance is 0.71. Greater irrigation efficiency can be expected from well designed and maintained systems."

As shown in this equation, the regional electricity intensity factor and utility carbon intensity factor do not play a role in determining the percentage reduction in GHG emissions. Furthermore, since ET_0 is a multiplier in both MAWA and ETWU, it cancels out and therefore ET_0 does not play a role in determining the percentage reduction in GHG emissions either.

Table WUW-3.1: Example Plant Factor (PF) Values from WUCOLS

Water Needs	PF Range	Plant Type	Species Examples
Low	0 - 0.3	tree	Quercus agrifolia (coast live oak)
			Yucca
			Pinus halepensis (Aleppo pine)
		shrub	Quercus berberidifolia (California scrub oak)
			Lonicera subspicata (chaparral honeysuckle)
			Salvia apiana (white sage)
		vine	Macfadyena unguis-cati (cat's claw)
		groundcover	Arctostaphylos spp. (manzanita)
		perennial	Monardella villosa (coyote mint)
Moderate	0.4 - 0.6	tree	Acer negundo (California box elder)
			Acer paxii (evergreen maple)
		shrub	Buxus microphylla japonica (Japanese boxwood)
		vine	Wisteria
			Aristolochia durior (Dutchman's pipe)
		groundcover	Ceratostigma plumbaginoides (dwarf plumbago)
		perennial	Monarda didyma (bee balm)
	0.6	turf grasses (warm season)	Bermudagrass
			kikuyugrass
			seashore paspalum
			St. Augustinegrass
			zoysiagrass
High	0.7 - 1.0	tree	Betula pendula (European white birch)
			Betula nigra (river/red birch)
		shrub	Cyathea cooperii (Australian tree fern)
			Cornus stolonifera (red osier dogwood)
		groundcover	Soleirolia soleirolii (baby's tears)
		perennial	Mimulus spp., herbaceous (monkey flower)
			Woodwardia radicans (European chain fern)
			Acorus gramineus (sweet flag)
	0.8	turf grasses (cool season)	annual bluegrass
			annual ryegrass
			colonial bentgrass
			creeping bentgrass
			hard fescue
			highland bentgrass
			Kentucky bluegrass
			meadow fescue
			perennial ryegrass
			red fescue
			rough-stalked bluegrass
			tall fescue

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	Assuming an irrigation efficiency of 71% as specified in the Model Water Efficient Landscape Ordinance and no Special Landscape Area: • 0% reduction if 100% of vegetation is Moderate PF • 13% reduction if 40% of vegetation is Low PF, 40% is Moderate PF, and 20% is High PF • 35% reduction if 50% of vegetation is Low PF and 50% is Moderate PF • 70% reduction if 100% of vegetation is Low PF
All other pollutants	Not Quantified[96]

Discussion:

Example calculations of MAWA and ETWU are provided in the Model Water Efficient Landscape Ordinance. In this example, assume that the Project Applicant has used the equations to calculate MAWA = 100 million gallons and ETWU = 80 million gallons. Then the GHG emissions reduction is 20%:

$$\text{GHG Emission Reduced} = \frac{100-80}{100} = 0.2 \text{ or } 20\%$$

Assumptions:

Data based upon the following references:

[1] California Department of Water Resources. 2009. Model Water Efficient Landscape Ordinance. Available online at: http://www.water.ca.gov/wateruseefficiency/docs/MWELO09-10-09.pdf
[2] ("WUCOLS"): California Department of Water Resources. 2000. A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California: The Landscape Coefficient Method and WUCOLS III. Available online at: http://www.water.ca.gov/pubs/conservation/a_guide_to_estimating_irrigation_water_needs_of_landscape_plantings_in_california__wucols/wucols00.pdf
[3] CEC. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December. Available online at: http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF

Preferred Literature:

The California Department of Water Resources Model Water Efficient Landscape Ordinance requires that the Estimated Total Water Use (ETWU) of certain landscape

[96] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

projects shall not exceed the Maximum Applied Water Allowance (MAWA) for that landscape area. The MAWA is calculated based on average irrigation efficiencies and plant factors, two major influences on the water demand of a landscape. The ETWU is calculated based on project-specific plant factors and irrigation efficiency.

Alternative Literature:

[4] ("WUCOLS"): California Department of Water Resources. 2000. A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California: The Landscape Coefficient Method and WUCOLS III. Available online at: http://www.water.ca.gov/pubs/conservation/a_guide_to_estimating_irrigation_water_needs_of_landscape_plantings_in_california__wucols/wucols00.pdf

[5] The Las Pilitas Nursery website has a user-friendly and searchable database of native California plants: http://www.laspilitas.com/shop/plant-products. As shown in WUCOLS, many California native plants have minimal or very low water needs.

The equation on page 9 of WUCOLS [4] shows that water demand for irrigation landscape plantings (ETL, landscape evapotranspiration) is calculated by multiplying two parameters: the landscape coefficient (KL) and the reference evapotranspiration (ETo). KL values are based on a species factor, density factor, and microclimate factor. The guidance provides detailed instructions on how to assign project-specific values for these three factors. KL can then be divided by the irrigation efficiency to obtain the Total Water Applied, as shown on page 31 of the guidance [4]. Total Water Applied is analogous to ETWU in the methodology shown above. Thus, the detailed WUCOLS methodology could be used to perform a more rigorous calculation of ETWU which incorporates microclimate effects (e.g. windy areas, areas shaded by buildings, etc) and vegetation density effects.

Other Literature Reviewed:

None

4.2.4 Use Water-Efficient Landscape Irrigation Systems

Range of Effectiveness: 6.1% reduction in GHG emissions from outdoor water

Measure Description:

Water use contributes to GHG emissions indirectly, via the production of the electricity that is used to pump, treat, and distribute the water. Using water-efficient landscape irrigation techniques such as “smart” irrigation technology reduces outdoor water demand, energy demand, and the associated GHG emissions.[97]

“Smart” irrigation control systems use weather, climate, and/or soil moisture data to automatically adjust watering schedules in response to environmental and climate changes, such as changes in temperature or precipitation levels. Thus, the appropriate amount of moisture for a certain vegetation type is maintained, and excessive watering is avoided. Many companies which design and install smart irrigation systems, such as Calsense, ET Water, and EPA-certified WaterSense Irrigation Partners, may be able to provide a site-specific estimate of the percent reduction in outdoor water use that can be expected from installing a smart irrigation system. Expected reductions are in the range of 1 – 30%, with the high end of the range associated with historically high water users. To take credit for the high end of the GHG emissions reductions based on these company quotes, the Project Applicant would need to provide detailed and substantial evidence supporting the proposed percent reduction in water use. Alternatively, the Project Applicant could apply the average percent reduction reported in a 2009 study conducted by Aquacraft, Inc. in cooperation with the California Department of Water Resources, the California Urban Water Conservation Council, and a consortium of California water utilities. This comprehensive study showed that smart irrigation systems of various brands achieve an average of 6.1% reduction in outdoor water use in California. This percent reduction is based on a two year study (one year pre and post installation of smart controllers) of over two thousand sites in seventeen different water utilities throughout northern and southern California. While the study also presents utility-specific percent reductions, variations in implementation and sample size between utilities renders these percent reductions insufficient for characterization in a mitigation measure at this time. The study also notes that for a sample of smart controllers where data was collected for three years after installation, the percent reduction in water use increased with time, with the greatest percent reduction achieved in year three.

[97] The installation of smart irrigation controllers will be required starting in 2011 as indicated in the 2010 Draft California Green Building Standards Code. As technology advances and newer generation smart irrigation controllers become available, the Project Applicant may choose to use this mitigation measure to quantify water use and associated GHG reductions beyond what would be achieved with the standards required by the California Green Building Standards Code.

The expected percent reduction is applied to the baseline water use, calculated according to the baseline methodology document. The energy-intensity factor associated with water conveyance and distribution is provided in the 2006 CEC report [2].

Measure Applicability:

- Outdoor water use

Inputs:

The following information needs to be provided by the Project Applicant:

- Total expected outdoor water demand, without installation of smart landscape irrigation controller (million gallons).
- (Optional) Project-specific percent reduction in outdoor water demand, after installation of smart landscape irrigation controller. Percent reduction must be verifiable. Otherwise, use the default value of 6.1%.

Baseline Method:

$$\text{GHG emissions} = \text{Water}_{\text{baseline}} \times \text{Electricity} \times \text{Utility}$$

Where:

GHG emissions = MT CO_2e

$\text{Water}_{\text{baseline}}$ = Total expected outdoor water demand, without installation of smart landscape irrigation controllers (million gallons)
Provided by Applicant

Electricity = Electricity required to supply, treat, and distribute water (kWh/million gallons)
Northern California Average: 3,500 kWh/million gallons
Southern California Average: 11,111 kWh/million gallons

Utility = Carbon intensity of Local Utility (CO_2e/kWh)

Mitigation Method:

Since this mitigation method does not change the electricity intensity factor (kWh/million gallons) associated with the supply and distribution of the water, the percent reduction in GHG emissions is dependent only on the change in water consumption:

$$\text{GHG emission reduction} = \text{PercentReduction} \times \text{Water}_{\text{baseline}}$$

Where:

GHG emission reduction = Percentage reduction in GHG emissions for outdoor water use.

$\text{Water}_{\text{baseline}}$ = Total expected outdoor water demand, without installation of smart landscape irrigation controllers (million gallons)

Provided by Applicant

PercentReduction = Expected percent reduction in water use after installation of smart landscape irrigation controllers (%)

Provided by Applicant or use default 6.1%

As shown in these equations, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	6.1% unless project-specific data is provided
All other pollutants	Not Quantified[98]

Discussion:

The percent reduction in GHG emissions is equivalent to the percent reduction in outdoor water usage. Therefore, if a Project Applicant uses the default percent reduction in water usage associated with installing smart landscape irrigation control systems (6.1%), the resulting reduction in GHG emissions is also 6.1%.

Assumptions:

Data based upon the following references:

[1] "Evaluation of California Weather-Based "Smart" Irrigation Controller Programs." July 2009. Presented to the California Department of Water Resources by The Metropolitan Water District of Southern California and The East Bay Municipal Utility District. Facilitated by the California Urban Water Conservation Council. Prepared by Aquacraft Inc., National Research Center Inc., and Dr. Peter J. Bickel. Available online at: http://www.aquacraft.com/Download_Reports/Evaluation_of_California_Smart_Controller_Programs_-_Final_Report.pdf

[2] CEC. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. Available online at: http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF

Preferred Literature:

As described above, the 2009 study [1] conducted by Aquacraft, Inc. in cooperation with the California Department of Water Resources, the California Urban Water Conservation Council, and a consortium of California water utilities showed that smart

[98] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

irrigation systems of various brands achieve an average of 6.1% reduction in outdoor water use in California.

Alternative Literature:

When common watering systems such as in-ground sprinklers are used, much of the water applied to lawns and landscapes is not absorbed by the vegetation. Instead, it is lost through runoff or evaporation. The USEPA reports that a study by the American Water Works Association found that households with in-ground sprinkler systems used 35% more water outdoors than households without these systems, while households with drip irrigation systems used 16% more water [3]. The USEPA reports that hand-held hoses or sprinklers are often more water efficient than automatic irrigation systems.

However, "smart" automatic landscape irrigation systems do exist. Examples include systems which automatically adjust watering schedules in response to environmental and climate changes, such as changes in temperature or precipitation levels. A few references have quantified reductions from this type of irrigation strategy. The Southern Nevada Water Authority reports that smart irrigation systems can reduce outdoor water use by an average of 15 to 30 percent, depending on the system, landscape type, and location [4]. One study conducted in 40 households with historically high water use in Irvine, California showed an average reduction in outdoor water use of 16% [5,6]. Another study conducted in Santa Barbara, California households with historically high water use showed an average water savings of 26% [5,7]. A Project Applicant could also hire an EPA-certified WaterSense Irrigation Partner to design and install a new irrigation system or audit an existing system in an effort to minimize the amount of water consumed [6].

[3] USEPA. 2002. Water-Efficient Landscaping: Preventing Pollution & Using Resources Wisely. Available online at: http://www.epa.gov/npdes/pubs/waterefficiency.pdf
[4] Southern Nevada Water Authority. Smart Irrigation Controllers. Available online at: http://www.snwa.com/html/land_irrig_smartclocks.html. Accessed March 2010.
[5] Irrigation Association. Smart Controller Efficiency Testing. Available online at: http://www.irrigation.org/SWAT/Industry/case-studies.asp. Accessed March 2010.
[6] Irvine Ranch Water District, et al. 2001. Residential Weather-Based Irrigation Scheduling: Evidence from the Irvine "ET Controller" Study. Available online at: http://www.irrigation.org/swat/images/irvine.pdf
[7] Santa Barbara County Water Agency, et al. 2003. Santa Barbara County ET Controller Distribution and Installation Program Final Report. Available online at: http://www.irrigation.org/swat/images/santa_barbara.pdf
[8] USEPA. WaterSense: Landscape Irrigation. Available online at: http://www.epa.gov/WaterSense/services/landscape_irrigation.html

4.2.5 Reduce Turf in Landscapes and Lawns

Range of Effectiveness: Varies and is equal to the percent commitment to turf reduction, assuming no other outdoor water uses

Measure Description:

Water use contributes to GHG emissions indirectly, via the production of the electricity that is used to pump, treat, and distribute the water. Turf grass (i.e. lawn grass) has relatively high water needs compared to most other types of vegetation. For example, trees planted in turf generally do not need additional watering besides what is required for the turf. Water agencies in Southern California have instituted turf removal programs which provide rebates for resident who reduce the turf area in their lawns. Reducing the turf size of landscapes and lawns reduces water consumption and the associated indirect GHG emissions.[99]

This measure describes how to calculate GHG savings from reducing the turf area of an existing lawn by X square feet, or designing a lawn to have X square feet less than the turf area of a standard lawn at the project location.[100]

Additional GHG emissions reductions may occur due to a reduction in fertilizer usage. Since this will vary based on individual occupant behavior, this reduction in GHG emissions from decreased fertilizer usage is not quantified.

Measure Applicability:

- Outdoor water use

Inputs:

The following information needs to be provided by the Project Applicant:

- Turf area of existing lawn or standard lawn at the project location (square feet)
- Turf area reduction commitment (square feet reduced or percent of baseline reduced)

Baseline Method:

---

[99] See the SoCal WaterSmart Residential Turf Program description at http://socalwatersmart.com/index.php?option=com_content&view=article&id=77&Itemid=10. Accessed March 2010.

[100] The Project Applicant would need to provide a value for and evidence supporting this “standard-sized lawn.” This value is likely to vary greatly depending on the type of building (single-family, condo, apartment complex, commercial space) as well as location (region in California, urban or suburban).

The methodology for calculating water demand presented here is based on the California Department of Water Resources (CDWR) 2009 Model Water Efficient Landscape Ordinance [1] and the CDWR 2000 report: "A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California: The Landscape Coefficient Method and WUCOLS III" [2].

The Project Applicant should first calculate the amount of water required to support the existing turf or standard-sized turf ($Water_{baseline}$).[101] In the equations below, "crop" also represents "turf grass," or lawn grasses.

$$ET_C = K_c \times ET_0$$

Where:

ET_C = Crop Evapotranspiration, the total amount of water the baseline turf loses during a specific time period due to evapotranspiration[102] (inches water/day)

K_C = Crop Coefficient, factor determined from field research, which compares the amount of water lost by the crop (e.g. turf) to the amount of water lost by a reference crop (unitless)

Species-specific; provided in Table WUW-5.1 below

ET_0 = Reference Evapotransporation, the amount of water lost by a reference crop (inches water/day)

Region-specific; provided in Appendix A of the CDWR Model Water Efficient Landscape Ordinance [1]

[101] Page 10 of the CDWR report explains that the objective of landscape management is to maintain the "health, appearance, and reasonable growth" of plants, and not necessarily to replenish all of the water lost at maximum evapotranspiration rates. Thus, the CDWR methodology presented here calculates only the amount of water required to sustain the health, appearance, and growth of the plants.

[102] Evapotranspiration is water lost to the atmosphere due to evaporation from soil and transpiration from plant leaves. For a more detailed definition, see this California Irrigation Management Information System (CIMIS) website: http://wwwcimis.water.ca.gov/cimis/infoEtoOverview.jsp;jsessionid=91682943559928B8A9A243D2A2665E19

Table WUW-5.1:
Crop Coefficient for Turf Grasses

Category	Kc	Species
cool season grasses	0.8	annual bluegrass annual ryegrass colonial bentgrass creeping bentgrass hard fescue highland bentgrass Kentucky bluegrass meadow fescue perennial ryegrass red fescue rough-stalked bluegrass tall fescue
warm season grasses	0.6	Bermudagrass kikuyugrass seashore paspalum St. Augustinegrass zoysiagrass

Reference: p. 6 and p. 137 of CDWS report

Then: $$Water_{baseline} = ETC \times Area_{baseline} \times 0.62 \times 365$$

Where:

$Water_{baseline}$ = Volume of water required to support the baseline turf (gallons/year)
$Area_{baseline}$ = Area of existing or standard turf (square feet)
Provided by the Applicant
0.62 = conversion factor (gallons/squarefoot·inches water)
365 = conversion factor (days/year)
ETC = Crop evapotranspiration
Calculated using the equation on page 280

Then the baseline GHG emissions are calculated as follows:

$$GHG\ emissions = Water_{baseline} \times Electricity \times Utility$$

Where:

GHG emissions = MT CO_2e
Electricity = Electricity required to supply, treat, and distribute water (kWh/million gallons)

Northern California Average (outdoor uses): 3,500 kWh/million gallons
Southern California Average (outdoor uses): 11,111 kWh/million gallons
Utility = Carbon intensity of Local Utility (CO_2e/kWh)

Mitigation Method:

The equations above show that the GHG emissions are directly proportional to the water demand, which is in turn directly proportional to the area of the turf. Therefore, only the area of the existing or standard turf and the commitment to turf area reduction (square feet reduced or percent of baseline reduced) are needed to calculate the percent reduction in GHG emissions:

$$\text{GHG emission reduction} = \frac{\text{Area}_{\text{reduction}}}{\text{Area}_{\text{baseline}}} = \text{AreaPercentReduction}$$

Where:

$\text{Area}_{\text{reduction}}$ = Area of turf to be reduced (square feet)
Provided by the Applicant
$\text{Area}_{\text{baseline}}$ = Area of existing or standard turf (square feet)
Provided by the Applicant
AreaPercentReduction = Percent reduction in turf area (%)
Provided by the Applicant

As shown in this equation, the regional electricity intensity factor for water and the utility carbon intensity factor do not play a role in determining the percentage reduction in GHG emissions.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	Up to 100%, assuming 100% reduction in turf grass area. This would be the case for rock-lawns, for example.
All other pollutants	Not Quantified[103]

Discussion:

In this example, assume that the Project Applicant has provided detailed evidence to show that the turf area of a standard lawn at the project location is 8,000 square feet. If the Project Applicant then commits to reducing the turf area of lawns by 3,000 square feet, then the GHG emissions reduction is 37.5%.

[103] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

$$\text{GHG Emission Reduced} = \frac{3{,}000}{8{,}000} = 0.375 \text{ or } 37.5\%$$

Assumptions:

Data based upon the following references:

[1] California Department of Water Resources. 2009. Model Water Efficient Landscape Ordinance. Available online at: http://www.water.ca.gov/wateruseefficiency/docs/MWELO09-10-09.pdf

[2] California Department of Water Resources. 2000. A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California: The Landscape Coefficient Method and WUCOLS III. Available online at: http://www.water.ca.gov/pubs/conservation/a_guide_to_estimating_irrigation_water_needs_of_landscape_plantings_in_california__wucols/wucols00.pdf

[3] CEC. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December. Available online at: http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF

Preferred Literature:

See above

Alternative Literature:

None

Other Literature Reviewed:

None

4.2.6 Plant Native or Drought-Resistant Trees and Vegetation

Range of Effectiveness: Best Management Practice; may be quantified if substantial evidence is available.

Measure Description:

California native plants within their natural climate zone and ecotype need minimal watering beyond normal rainfall, so less water is needed for irrigating native plants than non-native species. Drought-resistant vegetation needs even less watering. Water use contributes to GHG emissions indirectly, via the production of the electricity that is used to pump, treat, and distribute the water. Thus, planting native and drought-resistant vegetation reduces water use and the associated GHGs. Designing landscapes with native plants can provide many other benefits, including reducing the need for fertilization and pesticide use, and providing a more natural habitat for native wildlife. Although there is much anecdotal evidence for the benefits of planting native vegetation, few scientific studies have quantified the actual water savings. Therefore, this mitigation measure would most likely be employed as a Best Management Practice. Future studies may quantify the water-saving benefits of planting native or drought-resistant vegetation. In order to take quantitative credit for this mitigation measure, the Project Applicant would need to provide detailed and substantial evidence supporting a percent reduction in water use. The percent reduction would be applied to the baseline water use, calculated according to the baseline methodology described in WUW-3 (Design water efficient landscapes) and the baseline methodology document.

Measure Applicability:

- Outdoor water use

Inputs:

The following information needs to be provided by the Project Applicant:

- Percent reduction in water use, calculated using detailed and substantial evidence
- $Water_{baseline}$, to be calculated by the Project Applicant using the baseline methodology described in WUW-3 (Design water efficient landscapes) and the baseline methodology document

Baseline Method

See WUW-3 (Design water efficient landscapes)

Mitigation Method

Since this mitigation method does not change the electricity intensity factor (kWh/million gallons) associated with the supply, treatment, and distribution of the water, the percent reduction in GHG emissions is dependent only on the change in water consumption:

$$\text{GHG emission reduction} = \text{PercentReduction} \times \text{Water}_{baseline}$$

Where:

GHG emission reduction = Percentage reduction in GHG emissions for outdoor water use.

$\text{Water}_{baseline}$ = Baseline water demand, without planting native or drought-resistant vegetation
Provided by Applicant, calculated using baseline methodology of Mitigation Measure WUW-3

PercentReduction = Expected percent reduction in water use resulting from planting native or drought-resistant vegetation
Provided by Applicant

As shown in these equations, the carbon intensity of the local utility does not play a role in determining the percentage reduction in GHG emissions.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	To be determined by Applicant
All other pollutants	Not Quantified[104]

Discussion:

Currently there is not sufficient substantial evidence supporting a generalized reduction in emissions due to planting native or drought tolerant species. However, if the project applicant is able to provide sufficient substantial evidence supporting a reduction in water usage associated with native or drought tolerant species, the percent reduction in GHG emissions is equivalent to the percent reduction in outdoor water usage. Therefore, if a Project Applicant can support a 10% reduction in water use by native and drought tolerant species, the GHG emissions associated with water use are reduced by 10%.

Assumptions:

None

[104] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

Alternative Literature:

The EPA reports that while there is anecdotal evidence for the water-saving benefits of planting native and drought-resistant vegetation, there are very few scientific studies available which quantify the benefits. There are several good resources available which describe the qualitative benefits. The California Native Plant Society provides many resources for designing a native plant garden, including how to identify native plants and where to buy them. The Las Pilitas Nursery provides similar resources and also lists species of drought-resistant plants that are best for specific California regions. The EPA also provides tips for designing landscapes with native plants.

USEPA. "Exploring the Environmental, Social and Economic Benefits Conference," December 6-7, 2004. USEPA. Greenacres: Landscaping with Native Plants Research Needs. Available online at: http://www.epa.gov/greenacres/conf12_04/conf_A.html. Accessed March 2010.

California Native Plant Society. Homepage. Available online at: http://www.cnps.org/. Accessed March 2010.

Las Pilitas Nursery. Drought Tolerant or Resistant Native Plants. Available online at: http://www.laspilitas.com/garden/Drought_resistant_plants_for_a_California_garden.html. Accessed March 2010.

USEPA. Greenacres: Native Plants Brochure. Available online at: http://www.epa.gov/greenacres/navland.html#Introduction. Accessed March 2010.

Alternative Literature:

None.

Other Literature Reviewed:

None

5.0 Landscaping Equipment

5.1 Landscaping Equipment

5.1.1 Prohibit Gas Powered Landscape Equipment.

Measure Description:

Electric lawn equipment including lawn mowers, leaf blowers and vacuums, shredders, trimmers, and chain saws are available. When electric landscape equipment is used in place of a conventional gas-powered equipment, direct GHG emissions from natural gas combustion are replaced with indirect GHG emissions associated with the electricity used to power the equipment.

Measure Applicability:

[1] Landscaping equipment

Inputs:

The following information needs to be provided by the Project Applicant:

- Electricity provider for the Project
- Horsepower of landscaping equipment
- Hours of operation

Baseline Method:

Look up landscape equipment emission factor based on type of fuel used:

Landscaping Equipment Horsepower	CO_2 Emission Factor from Gasoline (g/hp-hr)
< 25	429.44
25 – 50	783.30
50 – 120	774.50
120 –175	753.25
> 175	732.00

$$\text{GHG emission} = EF \times Hp \times LF \times Hr \times 10^{-6}$$

Where:

GHG emission = MT CO_2e per year

EF = CO_2 emission factor for the relevant horsepower tier show in table above (g/hp-hr). Obtained from OFFROAD2007.

Hp = Horsepower of landscaping equipment
LF = Load factor of equipment for the relevant horsepower tier (dimensionless). Obtained from OFFROAD2007.
Hr = Hours of operation per year
10^{-6} = Unit conversion from grams to MT

Mitigation Method:

Landscaping equipment will run on electricity instead of gasoline. The indirect GHG emission from electricity generation is:

$$\text{GHG emission} = \text{Utility} \times \text{Hp} \times \text{LF} \times \text{Hr} \times \text{C}$$

Where:
GHG emissions = MT CO_2e
Utility = Carbon intensity of Local Utility (CO_2e/kWh). See table below.
Hp = Horsepower of landscaping equipment.
LF = Load factor of equipment for the relevant horsepower tier (dimensionless). Obtained from OFFROAD2007.
Hr = Hours of operation.
C = Unit conversion factor

Power Utility	Carbon-Intensity (lb CO_2e/kWh)
LADWP	1,238
PG&E	456
SCE	641
SDGE	781
SMUD	555

$$\text{GHG Reduction \%}^{105} = 1 - \frac{\text{Utility} \times \text{C}}{\text{EF} \times 10^{-6}}$$

EF = Emission Factor for the relevant fuel horsepower tier (g/hp-hr) Obtained from OFFROAD2007. See accompanying tables.

Emission Reduction Ranges and Variables:

Power Utility	Equipment Horsepower	Project GHG Emission Reductions
LADWP	< 25	2.5%
	25 – 50	46.5%

[105] This assumes energy from engine losses are the same.

Power Utility	Equipment Horsepower	Project GHG Emission Reductions
	50 – 120	45.9%
	120 –175	44.4%
	> 175	42.8%
PG&E	< 25	64.1%
	25 – 50	80.3%
	50 – 120	80.1%
	120 –175	79.5%
	> 175	78.9%
SCE	< 25	49.5%
	25 – 50	72.3%
	50 – 120	72.0%
	120 –175	71.2%
	> 175	70.4%
SDGE	< 25	38.5%
	25 – 50	66.3%
	50 – 120	65.9%
	120 –175	64.9%
	> 175	63.9%
SMUD	< 25	56.3%
	25 – 50	76.0%
	50 – 120	75.8%
	120 –175	75.1%
	> 175	74.3%

Criteria pollutants will be reduced by reduction in combustion. They will also increase through the increase in energy use. However, the increase may not be in the same air basin.

Discussion:

The output from OFFROAD2007 shows the same emissions within each horsepower tier regardless of the year modeled. Therefore, the emission reduction is dependent on the location of the Project and horsepower of the landscaping equipment only.

Assumptions:

Data based upon the following references:

California Air Resources Board. Off-road Emissions Inventory. OFFROAD2007. Available online at: http://www.arb.ca.gov/msei/offroad/offroad.htm

California Climate Action Registry Reporting Online Tool. 2006 PUP Reports. Available online at: https://www.climateregistry.org/CARROT/public/reports.aspx

Preferred Literature:

The amount of direct GHG emissions avoided can be calculated using CARB's OFFROAD model, which provides state-wide and regional emission factors for different types of landscaping equipment that can be converted to grams per horsepower-hour [1]. Multiplying this factor by the typical horsepower and load factor of the equipment and number of hours of operation gives the direct GHG emissions. Assuming the same number of operating hours and power output as the gas-powered equipment, the same amount of energy consumption multiplied by the carbon-intensity factor of the local utility gives the amount of indirect GHG emissions associated with using the electric landscape equipment. The GHG emissions reduction associated with this mitigation measure is therefore the difference in emissions from these two scenarios.

Companion Strategy:

In order to take credit for Mitigation Measure 80, a Project Applicant must also commit to providing electrical outlets on the exterior of all buildings (Mitigation Measure 60) so that electrical lawn equipment is compatible with built facilities.

Alternative Literature:

None

Notes:

1. CARB. OFFROAD 2007 Model. Available online at: http://www.arb.ca.gov/msei/offroad/offroad.htm. Accessed February 2010.

Other Literature Reviewed:

A. USEPA. Lawn Mower Exchange Program Calculator. Available online at: http://www.epa.gov/air/community/mowerexchange_calculator.html. Accessed February 2010.
B. USEPA. Improving Air Quality in Your Community: Outdoor Air – Transportation: Lawn Equipment. Available online at: http://www.epa.gov/air/community/details/yardequip.html. Accessed February 2010.
C. CARB. AB118 Lawn and Garden Equipment Replacement Project. Available online at: http://www.arb.ca.gov/msprog/aqip/lger.htm. Accessed February 2010.
D. SCAQMD. Mow Down Air Pollution Electric Lawn Mower Exchange. Available online at: http://www.aqmd.gov/tao/lawnmower2009.html. Accessed February 2010.
E. VCAPD. Lawn Mower Trade-In Program for Ventura County Residents. Available online at: http://www.vcapcd.org/LawnMower_EN.htm. Accessed February 2010.

F. SMAQMD. Mow Down Air Pollution. Available online at: http://www.airquality.org/mobile/mowdown/index.shtml. Accessed February 2010.

5.1.2 Implement Lawnmower Exchange Program

Range of Effectiveness: Best Management Practice, influences Area GHG emissions from landscape equipment

Measure Description:
When electric and rechargeable battery-powered lawnmowers are used in place of conventional gas-powered lawnmowers, direct GHG emissions from fuel combustion are displaced by indirect GHG emissions associated with the electricity used to power the equipment. The indirect GHG emissions from electricity generation are expected to be significantly less than the direct GHG emissions from gasoline or diesel fuel combustion. Since the magnitude of the GHG emissions reduction depends on the equipment model (including electric power efficiency and battery recharge time), hours of operation, fuel displaced, and number of lawnmowers replaced, the exact GHG emissions reduction is not quantifiable at this time. Therefore, this mitigation measure should be incorporated as a Best Management Practice to allow for educated residents and commercial tenants to reduce their contribution to GHG emissions from landscaping. Many California Air Districts, including eight air districts supported by the CARB Lawn and Garden Equipment Replacement (LGER) Project, already have lawnmower exchange programs in place. This Best Management Practice could involve participating in these established lawnmower exchange programs, supplementing the established programs, or implementing a new program for the Project. The Project Applicant should check with the local air district regarding participating in established programs. The Project Applicant could take quantitative credit for this mitigation measure if detailed and substantial evidence were provided.

Measure Applicability:
- GHG emissions from landscaping

Assumptions:
Data based upon the following references:

- CARB. AB118 Lawn and Garden Equipment Replacement Project. Available online at: http://www.arb.ca.gov/msprog/aqip/lger.htm. Accessed February 2010.
- SCAQMD. Mow Down Air Pollution Electric Lawn Mower Exchange. Available online at: http://www.aqmd.gov/tao/lawnmower2009.html. Accessed February 2010.
- VCAPD. Lawn Mower Trade-In Program for Ventura County Residents. Available online at: http://www.vcapcd.org/LawnMower_EN.htm. Accessed February 2010.
- SMAQMD. Mow Down Air Pollution. Available online at: http://www.airquality.org/mobile/mowdown/index.shtml. Accessed February 2010.

Emission Reduction Ranges and Variables:
This is a Best Management Practice and therefore there is no quantifiable reduction at this time. Check with local agencies for guidance on any allowed reductions associated with implementation of best management practices.

Preferred Literature:
CARB's Lawn and Garden Equipment Replacement (LGER) Project was established to encourage the use of cordless zero-emission lawn and garden equipment and to help bring more electric equipment to the market. The LGER Project provides vouchers for electric cordless residential lawn mowers valued up to $250 for each gas-powered lawnmower turned in. The LGER Project provides grants to eight air districts with existing lawnmower exchange programs, including AVAQMD, MDAQMD, SCAQMD, SDAPCD, SJVAPCD, SMAQMD, VCAPCD, and YSAQMD. Individual air districts may offer vouchers of different values.

Alternative Literature:

None

Other Literature Reviewed:

- USEPA. Lawn Mower Exchange Program Calculator. Available online at: http://www.epa.gov/air/community/mowerexchange_calculator.html. Accessed February 2010.
- USEPA. Improving Air Quality in Your Community: Outdoor Air – Transportation: Lawn Equipment. Available online at: http://www.epa.gov/air/community/details/yardequip.html. Accessed February 2010.

5.1.3 Electric Yard Equipment Compatibility

Range of Effectiveness: Best Management Practice, influences Area GHG emissions from landscape equipment. Not applicable on its own. This measure enhances effectiveness of A-1 and A-2.

Measure Description:

This measure is required to be grouped with measures A-1 "Prohibit Gas Powered Landscape Equipment" and A-2 "Implement a Lawnmower Exchange Program." In order for measures A-1 and A-2 to be feasible, electrical outlets on the exterior of buildings must be accessible so that the electric landscaping equipment can be charged. In this mitigation measure, the Project Applicant commits to providing electrical outlets on the exterior of Project buildings as necessary for sufficient powering of electric lawnmowers and other landscaping equipment.

Measure Applicability:

- This measure is part of a grouped measure
- This measure contributes to reductions in GHG emissions from landscaping

Emission Reduction Ranges and Variables:

This measure is a Best Management Practice grouped with other measures and therefore there is no quantifiable reduction at this time. Check with local agencies for guidance on any allowed reductions associated with implementation of Best Management Practices.

Preferred Literature:

None

6.0 Solid Waste

6.1 Sold Waste

6.1.1 Institute or Extend Recycling and Composting Services

Range of Effectiveness: Varies depending on Project Applicant and strategies selected. Best Management Practice.

Measure Description:
The transport and decomposition of landfill waste and the flaring of landfill gas all produce GHG emissions. Decomposition of waste produces methane, a GHG which has a global warming potential over 20 times that of CO_2. The transport of waste from the site of generation to the landfill produces GHG emissions from the combustion of the fuel used to power the vehicle. Choosing waste management practices which reduce the amount of waste sent to landfills will reduce GHG emissions. Strategies to reduce landfill waste include increasing recycling, reuse, and composting, and encouraging lifestyle choices and office practices which reduce waste generation.

Current protocols for quantifying emissions reductions from diverted landfill waste developed by the USEPA and the California Center for Integrated Waste Management Board (CIWMB) are based on life-cycle approaches, which reflect emissions and reductions in both the upstream and downstream processes around waste management. The Project Applicant should seek local agency guidance on comparing and/or combining operational emissions inventories and life cycle emissions inventories.

Furthermore, while tools are available to quantify the avoided landfill GHG emissions from a specified amount of diverted or recycled waste, taking credit for this mitigation measure also requires the determination of the effects of instituting or extending recycling and composting services. Since both government and privately-sponsored recycling and composting programs vary dramatically in scope, waste materials accepted, and outreach efforts, no literature references exist which provide default values for percent of waste diverted. To take credit for this measure, the Project Applicant would need to provide detailed and substantial evidence supporting the amount of waste reduced or diverted to recycling and composting due to the institution of extended recycling and composting services.

Measure Applicability:

[2] Solid waste disposed to landfill

Inputs:
The following information needs to be provided by the Project Applicant:

- For residential buildings: number of residents
- For shopping malls and office buildings: building square footage
- For public venues: annual number of visitors
- For all other commercial buildings: number of employees
- Waste disposal method
- Amount of waste reduced or diverted to recycling and composting due to the institution of extended recycling and composting services.

Baseline Method:
The Project Applicant must first calculate the total amount of waste generated at the project.

For residential buildings and all commercial buildings except shopping malls and offices:

$$Waste_{baseline\ total} = People \times DisposalRate$$

For shopping malls and office buildings:

$$Waste_{baseline\ total} = SF \times DisposalRate$$

Where:

People = Number of residents, employees, or visitors (for public venues)
Provided by Applicant
SF = Square feet of building
Provided by Applicant
DisposalRate = Annual disposal rate of waste (tons/resident/year, tons/employee/year, or tons/visitor/year)
From Tables SW-1.1 and SW-1.2

The total waste stream is then portioned into material-specific streams (paper, glass, metal, plastic, etc.) using the percentages listed in Table SW-1.3.

USEPA's Waste Reduction Model (WARM) is used to quantify baseline emissions and emissions reductions from diverting landfill waste to composting or recycling. This web-based tool is available online at http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html. The required inputs are the tons of waste associated with one of three waste management practices: landfill (baseline scenario), recycled (mitigated scenario), combusted (not applicable in California), and composted (mitigated scenario). The amount of each type of waste in tons is entered into the "Tons Landfilled" column in the Baseline Scenario of

WARM to calculate the baseline GHG emissions in metric MT carbon equivalent (MTCE). Other input variables include landfill type (presence of landfill gas control system or not) and distance of waste transport; however, default values can be used.

Mitigation Method:
In WARM, the project applicant specifies the amount of waste associated with each of the three alternative scenarios: waste reduced (e.g. reduced waste generation), waste recycled, and waste composted. WARM then calculates the GHG savings associated with the alternative scenarios as compared with the baseline scenario.

Assumptions:
Data based upon the following reference:

- USEPA. 2009. Waste Reduction Model. Available online at: http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html
- CIWMB. 1999. Statewide Waste Characterization Study: Final Results and Report. Available online at: http://www.calrecycle.ca.gov/publications/LocalAsst/34000009.pdf
- CIWMB. 2006. Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups. Available online at: http://www.ciwmb.ca.gov/WasteChar/WasteStudies.htm#2006Industry

Preferred Literature:
USEPA's WARM was developed to track GHG emission reductions from various waste management options. This tool calculates the GHG emissions associated with a baseline waste management strategy, as well as those associated with an alternative strategy that may include source reduction, recycling, composting, combusting, or landfilling. WARM then calculates the GHG savings associated with the alternative strategy as compared with the baseline strategy. WARM requires input of the estimated tons of waste per material type per disposal strategy. There are 34 different material types (e.g., aluminum cans, mixed paper, yard trimmings, carpet). Other input variables include landfill type (presence of landfill gas control system or not) and distance of waste transport; however, default values can be used. Note that WARM was developed based on a life-cycle approach, which reflects emissions and reductions in both the upstream and downstream processes around waste management. USEPA notes that emission factors developed based on this life cycle approach are not appropriate for use in GHG inventories.

Alternative Literature:
None

Other Literature Reviewed:

- HF&H Consultants. 2008. 5-Year Audit Program Assessment and Final Report. Prepared for StopWaste.Org. Available online at: http://www.stopwaste.org/docs/revised_assessment_report-final_1-08.pdf
- StopWaste.Org. 2008. Multifamily Dwelling Recycling Evaluation Report. Available online at: http://www.stopwaste.org/docs/mfd_evaluation_rpt.pdf

Table SW-1.1
Residential Waste Disposal Rates

Multi-family Homes		
All Counties	All Regions	**Annual Disposal Rate (tons/resident/year)**
		0.46

Single-family Homes		
County	**Region**	**Annual Disposal Rate (tons/resident/year)**
Alameda	Bay Area	0.42
Alpine	Mountain	0.25
Amador	Mountain	0.25
Butte	Central Valley	0.36
Calaveras	Mountain	0.25
Colusa	Central Valley	0.36
Contra Costa	Bay Area	0.42
Del Norte	Coastal	0.44
El Dorado	Mountain	0.25
Fresno	Central Valley	0.36
Glenn	Central Valley	0.36
Humbolt	Coastal	0.44
Imperial	Southern	0.41
Inyo	Mountain	0.25
Kern	Southern	0.41
Kings	Central Valley	0.36
Lake	Central Valley	0.36
Lassen	Mountain	0.25
Los Angeles	Southern	0.41
Madera	Central Valley	0.36
Marin	Bay Area	0.42
Mariposa	Mountain	0.25
Mendocino	Coastal	0.44
Merced	Central Valley	0.36
Modoc	Mountain	0.25
Mono	Mountain	0.25

Single-family Homes		
County	**Region**	**Annual Disposal Rate (tons/resident/year)**
Monterey	Coastal	0.44
Napa	Bay Area	0.42
Nevada	Mountain	0.25
Orange	Southern	0.41
Placer	Central Valley	0.36
Plumas	Mountain	0.25
Riverside	Southern	0.41
Sacramento	Central Valley	0.36
San Benito	Coastal	0.44
San Bernardino	Southern	0.41
San Diego	Southern	0.41
San Francisco	Bay Area	0.42
San Joaquin	Central Valley	0.36
San Luis Obispo	Southern	0.41
San Mateo	Bay Area	0.42
Santa Barbara	Southern	0.41
Santa Clara	Bay Area	0.42
Santa Cruz	Coastal	0.44
Shasta	Mountain	0.25
Sierra	Mountain	0.25
Siskiyou	Mountain	0.25
Solano	Bay Area	0.42
Sonoma	Coastal	0.44
Stanislaus	Central Valley	0.36
Sutter	Central Valley	0.36
Tehama	Central Valley	0.36
Trinity	Mountain	0.25
Tulare	Central Valley	0.36
Tuolumne	Mountain	0.25
Ventura	Southern	0.41
Yolo	Central Valley	0.36
Yuba	Central Valley	0.36

Source:

Single-family Homes		
County	**Region**	**Annual Disposal Rate (tons/resident/year)**

CalRecycle. Solid Waste Characterization Database: Residential Waste Disposal Rates. Available online at: http://www.calrecycle.ca.gov/wastechar/Resdisp.htm

CIWMB. 1999. Statewide Waste Characterization Study: Final Results and Report. Available online at: http://www.calrecycle.ca.gov/publications/LocalAsst/34000009.pdf.

Table SW-1.2
Commercial Waste Disposal Rates

Commercial Industry	Annual Disposal Rate	
Fast-Food Restaurants	2.1	tons/employee/year
Full-Service Restaurants	2.2	tons/employee/year
Food Stores	2.4	tons/employee/year
Durable Wholesale Distributors	1.2	tons/employee/year
Non-Durable Wholesale Distributors	1.4	tons/employee/year
Large Hotels	2.0	tons/employee/year
Building Material & Gardening, Big-Box Stores	3.2	tons/employee/year
Building Material & Gardening, Other Stores	1.7	tons/employee/year
Retail, Big-Box Stores	1.4	tons/employee/year
Retail, Other Stores	0.9	tons/employee/year
Shopping Malls, Anchor Stores	1.1	tons/1,000 sqft/year
Shopping Malls, Other	1.0	tons/1,000 sqft/year
Public Venues and Events	0.1	tons/100 visitors/year
Large Office Buildings	0.9	tons/1,000 sqft/year

Abbreviations:
lb - pound
sqft - square feet

Source:

CIWMB. 2006. Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups. Table 2. Available online at: http://www.ciwmb.ca.gov/WasteChar/WasteStudies.htm#2006Industry

Table SW-1.3
Waste Streams and Percent of Disposed Waste

Building Category	Disposed Waste Streams							
	Paper [Mixed Paper, Broad Definition]	Glass [Glass]	Metal [Mixed Metals]	Plastic [Mixed Plastics]	Electronics [Personal Computers]	Organics [Mixed Organics]	Construction & Demolition [Clay Bricks, Concrete]	Household Hazardous, Special, and Mixed Residue [Mixed MSW]
Residential	27.4%	4.0%	4.6%	8.8%	n/a	45.0%	4.5%	5.5%
Fast-Food Restaurants	33.0%	0.6%	1.6%	11.6%	0.0%	52.5%	0.6%	0.0%
Full-Service Restaurants	17.3%	2.7%	2.8%	7.3%	0.1%	66.5%	1.8%	1.5%
Food Stores	18.5%	0.5%	1.4%	9.5%	0.0%	65.0%	5.0%	0.0%
Durable Wholesale Distributors	26.3%	0.7%	11.4%	9.9%	0.5%	5.4%	43.5%	2.4%
Non-Durable Wholesale Distributors	26.5%	0.5%	3.3%	16.0%	2.6%	32.7%	18.4%	0.1%
Large Hotels	32.3%	4.7%	3.8%	9.7%	0.4%	44.2%	4.8%	0.1%
Building Material & Gardening, Big-Box Stores	12.2%	1.9%	8.3%	7.1%	1.2%	8.0%	60.1%	1.2%
Building Material & Gardening, Other Stores	13.4%	5.3%	3.9%	7.1%	1.9%	18.6%	47.4%	2.3%
Retail, Big-Box Stores	21.7%	1.1%	5.3%	16.0%	0.8%	23.6%	27.1%	4.4%
Retail, Other Stores	31.8%	6.2%	8.7%	14.4%	0.7%	17.5%	15.0%	5.7%
Shopping Malls, Anchor Stores	37.9%	5.0%	3.0%	28.8%	0.1%	15.5%	9.1%	0.5%
Shopping Malls, Other	32.7%	1.8%	2.3%	19.6%	0.2%	35.9%	5.3%	2.0%
Public Venues and Events	42.0%	5.5%	1.8%	14.8%	0.0%	34.0%	0.7%	1.2%
Large Office Buildings	50.3%	1.8%	1.6%	12.5%	0.1%	24.4%	8.3%	1.1%

Abbreviations:
MSW - municipal solid waste

Notes:
The USEPA report identifies waste streams with slightly different names than the CIWMB report. The CIWMB and USEPA waste stream categories were paired; USEPA categories are shown in brackets [ ] above.

Sources:
CIWMB. 1999. Statewide Waste Characterization Study: Final Results and Report. Available online at: http://www.calrecycle.ca.gov/publications/LocalAsst/34000009.pdf
CIWMB. 2006. Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups. Available online at: http://www.ciwmb.ca.gov/WasteChar/WasteStudies.htm#2006Industry
USEPA. 2006. Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks. Available online at: http://www.epa.gov/climatechange/wycd/waste/SWMGHGreport.html

6.1.2 Recycle Demolished Construction Material

Range of Effectiveness: Varies depending on Project Applicant and strategies selected. Best Management Practice.

Measure Description:
Recycling demolished construction material can contribute to GHG reductions in multiple ways. First, it displaces new construction materials, thereby reducing the need for new raw material acquisition and manufacturing of those new construction materials. Harvesting of raw materials and manufacturing new materials requires energy in the form of fuel combustion and electricity, both of which are associated with GHG emissions. If the process of recycling construction materials is less carbon-intensive than the processes required to harvest and produce new construction materials, recycling these construction materials results in a net reduction in GHG emissions. Second, using local recycled construction material reduces the emissions associated with the transportation of new construction materials, which are typically manufactured farther away from a project site. Third, recycling construction material avoids sending this material to landfills. Wood-based materials decompose in landfills and contribute to methane emissions.

Unlike measures which reduce GHG emissions during the operational lifetime of a project, such as reducing building electricity and water usage, this mitigation effort is realized prior to the actual operational lifetime of a project. Therefore, these GHG emissions reductions are best quantified in terms of a life-cycle analysis. Life cycle analyses examine all stages of the life of a product, including raw material acquisition, manufacture, transportation, installation, use, and disposal or recycling. The Project Applicant should seek local agency guidance on comparing and/or combining operational emissions inventories and life cycle emissions inventories.

Measure Applicability:

- Life cycle emissions from construction materials

Preferred Literature:
The California Integrated Waste Management Board (CIWMB) cites decreases in greenhouse gas emissions as a benefit of construction waste management and recycling in its document “Construction Waste Management” which is used as part of California Sustainable Design Training. The document is available online at: www.calrecycle.ca.gov/greenbuilding/training/statemanual/waste.doc

Alternative Literature:
None

Other Literature Reviewed:
None

7.0 Vegetation

7.1 Vegetation

7.1.1 Urban Tree Planting

Range of Effectiveness: CO_2 reduction varies by the number of trees. VOC emissions may increase.

Measure Description:

Planting trees sequesters CO_2 while the trees are actively growing. The amount of CO_2 sequestered depends on the type of tree. IPCC indicates that in most cases, the active growing period of a tree is 20 years and after this time the amount of carbon in biomass slows and will be completely offset by losses from clipping, pruning, and occasional death [1]. Therefore, the emissions only occur for a 20 year period and are summed over all years to give a net one-time GHG benefit.

If large areas of trees will be planted, the lead agency may want to ensure enforceability by requiring submission of annual inventory consistent with the Urban Forest Protocol [2]. This is a comprehensive protocol that requires maintenance and replacement of trees. If the Project Applicant desires to use this approach, calculation methodologies and assumptions presented in the protocol should be used. The information required to implement this protocol is often not available at the time of the CEQA process.

The type of tree species planted will result in varying degrees of carbon sequestration. In addition, trees emit volatile organic compounds (VOCs), which are criteria pollutant precursors. Therefore the Project Applicant may want to consider these issues when selecting the type of tree to plant. See [3] for details on low-VOC trees.

Measure Applicability:

- New trees

Inputs:

The following information needs to be provided by the Project Applicant:

- Species classes of trees planted, if known
- Number of net new trees in each species class, if known
- Total number of net new trees

Baseline Method:

In the baseline case, there are no net new trees planted.

Mitigation Method:

Look up default annual CO_2 sequestration rates on a per tree basis:

Broad species class	Default annual CO_2 accumulation per tree[1] (MT CO_2/ year)
Aspen	0.0352
Soft maple	0.0433
Mixed hardwood	0.0367
Hardwood maple	0.0521
Juniper	0.0121
Cedar/larch	0.0264
Douglas fir	0.0447
True fir/Hemlock	0.0381
Pine	0.0319
Spruce	0.0337
Miscellaneous[2]	0.0354

1. IPCC's carbon (C) values converted to carbon dioxide (CO_2) using ratio of molecular weights (44/12).
2. Average of all other broad species classes. To be assumed if tree type is not known.

Therefore, the reduction in GHG emissions associated with planting new trees is:

$$\text{GHG emission reduction} = (\text{Growing Period} \times \sum_{i=1}^{n} [\,\text{Sequestration } i \times \text{Trees } i\,]\,) \div \text{Total GHG emissions}$$

Where:

GHG emission reduction	=	Percentage reduction in GHG emissions as compared to total GHG emissions.
Growing Period	=	Growing period for all trees, expressed in years (20).
n	=	Number of broad species classes. Provided by Applicant.
Sequestration *i*	=	Default annual CO_2 accumulation per tree for broad species class *i*. Lookup in table above.
Trees *i*	=	Number of net new trees of broad species class *i*.
Total GHG emissions	=	Total GHG emissions. Provided by Applicant.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	Varies based on number of trees
VOC	May increase
All other pollutants	Not Quantified

Discussion:

If the applicant has baseline total project emissions of 5,000 MT CO_2e per year, and if the applicant elects to mitigate GHG emissions by committing to planting 500 net new "miscellaneous" trees, the applicant would reduce the amount of GHG emissions associated with the project by 7%.

$$\text{GHG Emission Reduced} = \frac{20 \times 0.0354 \times 500}{5{,}000} = 0.07 \text{ or } 7\%$$

Assumptions:

Data based upon the following reference:

[1] IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Table 8.2. Available online at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_08_Ch8_Settlements.pdf

Preferred Literature:

The IPCC Guidelines [1] provide a method for estimating the amount of carbon sequestered by trees. IPCC default annual CO_2 sequestration rates on a per tree basis are used. Table 8.2 of the IPCC Guidelines provides species class-specific sequestration values. For species that do not appear or if the species is unknown, the average value from Table 8.2 (0.035 MT CO_2 per year per tree) can be assumed to be representative of trees planted. Urban trees are only net carbon sinks when they are actively growing. The IPCC assumes an active growing period of 20 years (see p. 8.9). Thereafter, the accumulation of carbon in biomass slows with age, and will be completely offset by losses from clipping, pruning, and occasional death. Actual active growing periods are subject to, among other things, species, climate regime, and planting density. Additional credit may be taken for planting native trees. See WUW-3 for details on the design of water-efficient landscaping.

Alternative Literature:

The Center for Urban Forest Research Tree Carbon Calculator is based on a small set of data and extrapolates annual tree girth increases for various tree species [1]. Furthermore, it extrapolates the amount of carbon associated with a given girth for each tree species. This method is based on extrapolation of a limited dataset. In addition it requires considerably more input requirements that may not be available for CEQA projects. These inputs include knowledge of specific tree species that will be planted and assumptions regarding anticipated growth rates. Considering the order of magnitude of mitigation from this option, the additional complexity of this method would not generally be warranted for most CEQA projects.

The CAR Urban Forest Sector Protocol [2] provides guidelines for estimating the amount of CO_2 sequestered by common California tree species. This methodology would require Project Applicants to know the tree species to be planted at the time the CEQA analysis is prepared. Furthermore, this methodology would require Project Applicants to estimate the expected diameter of trees, which is dependent on climate and tree sub-species, among other things.

Alternative Literature References:

[2] CAR. 2010. Urban Forest Project Protocol Version 1.1. Available online at: http://www.climateactionreserve.org/how/protocols/adopted/urban-forest/current-urban-forest-project-protocol/

[3] The Center for Urban Forest Research Tree Carbon Calculator. Available online at: http://www.fs.fed.us/ccrc/topics/urban-forests/

Other Literature Reviewed:

None

7.1.2 Create New Vegetated Open Space

Range of Effectiveness: varies based on amount and type of land vegetated

Measure Description:

A development which re-vegetates or creates vegetated land from previously settled land sequesters CO_2 from the atmosphere which would not have been captured had there been no land-type change. There is no reduction in GHG emissions associated with preservation of a land.

Measure Applicability:

- Open space

Inputs:

The following information needs to be provided by the Project Applicant:

- Types of land uses created
- Acres of each land use created

Baseline Method:

In the baseline case, there is no preserved or created open space.

Mitigation Method:

Lookup carbon dioxide sequestered per acre for each land use that will be preserved or created:

Land Use	Sub-Category	Default annual CO_2 accumulation per acre[1] (MT CO_2/ acre)
Forest Land	Scrub	14.3
	Trees	111
Cropland	--	6.9
Grassland	--	4.31
Wetlands	--	0

1. Calculated by multiplying total biomass (MT dry matter/acre) from IPCC data by the carbon fraction in plant material (0.47), then using the ratio of molecular weights (44/12) to convert from MT of carbon (C) to MT of carbon dioxide (CO_2).

Land uses are defined by IPCC as follows:

(i) Forest Land

This category includes all land with woody vegetation consistent with thresholds used to define Forest Land in the national greenhouse gas inventory. It also includes systems with a vegetation structure that currently fall below, but *in situ* could potentially reach the threshold values used by a country to define the Forest Land category.

(ii) Cropland

This category includes cropped land, including rice fields, and agro-forestry systems where the vegetation structure falls below the thresholds used for the Forest Land category.

(iii) Grassland

This category includes rangelands and pasture land that are not considered Cropland. It also includes systems with woody vegetation and other non-grass vegetation such as herbs and brushes that fall below the threshold values used in the Forest Land category. The category also includes all grassland from wild lands to recreational areas as well as agricultural and silvi-pastural systems, consistent with national definitions.

(iv) Wetlands

This category includes areas of peat extraction and land that is covered or saturated by water for all or part of the year (e.g., peatlands) and that does not fall into the Forest Land, Cropland, Grassland or Settlements categories. It includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions.

$$\text{GHG emission reduction} = \left(\sum_{i=1}^{n} [\ \text{Sequestration } i \times \text{Acres } i\ ] \right) \div \text{Total GHG emissions}$$

Where:

GHG emission reduction = Percentage reduction in GHG emissions as compared to total GHG emissions.

n = Number of land uses. Provided by Applicant.

Sequestration *i* = Default annual CO_2 accumulation per acre for land use *i.* Look up in table above.

Acres *i* = Number of acres of land use *i.*

Total GHG emissions = Total one-time GHG emissions. Provided by Applicant.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	Varies
All other pollutants	Not Quantified

Discussion:

If the applicant has baseline one-time emissions of 5,000 MT CO_2e per year, and if the applicant elects to mitigate GHG emissions by committing to creating 50 acres of forest land (scrub) and 20 acres of grassland, the applicant would reduce the amount of one-time GHG emissions by 16%.

$$\text{GHG Emission Reduced} = \frac{14.3 \times 50 + 4.31 \times 20}{5,000} = 0.16 \text{ or } 16\%$$

Assumptions:

Data based upon the following references:

[1] IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4. Available online at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html

Preferred Literature:

The IPCC Guidelines provide a method for calculating changes in CO_2 sequestration due to land-type conversions. While other methods exist, notably the CCAR Forest Protocol [2], the IPCC Guidelines [1] have more general default values available that will be applicable to all areas of California without requiring detailed site-specific information. A general knowledge of the proposed change in land type is sufficient to quantify reductions in greenhouse gas emissions. IPCC designates four general vegetation types: forest land, cropland, grassland, and wetland. The amount of sequestered CO_2 is calculated based on the amount of carbon stock in each type of biomass (MT carbon / hectare vegetation). IPCC defaults for the carbon stock in each vegetation type are summarized in Table 8.4. (Note that this table represents the amount of carbon removed due to land conversion to settlements; it can also be used to calculate the amount of carbon sequestered due to conversion from settlement to vegetated land. Note also that a conversion to wetlands is not relevant for California). In addition to general default values, the IPCC Guidelines have climate and species-specific data available which can be used if details of the proposed development are known. To calculate the final mass of CO_2, the mass of carbon is then multiplied by 3.67, which is the ratio of molecular mass of CO_2 to the molecular mass of carbon. This method assumes that all of the carbon is converted into CO_2, which is appropriate for most CEQA projects.

Alternative Literature:

The CAR Forest Sector Protocol provides guidelines for estimating the amount of CO_2 sequestered by vegetated land [1]. The Protocol is specific to forest land only, and is not appropriate for estimating land-type conversions to or from cropland or grassland. Additionally, the methodology is limited to conversions from vegetated land to settlement or settlement to vegetated land, but is not appropriate for changes from one vegetated land type to another vegetated land type. The Protocol recommends accounting for changes in the organic carbon content of soil, which requires soil sampling and testing. While testing of existing soil is feasible, the protocol does not provide adequate methods for predicting the future soil organic carbon content after a land-type conversion has taken places. Furthermore, soil testing may be a burdensome task for a Project Applicant. Methodologies which provide default values, such as the IPCC Guidelines, are preferable.

Alternative Literature References:

[2] CAR. 2010. Urban Forest Project Protocol Version 1.1. Available online at: http://www.climateactionreserve.org/how/protocols/adopted/urban-forest/current-urban-forest-project-protocol/

Other Literature Reviewed:

None

8.0 Construction

8.1 Construction

8.1.1 Use Alternative Fuels for Construction Equipment

Range of Effectiveness: 0 – 22% reduction in GHG emissions

Measure Description:

When construction equipment is powered by alternative fuels such as compressed natural gas rather than conventional petroleum diesel or gasoline, GHG emissions from fuel combustion may be reduced.

Measure Applicability:

[3] Construction vehicles

Inputs:

The following information needs to be provided by the Project Applicant:

- Fuel type and Horsepower of Construction Equipment
- Hours of operation

Baseline Method:

For all pollutants besides ROG emissions from gasoline-fueled equipment, total emission is equivalent to exhaust emission and is calculated as follows:

$$\text{Exhaust Emission} = \frac{\text{Exhaust}}{\text{Activity} \times \text{AvgHP}} \times \text{Hp} \times \text{Hr} \times \text{C}$$

Where:

Exhaust Emission= MT or tons of pollutant per year

Exhaust = Statewide daily emission from equipment for the relevant horsepower tier of diesel or gasoline fuel (tons/day). Obtained from OFFROAD2007.

Activity = Statewide daily average operating hours for the relevant horsepower tier (hours/day). Obtained from OFFROAD2007.

AvgHP = Average horsepower for the relevant horsepower tier (HP). Obtained from OFFROAD2007.

Hp = Horsepower of equipment.

Hr = Hours of operation.

C = Unit conversion factor

Note that this method assumes the load factor of the equipment is same as the default in OFFROAD2007.

Total GHG emission is calculated as follows:

$$\text{GHG Emission} = CO_2 \text{ Emission} + CH_4 \text{ Emission} \times 21 + N_2O \text{ Emission} \times 310$$

Where:

GHG Emission = MT CO_2e
CO_2 Emission = CO_2 emission calculated as described above with data from OFFROAD2007.
CH_4 Emission = CH_4 emission calculated as described above with data from OFFROAD2007.
N_2O Emission = N_2O emission calculated as described above with data from OFFROAD2007.
21 = Global warming potential of CH_4 following CCAR GPR 2009.
310 = Global warming potential of N_2O following CCAR GPR 2009.

Total ROG emission from gasoline-fueled equipment is calculated as follows:

$$\text{Total ROG Emission} = \text{Exhaust ROG Emission} + \frac{\text{Resting} + \text{Diurnal} + \text{Hot Soak} + \text{Evaporative}}{\text{Activity} \times \text{AvgHP}} \times \text{Hp} \times \text{Hr} \times \text{C}$$

Where:

Total ROG Emission = Tons of ROG emission per year
Exhaust ROG Emission = ROG emission from exhaust calculated as described above (tons/year)
Resting = Statewide daily resting losses from equipment for the relevant horsepower tier (tons/day). Obtained from OFFROAD2007.
Diurnal = Statewide daily diurnal losses from equipment for the relevant horsepower tier (tons/day). Obtained from OFFROAD2007.
Hot Soak = Statewide daily hot soak losses from equipment for the relevant horsepower tier (tons/day). Obtained from OFFROAD2007.
Evaporative = Statewide daily evaporative losses from equipment for the relevant horsepower tier (tons/day). Obtained from OFFROAD2007.
Activity = Statewide daily average operating hours for the relevant horsepower tier (hours/day). Obtained from OFFROAD2007.
AvgHP = Average horsepower for the relevant horsepower tier (HP). Obtained from OFFROAD2007.
Hp = Horsepower of TRU.
Hr = Hours of operation.
C = Unit conversion factor

Mitigation Method:

Mitigated emissions for this measure are calculated using the same method as baseline method, but with emission factors from compressed natural gas in OFFROAD2007.

Emission Reduction Ranges and Variables:

GHG and criteria pollutant emission reductions from switching diesel or gasoline fuel to compressed natural gas fuel for different years are listed in accompanying tables. Only equipment with emission data for compressed natural gas and either diesel or gasoline fuel in OFFROAD2007 are included.

Discussion:

The emission changes vary over a large range for different pollutants and equipment and between diesel and gasoline. In fact, GHG emissions for several types of equipment running on gasoline and all equipment running on diesel would increase from switching to compressed natural gas, as reflected by the negative reductions in the tables. On the other hand, SO_2 emissions are 100% reduced as there is no SO_2 emissions from equipment running on compressed natural gas according to OFFROAD2007. Other trends include no significant change in PM emissions for most gasoline equipment, considerable decrease in CO emissions from gasoline equipment but significant increase in CO emissions from diesel equipment. Therefore, the Project Applicant has to weigh the costs and benefits from switching to compressed natural gas on a case-by-case basis.

Assumptions:

Data based upon the following references:

- California Air Resources Board. Off-road Emissions Inventory. OFFROAD2007. Available online at: http://www.arb.ca.gov/msei/offroad/offroad.htm
- California Climate Action Registry (CCAR). 2009. General Reporting Protocol. Version 3.1. Available online at: http://www.climateregistry.org/tools/protocols/general-reporting-protocol.html
  California Climate Action Registry Reporting Online Tool. 2006 PUP Reports. Available online at: https://www.climateregistry.org/CARROT/public/reports.aspx

Preferred Literature:

GHG emissions from the combustion of conventional petroleum diesel and gasoline fuel can be calculated using CARB's OFFROAD model emission factors [1]. The model provides state-wide and regional emission factors that can be converted to grams per horsepower-hour. Multiplying this factor by the typical horsepower of the equipment and the estimated number of hours of operation gives the total GHG emissions. In this mitigation measure, compressed natural gas was chosen as the alternative fuel. Emission factors for compressed natural gas can also be obtained from OFFROAD The

GHG emissions reduction associated with this mitigation measure is therefore the difference in emissions from using petroleum diesel or gasoline versus using compressed natural gas. Other types of alternative fuels besides compressed natural gas exist. In order to take credit for this mitigation measure, the Project Applicant would need to provide detailed and substantial documentation showing expected reductions in GHG emissions as a result of running construction equipment on these alternative fuels rather than petroleum diesel or gasoline. One potential issue with quantifying this mitigation measure is the difference in fuel economy between petroleum diesel and alternative fuels.

Alternative Literature:

Many USDOE, NREL, and USEPA reports exist which present data on exhaust emissions from engines operating with alternative fuels. The majority of these reports focuses on oxides of nitrogen (NOx) and particulate matter (PM) emissions and have limited CO_2 emissions and fuel economy data. One NREL report shows CO_2 emissions and fuel economy for three ethanol/diesel blends (7.7%, 10%, and 15%) in three off-road engines (6.8, 8.1, and 12.5 L) and compares the results to engine performance using conventional diesel fuel [5]. However, this report presented engine-specific data from a small study size. Issues with other reports include the study's focus on on-road engines rather than off-road engines which would be used in construction equipment. It would be difficult to generalize the data contained in these reports for a Project Applicant's ease of use.

Notes:

[1] CARB. OFFROAD 2007 Model. Available online at: http://www.arb.ca.gov/msei/offroad/offroad.htm. Accessed February 2010.

Other Literature Reviewed:

[2] USEPA. 2002. A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions. Available online at: http://www.epa.gov/otaq/models/analysis/biodsl/p02001.pdf
[3] USDOE. NREL: ReFUEL Laboratory: Data and Resources. Available online at: http://www.nrel.gov/vehiclesandfuels/refuellab/data_resources.html. Accessed March 2010.
[4] USDOE. 2006. NREL: Effects of Biodiesel Blends on Vehicle Emissions. Available online at: http://www.nrel.gov/vehiclesandfuels/npbf/pdfs/40554.pdf
[5] USDOE. 2003. NREL: The Effect of Biodiesel Composition on Engine Emissions from a DDC Series 60 Diesel Engine. Available online at: http://www.nrel.gov/vehiclesandfuels/npbf/pdfs/31461.pdf

Table C-1.1
Emission Reduction Due to Fuel Switch from Gasoline to Compressed Natural Gas

Equipment	Horsepower	2004					
		CO	CO_2e	NOx	PM	ROG	SO_2
Aerial Lifts	<15	59%	-27%	36%	91%	98%	100%
	15 - 25	61%	-40%	7%	90%	97%	100%
Air Conditioner	< 175	24%	14%	19%	0%	97%	100%
Baggage Tug	< 120	46%	15%	-4%	0%	93%	100%
Belt Loader	< 120	52%	18%	3%	0%	95%	100%
Bobtail	< 120	55%	17%	19%	0%	95%	100%
Cargo Loader	< 120	41%	16%	2%	0%	93%	100%
Catering Truck	< 250	31%	12%	25%	0%	94%	100%
Forklifts	< 25	53%	-46%	23%	-85%	92%	100%
	25 - 50	94%	22%	-33%	0%	97%	100%
	50 - 120	58%	19%	18%	0%	96%	100%
	120 - 175	24%	17%	24%	0%	94%	100%
Fuel Truck	<175	3%	18%	17%	0%	99%	100%
Generator Sets	<120	52%	18%	14%	0%	96%	100%
	120 - 175	22%	14%	21%	0%	95%	100%
Lav Truck	<175	32%	18%	17%	0%	94%	100%
Lift	<120	53%	17%	14%	0%	96%	100%
Passenger Stand	<175	27%	15%	22%	0%	96%	100%
Service Truck	<250	13%	16%	26%	0%	95%	100%

Equipment	Horsepower	2010					
		CO	CO_2e	NOx	PM	ROG	SO_2
Aerial Lifts	<15	58%	-27%	39%	91%	96%	100%
	15 - 25	58%	-37%	32%	90%	95%	100%
Air Conditioner	< 175	29%	14%	19%	0%	98%	100%
Baggage Tug	< 120	13%	13%	-114%	0%	84%	100%
Belt Loader	< 120	27%	15%	-82%	0%	91%	100%
Bobtail	< 120	29%	16%	11%	0%	96%	100%
Cargo Loader	< 120	15%	14%	-70%	0%	89%	100%
Catering Truck	< 250	35%	12%	29%	0%	95%	100%
Forklifts	< 25	53%	-51%	3%	-85%	85%	100%
	25 - 50	95%	22%	18%	0%	98%	100%
	50 - 120	52%	18%	5%	0%	95%	100%
	120 - 175	27%	14%	23%	0%	94%	100%
Fuel Truck	<175	9%	16%	15%	0%	100%	100%
Generator Sets	<120	40%	17%	16%	0%	97%	100%
	120 - 175	26%	14%	23%	0%	95%	100%
Lav Truck	<175	36%	15%	-18%	0%	94%	100%
Lift	<120	44%	17%	16%	0%	96%	100%

Passenger Stand	<175	32%	15%	25%	0%	97%	100%
Service Truck	<250	19%	14%	40%	0%	95%	100%

Equipment	Horsepower	2015					
		CO	CO_2e	NOx	PM	ROG	SO_2
Aerial Lifts	<15	58%	-27%	39%	91%	96%	100%
	15 - 25	58%	-37%	32%	90%	94%	100%
Air Conditioner	< 175	31%	13%	23%	0%	99%	100%
Baggage Tug	< 120	8%	14%	-93%	0%	85%	100%
Belt Loader	< 120	22%	16%	-69%	0%	92%	100%
Bobtail	< 120	25%	16%	13%	0%	96%	100%
Cargo Loader	< 120	5%	14%	-91%	0%	88%	100%
Catering Truck	< 250	38%	11%	33%	0%	95%	100%
Forklifts	< 25	53%	-51%	3%	-85%	84%	100%
	25 - 50	95%	22%	34%	0%	98%	100%
	50 - 120	52%	18%	6%	0%	95%	100%
	120 - 175	27%	14%	25%	0%	95%	100%
Fuel Truck	<175	12%	15%	13%	0%	100%	100%
Generator Sets	<120	21%	16%	17%	0%	97%	100%
	120 - 175	29%	13%	24%	0%	96%	100%
Lav Truck	<175	36%	15%	-24%	0%	95%	100%
Lift	<120	37%	16%	16%	0%	96%	100%
Passenger Stand	<175	34%	14%	28%	0%	98%	100%
Service Truck	<250	22%	13%	46%	0%	96%	100%

Equipment	Horsepower	2020					
		CO	CO_2e	NOx	PM	ROG	SO_2
Aerial Lifts	<15	58%	-27%	39%	91%	96%	100%
	15 - 25	58%	-37%	32%	90%	94%	100%
Air Conditioner	< 175	32%	13%	24%	0%	99%	100%
Baggage Tug	< 120	7%	15%	-49%	0%	89%	100%
Belt Loader	< 120	21%	16%	-27%	0%	94%	100%
Bobtail	< 120	26%	16%	13%	0%	96%	100%
Cargo Loader	< 120	3%	15%	-62%	0%	91%	100%
Catering Truck	< 250	39%	11%	36%	0%	96%	100%
Forklifts	< 25	53%	-51%	3%	-85%	84%	100%
	25 - 50	95%	22%	36%	0%	98%	100%
	50 - 120	52%	18%	8%	0%	95%	100%
	120 - 175	27%	14%	26%	0%	95%	100%
Fuel Truck	<175	12%	14%	9%	0%	100%	100%
Generator Sets	<120	-5%	16%	17%	0%	98%	100%
	120 - 175	30%	13%	25%	0%	97%	100%
Lav Truck	<175	36%	15%	3%	0%	96%	100%

Lift	<120	30%	16%	15%	0%	97%	100%
Passenger Stand	<175	35%	14%	30%	0%	98%	100%
Service Truck	<250	23%	13%	42%	0%	96%	100%

Equipment	Horsepower	2025					
		CO	CO_2e	NOx	PM	ROG	SO_2
Aerial Lifts	<15	58%	-27%	39%	91%	96%	100%
	15 - 25	58%	-37%	32%	90%	94%	100%
Air Conditioner	< 175	32%	13%	27%	0%	99%	100%
Baggage Tug	< 120	8%	15%	-27%	0%	92%	100%
Belt Loader	< 120	21%	17%	-7%	0%	96%	100%
Bobtail	< 120	25%	16%	13%	0%	96%	100%
Cargo Loader	< 120	3%	16%	-40%	0%	93%	100%
Catering Truck	< 250	39%	11%	36%	0%	96%	100%
Forklifts	< 25	53%	-51%	3%	-85%	84%	100%
	25 - 50	95%	21%	36%	0%	98%	100%
	50 - 120	52%	18%	8%	0%	95%	100%
	120 - 175	27%	14%	26%	0%	95%	100%
Fuel Truck	<175	13%	14%	13%	0%	100%	100%
Generator Sets	<120	-15%	16%	18%	0%	98%	100%
	120 - 175	30%	13%	26%	0%	98%	100%
Lav Truck	<175	36%	15%	22%	0%	97%	100%
Lift	<120	27%	16%	15%	0%	97%	100%
Passenger Stand	<175	35%	13%	30%	0%	99%	100%
Service Truck	<250	24%	12%	34%	0%	96%	100%

Table C-1.2
Emission Reduction Due to Fuel Switch from Diesel to Compressed Natural Gas

Equipment	Horsepower	2004					
		CO	CO_2e	NOx	PM	ROG	SO_2
Aerial Lifts	<15	-2749%	-27%	55%	36%	73%	100%
	15 - 25	-2912%	-31%	46%	26%	74%	100%
Air Conditioner	<175	-451%	-21%	-30%	84%	87%	100%
Baggage Tug	<120	-507%	-24%	10%	94%	88%	100%
Belt Loader	<120	-469%	-23%	6%	93%	89%	100%
Bobtail	<120	-441%	-22%	23%	93%	91%	100%
Cargo Loader	<120	-625%	-25%	-4%	93%	84%	100%
Catering Truck	<250	-1152%	-22%	-44%	70%	78%	100%
Forklifts	<50	-21%	-23%	-51%	93%	95%	100%
	50 - 120	-594%	-25%	5%	93%	87%	100%
	120 - 175	-581%	-22%	-2%	88%	89%	100%
Generator Sets	<120	-397%	-12%	-2%	92%	91%	100%
	<175	-415%	-12%	-11%	85%	89%	100%
Lav Truck	<175	-457%	-22%	-11%	88%	89%	100%
Lift	<120	-465%	-23%	-5%	92%	89%	100%

Equipment	Horsepower	2010					
		CO	CO_2e	NOx	PM	ROG	SO_2
Aerial Lifts	<15	-3037%	-27%	31%	-29%	59%	100%
	15 - 25	-3755%	-32%	40%	-3%	60%	100%
Air Conditioner	<175	-450%	-20%	-36%	73%	85%	100%
Baggage Tug	<120	-556%	-22%	22%	92%	88%	100%
Belt Loader	<120	-513%	-22%	21%	92%	90%	100%
Bobtail	<120	-480%	-19%	64%	91%	96%	100%
Cargo Loader	<120	-678%	-24%	6%	91%	84%	100%
Catering Truck	<250	-1732%	-21%	-38%	53%	73%	100%
Forklifts	<50	-54%	-21%	26%	90%	96%	100%
	50 - 120	-647%	-22%	32%	90%	90%	100%
	120 - 175	-598%	-21%	38%	82%	90%	100%
Generator Sets	<120	-430%	-11%	11%	89%	91%	100%
	<175	-436%	-11%	0%	81%	89%	100%
Lav Truck	<175	-477%	-21%	1%	84%	90%	100%
Lift	<120	-503%	-22%	9%	90%	89%	100%

Equipment	Horsepower	2015					
		CO	CO_2e	NOx	PM	ROG	SO_2
Aerial Lifts	<15	-3040%	-27%	28%	-86%	57%	100%
	15 - 25	-4465%	-32%	32%	-48%	46%	100%
Air Conditioner	<175	-450%	-19%	-41%	47%	85%	100%
Baggage Tug	<120	-590%	-21%	30%	91%	89%	100%
Belt Loader	<120	-541%	-21%	31%	90%	91%	100%
Bobtail	<120	-505%	-19%	65%	89%	96%	100%
Cargo Loader	<120	-720%	-22%	4%	88%	83%	100%
Catering Truck	<250	-1899%	-20%	-54%	16%	72%	100%
Forklifts	<50	-85%	-20%	41%	83%	94%	100%
	50 - 120	-682%	-21%	23%	81%	89%	100%
	120 - 175	-596%	-20%	36%	68%	91%	100%
Generator Sets	<120	-456%	-11%	22%	84%	91%	100%
	<175	-444%	-10%	12%	71%	90%	100%
Lav Truck	<175	-483%	-20%	10%	76%	91%	100%
Lift	<120	-531%	-21%	17%	85%	89%	100%

Equipment	Horsepower	2020					
		CO	CO_2e	NOx	PM	ROG	SO_2
Aerial Lifts	<15	-3040%	-27%	28%	-91%	57%	100%
	15 - 25	-4722%	-32%	29%	-91%	39%	100%
Air Conditioner	<175	-449%	-19%	-104%	-81%	88%	100%
Baggage Tug	<120	-621%	-20%	31%	87%	90%	100%
Belt Loader	<120	-569%	-20%	31%	85%	91%	100%
Bobtail	<120	-526%	-19%	53%	84%	95%	100%
Cargo Loader	<120	-757%	-21%	-9%	78%	81%	100%
Catering Truck	<250	-1946%	-20%	-120%	-75%	73%	100%
Forklifts	<50	-100%	-20%	32%	60%	91%	100%
	50 - 120	-696%	-21%	-17%	55%	84%	100%
	120 - 175	-596%	-20%	-12%	31%	89%	100%
Generator Sets	<120	-476%	-10%	25%	69%	91%	100%
	<175	-446%	-10%	5%	48%	90%	100%
Lav Truck	<175	-485%	-19%	-3%	56%	91%	100%
Lift	<120	-553%	-20%	13%	72%	89%	100%

Equipment	Horsepower	2025					
		CO	CO_2e	NOx	PM	ROG	SO_2
Aerial Lifts	<15	-3040%	-27%	28%	-91%	57%	100%
	15 - 25	-4803%	-32%	27%	-109%	37%	100%
Air Conditioner	<175	-450%	-19%	-346%	-331%	88%	100%
Baggage Tug	<120	-640%	-19%	17%	79%	89%	100%
Belt Loader	<120	-587%	-20%	16%	72%	90%	100%
Bobtail	<120	-548%	-19%	32%	72%	93%	100%
Cargo Loader	<120	-763%	-20%	-40%	56%	78%	100%
Catering Truck	<250	-1936%	-20%	-330%	-294%	72%	100%
Forklifts	<50	-106%	-20%	19%	-26%	89%	100%
	50 - 120	-703%	-21%	-69%	-48%	79%	100%
	120 - 175	-597%	-20%	-172%	-110%	83%	100%
Generator Sets	<120	-483%	-10%	13%	37%	90%	100%
	<175	-446%	-10%	-37%	-3%	90%	100%
Lav Truck	<175	-486%	-19%	-57%	5%	90%	100%
Lift	<120	-560%	-20%	-8%	37%	87%	100%

8.1.2 Use Electric and Hybrid Construction Equipment

Range of Effectiveness: 2.5 – 80% of GHG emissions from equipment that is electric or hybrid if used 100% of the time

Measure Description:

When construction equipment is powered by grid electricity rather than fossil fuel, direct GHG emissions from fuel combustion are replaced with indirect GHG emissions associated with the electricity used to power the equipment. When construction equipment is powered by hybrid-electric drives, GHG emissions from fuel combustion are reduced.

Measure Applicability:

- Construction vehicles

Inputs:

The following information needs to be provided by the Project Applicant:

- Electricity provider for the Project
- Fuel type and Horsepower of Construction Equipment
- Hours of operation

Baseline Method:

$$\text{Baseline Emission} = EF \times Hp \times LF \times Hr \times C$$

Where:

Emission = MT CO_2e or MT Criteria Pollutant
EF = Emission factor for the relevant fuel horsepower tier (g/hp-hr). Obtained from OFFROAD2007. See accompanying tables
Hp = Horsepower of equipment.
LF = Load factor of equipment for the relevant horsepower tier (dimensionless). Obtained from OFFROAD2007.
Hr = Hours of operation.
C = Unit conversion factor

Mitigation Method:

Fully Electric Vehicle

Construction vehicles will run solely on electricity. The indirect GHG emission from electricity generation is:

$$\text{Mitigated GHG Emission} = Utility \times Hp \times LF \times Hr \times C$$

Where:

GHG emissions = MT CO_2e
Utility = Carbon intensity of Local Utility (CO_2e/kWh)
Hp = Horsepower of equipment.
LF = Load factor of equipment for the relevant horsepower tier (dimensionless). Obtained from OFFROAD2007.
Hr = Hours of operation.
C = Unit conversion factor

Criteria pollutant emissions will be 100% reduced for equipment running solely on electricity.

$$\text{GHG Reduction \%}^{106} = 1 - \frac{\text{Utility} \times C}{EF \times 10^{-6}}$$

Hybrid-Electric Vehicle

GHG Reduction % = Percent Reduction in Fuel Consumption

Emission Reduction Ranges and Variables:

Fully Electric Vehicle

GHG

Utility	Diesel	Compressed Natural Gas 4-strokes	Gasoline 2-strokes	Gasoline 4-strokes				
				<25 HP	25-50 HP	50-120 HP	120-175 HP	175-500 HP
LADW&P	26.3%	37.9%	2.5%	2.5%	46.5%	45.9%	44.4%	42.8%
PG&E	72.9%	77.1%	64.1%	64.1%	80.3%	80.1%	79.5%	78.9%
SCE	61.8%	67.9%	49.5%	49.5%	72.3%	72.0%	71.2%	70.4%
SDGE	53.5%	60.9%	38.5%	38.5%	66.3%	65.9%	64.9%	63.9%
SMUD	67.0%	72.2%	56.3%	56.3%	76.0%	75.8%	75.1%	74.3%

Criteria pollutant

Emissions will be 100% reduced for equipment running on electricity.

Hybrid-Electric Vehicle

GHG

The Project Applicant has to determine the fuel consumption reduced from using the hybrid-electric vehicle. The emission reductions for all pollutants are the same as the fuel reduction.

[106] This assumes energy from engine losses are the same.

Discussion:

The CO_2 emission factor show in the accompanying tables obtained from OFFROAD2007 [1] shows the same emissions within each horsepower tier regardless of the scenario year or equipment model year. The contributions of CH_4 and N_2O to overall GHG emissions is likely small (< 1% of total CO_2e) from diesel construction equipment [2] and were therefore not included. Therefore, the CO_2e emission reduction is dependent on the electricity provider for the Project, horsepower and fuel of the construction equipment only.

On the other hand, the criteria pollutant emission factors from OFFROAD2007 vary for different scenario and equipment model years. The criteria pollutant emission factors presented in the accompanying tables correspond to those of new equipment in the respective scenario years, i.e., model year is the same as scenario year. Since older equipment have higher emission factors due to deterioration and less regulation, the emission reduction calculated from this methodology is likely to be an underestimate.

Assumptions:

Data based upon the following references:

[1] California Air Resources Board. Off-road Emissions Inventory. OFFROAD2007. Available online at: http://www.arb.ca.gov/msei/offroad/offroad.htm

[2] California Climate Action Registry (CCAR). 2009. General Reporting Protocol. Version 3.1. Available online at: http://www.climateregistry.org/tools/protocols/general-reporting-protocol.html

[3] California Climate Action Registry Reporting Online Tool. 2006 PUP Reports. Available online at: https://www.climateregistry.org/CARROT/public/reports.aspx

Preferred Literature:

Electric construction equipment is available commercially from companies such as Peterson Pacific Corporation and Komptech USA, which specialize in the mechanical processing equipment like grinders and shredders [4,5]. The amount of direct GHG emissions avoided can be calculated using CARB's OFFROAD2007 model, which provides state-wide and regional emission factors for a variety of construction equipment that can be converted to grams per horsepower-hour [6]. Multiplying this factor by the number of hours of operation gives the direct GHG emissions. Assuming the same number of operating hours as the diesel-powered equipment, the electricity required to run a piece of electric construction equipment can be calculated by multiplying the operating hours by the amperage required to run the equipment and the voltage rating (obtained from manufacturer technical specifications) to obtain total kWh required. Multiplying this value by the carbon-intensity factor of the local utility gives the amount of indirect GHG emissions associated with using the electric equipment. The

GHG emissions reduction associated with this mitigation measure is therefore the difference in emissions from these two scenarios.

Construction equipment powered by hybrid-electric drives is also commercially available from companies such as Caterpillar [7]. For example, Caterpillar reports that during an 8-hour shift, its D7E hybrid dozer burns 19.5% fewer gallons of fuel than a conventional dozer while achieving a 10.3% increase in productivity. The D7E model burns 6.2 gallons per hour compared to a conventional dozer which burns 7.7 gallons per hour. The percent reduction in fuel use is directly proportional to the percent reduction in GHG emissions. Assuming complete combustion to CO_2 and a carbon content of 87%, the CO_2 emissions reductions can be calculated. Fuel usage and savings are dependent on the make and model of the construction equipment used. The Project Applicant should calculate project-specific savings and provide manufacturer specifications indicating fuel burned per hour.

Alternative Literature:

None

Notes:

[4] Peterson Pacific Corp. Product Brochure Downloads. Available online at: http://www.petersonpacific.com/content/MediaGallery_56_v. Accessed March 2010.
[5] Komptech USA. Products. Available online at: http://www.komptech.com/usa/products.htm. Accessed March 2010.
[6] CARB. OFFROAD 2007 Model. Available online at: http://www.arb.ca.gov/msei/offroad/offroad.htm. Accessed February 2010.
[7] Caterpillar. D7E Efficiency. Accessed February 2010. Available online at: http://www.cat.com/D7E

Other Literature Reviewed:

None

Table C-2.1
Emissions Factors from Different Fuels

Fuel	HP	CO_2 Emission Factor (g/hp-hr)
		All Years
Compressed Natural Gas 4-stroke	All	674.66
Diesel	All	568.30
Gasoline 2-stroke	All	429.44
Gasoline 4-stroke	<25	429.44
	25-50	783.30
	50-120	774.50
	120-175	753.25
	175-500	732.00

Fuel	HP	ROG Emission Factor (g/hp-hr)		
		2004	2010	2015+
Compressed Natural Gas 4-strokes	<15	0.14	0.14	0.14
	15-25	0.14	0.14	0.14
	25-50	0.06	0.01	0.01
	50-120	0.07	0.01	0.01
	120-175	0.06	0.01	0.01
	175-250	0.06	0.01	0.01
	250-500	0.06	0.01	0.01
Diesel	<15	0.57	0.41	0.41
	15-25	0.54	0.48	0.48
	25-50	0.54	0.20	0.08
	50-120	0.38	0.16	0.08
	120-175	0.18	0.13	0.08
	175-250	0.12	0.08	0.06
	250-500	0.10	0.08	0.06
	500-750	0.12	0.08	0.06
	750-1000	0.57	0.08	0.06
	>1000	0.57	0.08	0.08
Gasoline 2-stroke	<2	6.70	5.52	5.52
	2-15	4.19	3.59	3.59
	15-25	4.07	3.79	3.79
Gasoline 4-stroke	<5	6.70	5.52	5.52
	5-15	4.19	3.59	3.59
	15-25	4.07	3.79	3.79

Fuel	HP	ROG Emission Factor (g/hp-hr)		
		2004	2010	2015+
	25-50	1.49	0.65	0.65
	50-120	0.91	0.24	0.24
	120-175	0.72	0.15	0.15
	175-250	0.72	0.15	0.15
	250-500	0.72	0.15	0.15

Fuel	HP	CO Emission Factor (g/hp-hr)		
		2004	2010	2015+
Compressed Natural Gas 4-strokes	<15	300	300	300
	15-25	300	300	300
	25-50	7.02	7.02	7.02
	50-120	20	20	20
	120-175	16	16	16
	175-250	16	16	16
	250-500	16	16	16
Diesel	<15	3.47	3.47	3.47
	15-25	2.34	2.34	2.34
	25-50	3.27	2.86	2.72
	50-120	3.23	3.09	3.05
	120-175	2.70	2.70	2.70
	175-250	0.92	0.92	0.92
	250-500	0.92	0.92	0.92
	500-750	0.92	0.92	0.92
	750-1000	2.70	0.92	0.92
	>1000	2.70	0.92	0.92
Gasoline 2-stroke	<2	318	236	236
	2-15	274	225	225
	15-25	284	238	238
Gasoline 4-stroke	<5	318	236	236
	5-15	274	225	225
	15-25	284	238	238
	25-50	71	38	38
	50-120	38	8.76	8.76
	120-175	21	21	21
	175-250	21	21	21
	250-500	21	21	21

Fuel	HP	NOx Emission Factor (g/hp-hr)		
		2004	2010	2015+
Compressed Natural Gas 4-strokes	<15	8.44	8.44	8.44
	15-25	8.44	8.44	8.44
	25-50	5.19	1.95	1.95
	50-120	4.57	1.58	1.58
	120-175	4.56	1.58	1.58
	175-250	4.56	1.58	1.58
	250-500	4.56	1.58	1.58
Diesel	<15	6.08	4.37	4.37
	15-25	5.79	4.57	4.57
	25-50	5.10	4.88	4.80
	50-120	5.64	5.01	2.53
	120-175	4.72	4.44	2.27
	175-250	4.58	2.45	1.36
	250-500	4.29	2.45	1.36
	500-750	4.51	2.45	1.36
	750-1000	8.17	4.08	2.36
	>1000	8.17	4.08	2.36
Gasoline 2-stroke	<2	2.32	2.70	2.70
	2-15	2.84	2.90	2.90
	15-25	2.32	2.68	2.68
Gasoline 4-stroke	<5	2.32	2.70	2.70
	5-15	2.84	2.90	2.90
	15-25	2.32	2.68	2.68
	25-50	4.52	1.33	1.33
	50-120	5.06	1.78	1.78
	120-175	4.98	1.94	1.94
	175-250	4.98	1.94	1.94
	250-500	4.98	1.94	1.94

Fuel	HP	PM Emission Factor (g/hp-hr)		
		2004	2010	2015+
Compressed Natural Gas 4-strokes	<15	0.90	0.90	0.90
	15-25	0.90	0.90	0.90
	25-50	0.06	0.06	0.06
	50-120	0.06	0.06	0.06
	120-175	0.06	0.06	0.06
	175-250	0.06	0.06	0.06
	250-500	0.06	0.06	0.06
Diesel	<15	0.47	0.38	0.38
	15-25	0.38	0.38	0.38
	25-50	0.43	0.35	0.16
	50-120	0.39	0.24	0.01
	120-175	0.19	0.16	0.01
	175-250	0.11	0.11	0.01
	250-500	0.11	0.11	0.01
	500-750	0.11	0.11	0.01
	750-1000	0.38	0.11	0.06
	>1000	0.38	0.11	0.06
Gasoline 2-stroke	<2	0.74	0.74	0.74
	2-15	0.14	0.14	0.14
	15-25	0.14	0.14	0.14
Gasoline 4-stroke	<5	0.74	0.74	0.74
	5-15	0.14	0.14	0.14
	15-25	0.14	0.14	0.14
	25-50	0.06	0.06	0.06
	50-120	0.06	0.06	0.06
	120-175	0.06	0.06	0.06
	175-250	0.06	0.06	0.06
	250-500	0.06	0.06	0.06

8.1.3 Limit Construction Equipment Idling beyond Regulation Requirements

Range of Effectiveness: Varies with the amount of Project Idling occurring and the amount reduced.

Measure Description:

Heavy duty vehicles will idle during loading/unloading and during layovers or rest periods with the engine still on. Idling requires fuel use and results in emissions. The California Air Resources Board (CARB) Heavy-Duty Vehicle Idling Emission Reduction Program limits diesel-fueled commercial motor vehicles idling time to 5 minutes. There are some exceptions to the regulation such as positioning or providing a power source for equipment or operations such as lift, crane, pump, drill, hoist or other auxiliary equipment. Reduction in idling time beyond required under the regulation would further reduce fuel consumption and thus emissions. The project applicant should develop an enforceable mechanism that monitors the idling time to ensure compliance with this mitigation measure.

Measure Applicability:

- Heavy Duty Commercial Vehicles

Inputs:

The following information needs to be provided by the Project Applicant:

- Idling time of vehicle

Baseline Method:

For all pollutants, the idling emission from each idling period is calculated as follows:

$$\text{Emission} = EF \times t \times C$$

Where:

Emission = grams of pollutant per idling period

EF = Idling emission factor for diesel-fueled heavy duty vehicles obtained from EMFAC (g/idling-hour).

t = Baseline idling period (minute). This is 5 minutes for all vehicles which do not have auxiliary equipment powered by the primary engine exempted from the regulation. For exempted vehicles, the Project applicant shall determine the baseline idling period.

C = Time conversion factor = 1/60

Mitigation Method:

Mitigated emissions for this measure are calculated using the same method as baseline method, but with mitigated idling period.

Emission Reduction Ranges and Variables:

Emission reduction is calculated as follows:

$$\text{Reduction} = 1 - \frac{t_M}{t_B}$$

Where:

t_M = mitigated idling period
t_B = baseline idling period

Discussion:

If a heavy duty truck is regulated under the CARB Idling Emission Reduction Program, and the Project Applicant has committed to enforce a reduced idling period to 3 minutes, then the emissions for all pollutants from idling emissions would be reduced by:

$$1 - \frac{3}{5} = 0.4 = 40\%$$

If the Project Applicant determines that the average idling period for a heavy duty vehicle with a hoist powered by the primary engine is 20 minutes, and has committed to enforce a reduced idling time to 15 minutes, then the emissions for all pollutants would be reduced by:

$$1 - \frac{15}{20} = 0.25 = 25\%$$

Assumptions:

Data based upon the following references:

- California Air Resources Board (CARB) 2009. Heavy-Duty Vehicle Idling Emission Reduction Program. Available at: http://www.arb.ca.gov/msprog/truck-idling/truck-idling.htm
- CARB 2010. EMFAC2007 Model. Available at: http://www.arb.ca.gov/msei/onroad/latest_version.htm

Preferred Literature:

Idling of heavy duty commercial vehicles requires fuel use and results in emissions. Project Applicant can obtain the average idling emission factor for diesel-fueled heavy duty trucks in the county where the Project would be located from EMFAC. The total idling emissions can be determined by multiplying this emission factor by the total idling period. The California Air Resources Board (CARB) Heavy-Duty Vehicle Idling Emission Reduction Program limits diesel-fueled commercial motor vehicles idling time to 5 minutes, with exceptions for some vehicles with auxiliary equipment powered by the primary engine [1]. The Project Applicant has to determine the appropriate baseline idling periods for such exempted vehicles. A plan should also be developed to ensure enforcement of the reduced idling period that the Project Applicant has committed to.

Alternative Literature:

None

Notes:

[1] California Air Resources Board (CARB) 2009. Heavy-Duty Vehicle Idling Emission Reduction Program. Available at: http://www.arb.ca.gov/msprog/truck-idling/truck-idling.htm

Other Literature Reviewed:

None

8.1.4 Institute a Heavy-Duty Off-Road Vehicle Plan

Range of Effectiveness:

Not applicable on its own. This measure ensures compliances with other mitigation measures.

Measure Description:

The Project Applicant should provide a detailed plan that discusses a construction vehicle inventory tracking system to ensure compliances with construction mitigation measures. The system should include strategies such as requiring hour meters on equipment, documenting the serial number, horsepower, manufacture age, fuel, etc. of all onsite equipment and daily logging of the operating hours of the equipment.

Measure Applicability:

- This measure ensures compliances with other mitigation measures.
- Construction vehicles.

Preferred Literature:

None

Alternative Literature:

None

Literature References:

None

8.1.5 Implement a Construction Vehicle Inventory Tracking System

Range of Effectiveness:

Not applicable on its own. This measure ensures compliances with other mitigation measures.

Measure Description:

The Project Applicant should provide a detailed plan that discusses a construction vehicle inventory tracking system to ensure compliances with construction mitigation measures. The system should include strategies such as requiring engine run time meters on equipment, documenting the serial number, horsepower, manufacture age, fuel, etc. of all onsite equipment and daily logging of the operating hours of the equipment.

Measure Applicability:

- This measure ensures compliance with other mitigation measures.
- Construction vehicles.

Preferred Literature:

None

Alternative Literature:

None

Literature References:

None

9.0 Miscellaneous

9.1 Miscellaneous

9.1.1 Establish a Carbon Sequestration Project

Range of Effectiveness: Varies depending on Project Applicant and projects selected. The GHG emissions reduction is subtracted from the overall baseline project emissions inventory.

Measure Description:
The Project Applicant would establish a carbon sequestration project. This might include (a) geologic sequestration or carbon capture and storage techniques in which CO_2 from point sources such as power plants and fuel processing plants is captured and injected underground, (b) terrestrial sequestration in which ecosystems such as wetlands and forestlands are established or preserved to serve as CO_2 sinks, (c) novel techniques involving advanced chemical or biological pathways, or (d) technologies yet to be discovered. The Project Applicant would commit to a desired amount of carbon sequestration in MT per year. This amount would be subtracted from the overall baseline project emissions inventory. In order to take credit for this measure, the Project Applicant should be required to establish a reporting and verification mechanism to quantify the amount of carbon sequestered. Furthermore, the Project Applicant should be required to prove additionality.[107]

Measure Applicability:
- Overall baseline project GHG emissions inventory

Inputs:
- Amount of CO_2e sequestered (MT/year)

Baseline Method:
The Project Applicant should calculate the baseline project emissions inventory ($CO_2e_{baseline}$, the total baseline CO_2e emissions in MT per year) using the methods described in the baseline methodology document.

Mitigation Method:
The amount of CO_2e sequestered is subtracted from the overall project emissions inventory. Therefore, the percent GHG reduction is

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[107] Additionality is the reduction in emissions by sources or enhancement of removals by sinks that is additional to any that would occur in the absence of the Project. In other words, the Project should not subsidize or take credit for emissions reductions which would have occurred regardless of the Project.

$$\textbf{GHG emission reduction} = \frac{CO_2e_{sequestered}}{CO_2e_{baseline}}$$

Where:

GHG emission reduction	=	Percentage reduction in overall GHG emissions from carbon sequestration project
$CO_2e_{sequestered}$	=	Amount of CO_2e sequestered (MT/year) Provided by Applicant
$CO_2e_{baseline}$	=	Total baseline CO_2e emissions (MT/year)

Assumptions:
Data based upon the following references:

- USDOE. Fossil Energy: Carbon Sequestration. Available online at: http://www.fossil.energy.gov/programs/sequestration/

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	To be determined by Applicant
All other pollutants	None

Preferred Literature:
The DOE Fossil Energy – Carbon Sequestration website describes the four core carbon sequestration technologies: geologic, carbon capture and storage, terrestrial, and novel biological and chemical pathways. The DOE website discusses current challenges and research projects associated with each of the carbon sequestration technologies, as well as the trade-offs between local environmental impacts and global environmental benefits.

Alternative Literature:
None

Other Literature Reviewed:
None

9.1.2 Establish Off-Site Mitigation

Range of Effectiveness: Varies depending on Project Applicant and projects selected. The GHG emissions reduction is subtracted from the overall baseline project emissions inventory.

Measure Description:
The Project Applicant may decide to establish GHG reduction measures similar to any of the measures discussed in this report. These reductions would take place outside of the Project Site. In order to take credit for this measure, the Project Applicant should be required to establish a method for registering and verifying the GHG emissions reduction. Furthermore, the Project Applicant should be required to prove additionality.[108]

Measure Applicability:

- Overall baseline project GHG emissions inventory

Inputs:

- Amount of CO_2e reduced off-site (MT/year)

Baseline Method:
The Project Applicant should calculate the baseline project emissions inventory ($CO_2e_{baseline}$, the total baseline CO_2e emissions in MT per year) using the methods described in the baseline methodology document.

Mitigation Method:
The amount of CO_2e reduced off-site is subtracted from the overall project emissions inventory. Therefore, the percent GHG reduction is:

$$\text{GHG emission reduction} = \frac{CO_2e_{\text{reduced off-site}}}{CO_2e_{\text{baseline}}}$$

Where:

GHG emission reduction	=	Percentage reduction in overall GHG emissions from off-site mitigation
$CO_2e_{\text{reduced off-site}}$	=	Amount of CO_2e reduced off-site (MT/year) Provided by Applicant
CO_2e_{baseline}	=	Total baseline CO_2e emissions (MT/year)

[108] Additionality is the reduction in emissions by sources or enhancement of removals by sinks that is additional to any that would occur in the absence of the Project. In other words, the Project should not subsidize or take credit for emissions reductions which would have occurred regardless of the Project.

Misc-2 Off-site Mitigation

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	To be determined by Applicant
All other pollutants	To be determined by Applicant. Reductions in criteria pollutant emissions may be achieved if the off-site mitigation involves removing or retrofitting combustion sources or reducing electricity use.[109]

Preferred Literature:
None

[109] Note that the reduction in criteria pollutant emissions may not occur in the same air basin as the project.

9.1.3 Use Local and Sustainable Building Materials

Range of Effectiveness: Varies depending on Project Applicant and strategies selected. Best Management Practice.

Measure Description:
Using building materials which are sourced and processed locally (i.e. close to the project site, as opposed to in another state or country) reduces transportation distances and therefore reduces GHG emissions from fuel combustion. Using sustainable building materials, such as recycled concrete or sustainably harvested wood, also contributes to GHG emissions reductions due to the less carbon-intensive nature of the production and harvesting of these materials. Unlike measures which reduce GHG emissions during the operational lifetime of a project, such as reducing building electricity and water usage, these mitigation efforts are realized prior to the actual operational lifetime of a project. Therefore, these GHG emissions are best quantified in terms of a life-cycle analysis. Life cycle analyses examine all stages of the life of a product, including raw material acquisition, manufacture, transportation, installation, use, and disposal or recycling. The Project Applicant should seek local agency guidance on comparing and/or combining operational emissions inventories and life cycle emissions inventories.

Measure Applicability:

- Life cycle emissions from building materials

Inputs:
The following information needs to be provided by the Project Applicant:

- Project location
- Material transport distance
- Material type
- Building assembly type and square footage

Preferred Literature:
Several software packages and web-based tools are available which can be used to quantify the life cycle emissions from building materials.

The Building for Environmental and Economic Sustainability (BEES) software developed by the National Institute of Standards and Technology (NIST) can calculate global warming potential (in terms of CO_2 emissions in grams per product) for a variety of building products, including a multitude of cement varieties, fabrics, tiles, glass, wood, and shelving materials. Required inputs are the type of building material (e.g. generic 100% Portland cement, generic 20% limestone cement), and transportation distance. The user can compare between different types of materials and associated transportation distances.

The BEES software and user manual is available for public download here: http://www.bfrl.nist.gov/oae/software/bees/bees.html

The Athena EcoCalculator for Assemblies software developed by the Athena Institute analyzes the environmental impacts of whole buildings in terms of global warming potential (in terms of CO_2e) from raw material extraction, final material manufacturing, transportation, on-site construction, maintenance, and demolition and disposal. Required inputs include the project location, assembly type (columns and beams, floor, exterior wall, interior wall, window, or roof), type of material, and square footage of material. The Athena EcoCalculator compares CO_2e emissions from the project-specific assembly to default assemblies of similar material and size. The Athena EcoCalculator is based on the more rigorous Athena Impact Estimator software, which requires detailed information about the building design including the number of columns and beams, supported span, wall height, and type of material used for all aspects. In contrast, the Athena EcoCalculator assumes default values for many of the architectural details.

A free public version of the Athena EcoCalculator is available for download here: http://www.athenasmi.org/tools/ecoCalculator/index.html

Alternative Literature:
None

Other Literature Reviewed:
None

9.1.4 Require Best Management Practices in Agriculture and Animal Operations

9.1.5 Require Environmentally Responsible Purchasing

Range of Effectiveness: Varies depending on Project Applicant and strategies selected. Best Management Practice.

Measure Description:
Requiring environmentally responsible purchasing has the potential to have a net effect of reducing GHG emissions by reducing the life cycle emissions, operating emissions, and/or transportation emissions associated with a product. Examples of environmentally responsible purchases which reduce life cycle emissions include but are not limited to: purchasing products with sustainable packaging; purchasing post-consumer recycled copier paper, paper towels, and stationary; purchasing and stocking communal kitchens with reusable dishes and utensils; choosing sustainable cleaning supplies; and leasing equipment from manufacturers who will recycle the components at their “end of life.” Examples of environmentally responsible purchases which reduce a Project’s operating emissions include choosing ENERGY STAR appliances and Water Sense-certified water fixtures; choosing electronic appliances with built in sleep-mode timers; and purchasing “green power” (e.g. electricity generated from renewables or hydropower) from the utility. Choosing locally-made and distributed products reduces the transportation distances required to move the product from the distribution or manufacturing center to the Project, and therefore reduce GHG emissions associated with the transportation vehicles.

Since the magnitude of the energy and GHG reduction depends on the purchasing strategies implemented, the expected GHG reduction is not quantifiable at this time. Therefore, this mitigation measure should be incorporated as a Best Management Practice to encourage homeowners, commercial space tenants, and builders to make sustainable purchases and therefore reduce their contribution to GHG emissions. The Project Applicant could take quantitative credit for this mitigation measure if detailed and substantial evidence were provided.

Measure Applicability:
- Purchase of consumer and business goods and appliances

Assumptions:
Data based upon the following references:

- City of Chicago and ICLEI. Chicago Green Office Challenge: Waste. Available online at: http://www.chicagogreenofficechallenge.org/pages/waste/50.php
- Cool California.org. Small Business Money Saving Actions: Recycle and Cut Waste. Available online at: http://www.coolcalifornia.org/article/recycle-and-cut-waste

- Flex Your Power.org. Commercial Overview Energy Saving Tips: Office Equipment Tips. Available online at: http://www.fypower.org/com/tools/energy_tips_results.html?tips=office
- ENERGY STAR. 2007. Putting Energy into Profits: ENERGY STAR Guide for Small Businesses. Available online at: http://www.energystar.gov/ia/business/small_business/sb_guidebook/smallbizguide.pdf

Emission Reduction Ranges and Variables:
This is a Best Management Practice and therefore at this time there is no quantifiable reduction. Check with local agencies for guidance on any allowed reductions associated with implementation of best management practices.

Preferred Literature:
The Chicago Green Office Challenge, Cool California.org, and Flex Your Power.org website resources provide many examples of office and small business purchasing strategies which reduce waste and energy use. The ENERGY STAR Guide provides more details about energy-efficient appliance choices and the option to purchase renewable or clean energy from the utility for a higher cost.

Alternative Literature:
None

Other Literature Reviewed:
None

9.1.6 Implement an Innovative Strategy for GHG Mitigation

Range of Effectiveness: Varies depending on Project Applicant and strategies selected. The GHG emissions reduction may be quantifiable. If not quantifiable, this mitigation measure should be implemented as a Best Management Practice.

Measure Description:
The Project Applicant may develop a novel strategy to reduce GHG emissions at the project site or off-site. This strategy may incorporate technologies which have yet to be developed at the time of the publication of this report. In order to take quantifiable credit for this measure, the Project Applicant must provide detailed and substantial evidence showing the quantification and verification of the GHG emissions reduction. If the GHG emissions reduction is not quantifiable, it should be implemented as a Best Management Practice.

Measure Applicability:
- To be determined by Project Applicant

Inputs:
- Amount of CO_2e reduced due to Innovative Strategy
- Baseline CO_2e for applicable inventory sector

Baseline Method:
The Project Applicant should calculate the baseline CO_2e emissions associated with the applicable GHG emissions inventory sector ($CO_2e_{baseline\text{-}sector}$, the baseline CO_2e emissions in MT per year for the applicable sector) using the methods described in the baseline methodology document. For example, if the Innovative Strategy achieves GHG reductions by reducing building energy use, $CO_2e_{baseline\text{-}sector}$ is the total CO_2e emissions associated with baseline building energy use.

Mitigation Method:
The amount of CO_2e reduced due to the Innovative Strategy is subtracted from applicable emissions inventory sector. Therefore, the percent GHG reduction is:

$$\text{GHG emission reduction} = \frac{CO_2e_{reduced\text{-}sector}}{CO_2e_{baseline\text{-}sector}}$$

Where:

GHG emission reduction	=	Percentage reduction in sector GHG emissions due to Innovative Strategy
$CO_2e_{reduced\text{-}sector}$	=	Amount of CO_2e reduced due to Innovative Strategy (MT/year) Provided by Applicant
$CO_2e_{baseline\text{-}sector}$	=	Baseline sector CO_2e emissions (MT/year)

If the GHG emissions reduction cannot be quantified and/or verified, check with local agencies for guidance on any allowed reductions associated with implementation of Best Management Practices.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	To be determined by Applicant
All other pollutants	None

Preferred Literature:

None

10.0 General Plans

In addition to fact sheets and BMPs, this document includes measures that are more applicable for General Plans. The following measures have substantial evidence of reductions when implemented at a General Plan level rather than a project level.

10.1 General Plans

10.1.1 Fund Incentives for Energy Efficiency

Range of Effectiveness: Varies depending on Project Applicant and strategies selected. Best Management Practice.

Measure Description:
By funding incentives for energy-efficient choices in equipment, fixtures in buildings, or energy sources, a Project Applicant can promote reductions in GHG emissions associated with fuel combustion and electricity use. The Project Applicant may choose to contribute to an existing municipal energy fund or establish a new energy fund for the Project. The Project Applicant should check with the local air district regarding participating in established programs. These energy funds may provide financial incentives or grants for any number of energy efficiency measures including but not limited to: retrofitting or designing new buildings, parking lots, streets, and public areas with energy-efficient lighting; retrofitting or designing new buildings with low-flow water fixtures and high-efficiency appliances; retrofitting or purchasing new low-emissions equipment; purchasing electric or hybrid vehicles; and investing in renewable energy systems such as photovoltaics or wind turbines. Recipients of energy fund grants could include neighborhood developers, home and commercial space builders, homeowners, and utilities. Energy funds allow recipients flexibility in choosing efficiency strategies while still achieving the desired effects of reduced energy use and associated GHG emissions.

Since the magnitude of the energy and GHG reduction depends on the strategies selected by the energy fund recipients, the expected GHG reduction is not quantifiable at this time. Therefore, this mitigation measure should be incorporated as a Best Management Practice to encourage utilities, builders, residents, and commercial tenants to reduce their energy use and/or choose cleaner energy, and therefore reduce their contribution to GHG emissions. The Project Applicant could take quantitative credit for this mitigation measure if detailed and substantial evidence were provided.

Measure Applicability:
- GHG emissions from energy use (fuel combustion and electricity use)

Assumptions:
Data based upon the following references:

- City of Ann Arbor. Energy Office: Energy Fund. Available online at: http://www.a2gov.org/government/publicservices/systems_planning/energy/Pages/EnergyFund.aspx
- Go Solar California. California Solar Initiative. Available online at: http://www.gosolarcalifornia.org/csi/index.html
- USDOE. Database of State Initiatives for Renewables and Efficiency: California. Available online at: http://www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=CA
- California Clean Energy Fund. About Us. Available online at: http://www.calcef.org/about.htm

Emission Reduction Ranges and Variables:
This is a Best Management Practice and therefore there is no quantifiable reduction at this time. Check with local agencies for guidance on any allowed reductions associated with implementation of best management practices.

Preferred Literature:
The City of Ann Arbor's Energy Fund provides a good example of a municipal general energy fund which provides grants for a wide variety of energy efficiency and renewable energy investments. The California Solar Initiative and the Energy Efficient Appliance Rebate Program (found on the DOE Database of State Initiatives for Renewables and Efficiency) are examples of California state energy funds which incentivize specific types of purchases. The DOE database provides a listing of many more California municipal and local programs.

Alternative Literature:

None

Other Literature Reviewed:
- The Energy Foundation. Programs: Power. Available online at: http://www.ef.org/programs.cfm

10.1.2 Establish a Local Farmer's Market

Range of Effectiveness: Varies depending on Project Applicant and strategies selected. Best Management Practice.

Measure Description:

Establishing a local farmer’s market has the potential to reduce greenhouse gas emissions by providing project residents with a more local source of food, potentially resulting in a reduction in the number of trips and vehicle miles traveled by both the food and the consumers to grocery stores and supermarkets. If the food sold at the local farmer’s market is produced organically, it can also contribute to greenhouse gas reductions by displacing carbon-intensive food production practices. As discussed in more detail below, these emissions reductions cannot be reasonably quantified at this time because they are based on several undefined parameters: the relative locations of the farmer’s market, supermarket, and supermarket produce suppliers; the carbon intensity of food production practices; and the role of the farmer’s market in a development, such as whether it supplements trips to the grocery store or completely displaces them.

Measure Applicability:

- Number of trips to supermarket and vehicle miles traveled
- Life cycle emissions of food production

Discussion:

Potential greenhouse gas emissions from establishing a local farmer’s market can be divided into two types: emissions reductions from transportation and emissions reductions from food production practices. The transportation of food from a field to a store and the transportation of consumers from their homes to a store both contribute to greenhouse gas emissions. In many cases, especially in urban areas, a local farmer’s market will reduce emissions associated with the distribution of food from the field to the consumer, since the farms represented at the local farmer’s market are theoretically closer to the consumer than the farms which produce most of the food found at supermarkets and grocery stores. However, California has a large number of farms and orchards and in some cases the farms represented at a local farmer’s market may not be different than those represented at the neighborhood grocery store. If a consumer obtains produce from a local farmer’s market when they would otherwise drive a farther distance to purchase produce from a grocery store, the trip to the grocery stores is displaced, VMT is reduced, and GHG emissions reductions are achieved. However, if a consumer drives to the farmer’s market and then to the grocery store (for example, to purchase food which the farmer’s market cannot provide), the trip to the farmer’s market is made in addition to the trip to the grocery store. Thus, an additional trip is made, VMT is added, and greenhouse gas emissions are actually increased. It is unclear how local farmer's markets affect the food purchasing behavior of consumers, and therefore the effect of a farmer's market on transportation greenhouse gas emissions is not quantifiable at this time. The carbon intensity of food production practices also contributes to greenhouse gas emissions; however, these emissions are accounted for in the life cycle analysis of the food and cannot be directly compared to a development's operational greenhouse gas emissions inventory (such as the transportation emissions detailed above). If food at a local farmer's market is produced organically, it is likely that less carbon-intensive practices were used than at the large-scale farms and orchards which produce most food found at grocery stores and supermarkets. Examples of carbon-intensive gardening practices include heated greenhouses and the heavy use of fertilizers and pesticides derived from fossil fuels. Local farms which do not practice organic or sustainable farming may employ these more carbon-intensive practices. Thus, the magnitude of the life-cycle greenhouse gas emissions is difficult to quantify and compare to operational inventories.

Preferred Literature:

None

10.1.3 Establish Community Gardens

Range of Effectiveness: Varies depending on Project Applicant and strategies selected. Best Management Practice.

Measure Description:

Establishing a community garden has the potential to reduce greenhouse gas emissions by providing project residents with a local source of food, potentially resulting in a reduction in the number of trips and vehicle miles traveled by both the food and the consumers to grocery stores and supermarkets. Community gardens can also contribute to greenhouse gas reductions by displacing carbon-intensive food production practices. As discussed in more detail below, these emissions reductions cannot be reasonably quantified at this time because they are based on several undefined parameters: the relative locations of the community garden, supermarket, and supermarket produce suppliers; the carbon intensity of gardening and farming practices; and the role of a community garden in a development, such as whether it supplements trips to the grocery store or completely displaces them.

Measure Applicability:

- Number of trips to supermarket and vehicle miles traveled
- Life cycle emissions of food production

Discussion:

Potential greenhouse gas emissions from establishing a community garden can be divided into two types: emissions reductions from transportation and emissions reductions from food production practices. The transportation of food from a field to a store and the transportation of consumers from their homes to a store both contribute to greenhouse gas emissions. In most cases a community garden will reduce emissions associated with the distribution of food from the field to the consumer, since with community gardens the food goes directly from the field to the consumer, while in grocery stores and supermarkets the path is more likely field to regional distribution center to store to consumer. If a consumer obtains produce from a community garden when they would otherwise drive a farther distance to purchase produce from a grocery store, the trip to the grocery stores is displaced, VMT is reduced, and GHG emissions reductions are achieved. However, if a consumer drives to the community garden and then to the grocery store (for example, to purchase food which the community garden cannot provide), the trip to the community garden is made in addition to the trip to the grocery store. Thus, an additional trip is made, VMT is added, and greenhouse gas emissions are actually increased. Furthermore, if community gardens displace backyard gardens, they increase transportation emissions. It is unclear how community gardens affect the food purchasing behavior of consumers, and therefore the effect of a community garden on transportation greenhouse gas emissions is not quantifiable at this time. The carbon intensity of food production practices also contributes to greenhouse gas emissions; however, these emissions are accounted for in the life cycle analysis of the food and cannot be directly compared to a development's operational greenhouse gas emissions inventory (such as the transportation emissions detailed above). Community gardens are likely to produce food using less carbon-intensive practices than the large-scale farms and orchards which produce most food found at grocery stores and supermarkets. Examples of carbon-intensive gardening practices include heated greenhouses and the heavy use of fertilizers and pesticides derived from fossil fuels; these practices are not likely to be used at community gardens. Although these qualitative conclusions can be drawn, the magnitude of the life-cycle greenhouse gas emissions is difficult to quantify and compare to operational inventories.

Preferred Literature:

None

10.1.4 Plant Urban Shade Trees

Range of Effectiveness: The reduction in GHG emissions is not quantifiable at this time, therefore this mitigation measure should be implemented as a Best Management Practice. If the study data were updated to account for Title 24 standards, the GHG emissions reductions could be quantified but would vary based on location, building type, and building size.

Measure Description:

Planting shade trees around buildings has been shown to effectively lower the electricity cooling demand of buildings by blocking incident sunlight and reducing heat gain through windows, walls, and roofs. Deciduous trees with large canopies are a desirable choice of shade tree because they provide shade in the warm months and shed their leaves in the winter months to allow sunlight to pass through and warm the building. By reducing cooling demand, shade trees help reduce electricity demand from the local utility and therefore reduce GHG emissions which would otherwise be emitted during the production of that electricity.

A study entitled "Calculating energy-saving potentials of heat-island reduction strategies" conducted by the Lawrence Berkeley National Laboratory (LBNL) Heat Island Group provides a method to quantify reductions in electricity use from planting shade trees around residences, offices, and retail stores. The electricity reductions are based on the LBNL model which assumes 4 shade trees are planted around residences, 8 trees are planted around offices, and 10 trees are planted around retail stores. The LBNL model is also based on electricity use data for two building stocks: Pre-1980 buildings (buildings constructed prior to 1980) and 1980+ buildings (buildings constructed on or after 1980). Other assumptions, including the geometry of the modeled trees and sunlight transmittance, are detailed in Section 2.5 of the study. This mitigation measure describes how to estimate greenhouse gas emissions reductions from planting shade trees based on the LBNL data. Since the model is based on electricity data for Pre-1980 and 1980+ buildings[110] it does not incorporate electricity use improvements due to the California 2001, 2005, or 2008 Title 24 measures. Given that buildings constructed in 2001 or later incorporate Title 24 electricity efficiency improvements, the electricity savings reported in the LBNL study are overestimates of the savings that would actually be achieved for these newer buildings.[111]

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[110] This data for these buildings is based on U.S. Department of Energy and California Energy Commission studies conducted in 1987 through 2001.

[111] The CEC 2003 Impact Analysis Report estimates a state-average 14.9%-26% savings in electricity use for cooling in residential buildings and 6.7% savings in electricity use for cooling in non-residential

While the electricity savings in the study overestimates savings for newer buildings, the data does show that electricity savings (and associated greenhouse gas emissions savings) from planting shade trees are real. A follow-up study which uses similar methodologies with models updated with the Title 24 standards would provide data which could be used to more accurately quantify electricity savings for new buildings.

Measure Applicability:

- Electricity use
- Limitation: It takes several years for trees to grow to the height necessary to provide shade to a building. Furthermore, without deed restrictions, the presence of shade trees around a building may not be permanent, as a new owner may decide to remove the trees or not replace them if they die.

Inputs:

The following information needs to be provided by the Project Applicant:

- Type of building (residential, office, or retail store)
- Square footage of roof
- Heating Degree Days (HDD) or Cooling Degree Days (CDD) of Project location

Baseline Method:

The CEC Residential Appliance Saturation Survey (RASS) and California Commercial Energy Use Survey (CEUS) datasets can be used to calculate the baseline electricity for building cooling. The data is available for different climate zones in California and electricity use from cooling alone can be extracted. The methodology for using RASS and CEUS to calculate $GHG_{baseline}$ is described in the baseline document.

Mitigation Method:

The electricity savings from reduced cooling demand are based on the location of the building. Table 4 of the LBNL study provides a list of cities and their HDD and CDD values. If a project's location is not listed, the Project Applicant should choose a representative city with climate similar to that of the project. Alternatively, the Project Applicant could determine the HDD and CDD of the project location from local meteorological data.

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buildings due to the 2005 update to the 2001 Title 24 standards. The CEC 2007 Impact Analysis Report estimates a state-average 19.7%-22.7% savings in overall electricity use for residential buildings and a 8.3% savings in electricity use for cooling in non-residential buildings due to the 2008 update to the 2005 Title 24 standards.

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Tables 6 through 16 of the LBNL study show the expected electricity savings (in kWh per 1000 sqft of roof) based on the following parameters:

- Building type (residential, office, or retail store)
- Climate method (HDD or CDD – either can be used)
- Heating method (Gas heated-buildings or electric-heated buildings)

The Project Applicant should select data based on the appropriate parameters above. The entry corresponding to the "Shade tree savings" row and "1980+" column will provide the electricity savings in kWh per 1000 sqft of roof for the specified building type, climate method, and heating method. Note that value is an overestimate of savings for buildings which were manufactured under Title 24 standards.

Then the reduction in GHG emissions is calculated as follows:

$$GHG_{reduction} = SF \times ElecSavings \times Utility$$

Where

$GHG_{reduction}$ = Reduction in GHG emissions from planting shade trees (MT)
SF = Sqft of roof
Provided by Applicant
ElecSavings = Electricity savings (kWh / sqft roof)
From Tables 6 through 16 of LBNL study
Utility = Carbon intensity of local utility (MT CO_2e / kWh)
From Table below

Power Utility	Carbon-Intensity (lbs CO_2e/MWh)
LADW&P	1,238
PG&E	456
SCE	641
SDGE	781
SMUD	555

Therefore:

$$\text{Percent reduction in GHG emissions} = GHG_{reduction} / GHG_{baseline}$$

Since the Utility term is a factor of both $GHG_{reduction}$ and $GHG_{baseline}$, the percent reduction in GHG emissions does not depend on the value of Utility.

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Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	The following emissions reductions reflect the implementation of three heat island reduction strategies (installing reflective roofs, planting shade trees, and using high-albedo pavements) for the 1980+ stock buildings. The reduction from planting shade trees around new buildings is expected to be smaller than the estimate below. Additionally, savings are expected to be smaller for new buildings due to the Title 24 standards. • 20% for residential buildings • 5-12% for office buildings • 10-17% for retail buildings
All other pollutants	Same as above[112]

Assumptions:

Data based upon the following reference:

- H. Akbari, S. Konopacki. Lawrence Berkeley National Laboratory. 2005. Calculating Energy-Saving-Potentials of Heat-Island Reduction Strategies. Journal of Energy Policy. Volume 33, p. 721-756.

Preferred Literature:

The LBNL study conducted by Akbari and Konopacki of the Heat Island Group modeled energy savings from shade trees for residential, office, and retail building types. The model accounted for differences in climate by modeling in a range of heating-degree-days and cooling-degree days, and compared a basecase (building with no external shading) to a mitigated case (building with 4, 8, and 10 shade trees, depending on the building type). However, the study is based on pre-2001 data and does not account for updates to California's Title 24 standards. Furthermore, the model assumes a specific number of shade trees planted at specific orientations.

Alternative Literature:

- CCAR. 2010. Urban Forest Project Protocol Version 1.1. Available online at: http://www.climateactionreserve.org/how/protocols/adopted/urban-forest/current-urban-forest-project-protocol/

Section D.3 of the protocol describes a method to quantify the reductions in cooling and heating demand due to the planting of shade trees. Computer simulations incorporating

[112] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

building, climate, and shading effects were used to calculate the change in unit energy consumption (UEC) on a per tree basis. Total change in energy use is calculated by multiplying the change in UEC per try by the total number of trees. Buildings were modeled in three stocks with similar building characteristics: buildings constructed prior to 1950, buildings constructed between 1950 and 1980, and buildings constructed after 1980. As with the primary reference above, the data does not account for electricity efficiency improvements due to California's Title 24 standards.

Other Literature Reviewed:

- E. G. McPherson, J. R. Simpson. USDA Forest Service. 2003. Potential Energy Savings in Buildings by an Urban Tree Planting Programme in California. Journal of Urban Forestry & Urban Greening. Volume 2, p. 73-86.
- H. Akbari. Lawrence Berkeley National Laboratory. 2002. Shade Trees Reduce Building Energy Use and CO_2 Emissions from Power Plants. Journal of Environmental Pollution. Volume 116, p. 119-126.
- J. R. Simpson. Department of Environmental Horticulture at the University of California. 2002. Improved Estimates of Tree-Shade Effects on Residential Energy Use. Journal of Energy and Buildings. Volume 34, p. 1067-1076.

10.1.5 Implement Strategies to Reduce Urban Heat-Island Effect

Range of Effectiveness: The reduction in GHG emissions is not quantifiable at this time, therefore this mitigation measure should be implemented as a Best Management Practice. If the study data were updated to account for Title 24 standards, the GHG emissions reductions could be quantified but would vary based on location, building type, and building size.

Measure Description:

The urban heat island effect is the phenomenon in which a metropolitan area is warmer than its surrounding rural areas due to increased land surface which retains heat, such as concrete, asphalt, metal, and other materials found in buildings and pavements. This warming effect causes warmer locations, such as many cities in California, to require more energy for air conditioning and refrigeration than the surrounding rural areas. Higher energy requirements in turn result in higher CO_2 emissions from the generation of this energy.

Three strategies have been shown to have a positive impact on reducing localized temperatures and reducing the electricity demand for building cooling. These strategies are planting urban shade trees, installing reflective roofs, and using light-colored or high-albedo[113] pavements and surfaces. Planting shade trees around buildings and installing reflective roofs have both been found to result in direct electricity savings for buildings. The per building direct electricity savings from planting shade trees is discussed in a separate mitigation measure. Reflective roofs are covered under Title 24 Part 6 and the electricity savings is therefore incorporated in savings due to Title 24. The combination of the three strategies, however, has been shown to have a city-wide effect: a reduction in ambient air temperature. This reduction in air temperature results in buildings requiring less electricity for cooling, and is quantified as indirect savings in electricity use. The savings can be quantified on a per-building basis or on a city-wide basis.

A study entitled “Calculating energy-saving potentials of heat-island reduction strategies” conducted by the Lawrence Berkeley National Laboratory (LBNL) Heat Island Group provides a method to quantify per-building reductions in electricity use from implementing these three strategies on a city-wide scale. In addition, the study reports modeled city-wide electricity savings. The electricity reductions are based on a LBNL model with certain assumptions about the number and orientation of shade trees

[113] The albedo ratio of a surface represents how strongly the surface reflects sunlight. Pavements with higher albedo ratios reflect more sunlight and therefore retain less heat.

and the albedo values of roofs and pavements. Per-building electricity savings are also based on for two building stocks: Pre-1980 buildings (buildings constructed prior to 1980) and 1980+ buildings (buildings constructed on or after 1980).

This mitigation measure describes how to estimate greenhouse gas emissions reductions from implementing heat-island effect reduction strategies as reported in the LBNL study. Since the LBNL model is based on electricity data for Pre-1980 and 1980+ buildings[114] it does not incorporate electricity use improvements due to the California 2001, 2005, or 2008 Title 24 measures. Given that buildings constructed in 2001 or later incorporate Title 24 electricity efficiency improvements, the electricity savings reported in the LBNL study are overestimates of the savings that would actually be achieved for these newer buildings.[115]

While the electricity savings in the study overestimates savings for newer buildings, the data does show that electricity savings (and associated greenhouse gas emissions savings) from planting shade trees are real. A follow-up study which uses similar methodologies with models updated with the Title 24 standards would provide data which could be used to more accurately quantify electricity savings for new buildings.

Measure Applicability:

- Electricity use
- Limitation: It takes several years for trees to grow to the height necessary to provide shade to a building. Furthermore, without deed restrictions, the presence of shade trees around a building may not be permanent, as a new owner may decide to remove the trees or not replace them if they die.
- Limitation: it is assumed that the heat-island effect reduction strategies are implemented on a city-wide scale.

Inputs:

The following information needs to be provided by the Project Applicant:

- Type of building (residential, office, or retail store)
- Square footage of roof

[114] This data for these buildings is based on U.S. Department of Energy and California Energy Commission studies conducted in 1987 through 2001.
[115] The CEC 2003 Impact Analysis Report estimates a state-average 14.9%-26% savings in electricity use for cooling in residential buildings and 6.7% savings in electricity use for cooling in non-residential buildings due to the 2005 update to the 2001 Title 24 standards. The CEC 2007 Impact Analysis Report estimates a state-average 19.7%-22.7% savings in overall electricity use for residential buildings and a 8.3% savings in electricity use for cooling in non-residential buildings due to the 2008 update to the 2005 Title 24 standards.

- Heating Degree Days (HDD) or Cooling Degree Days (CDD) of Project location

Baseline Method:

The CEC Residential Appliance Saturation Survey (RASS) and California Commercial Energy Use Survey (CEUS) datasets can be used to calculate the baseline electricity for building cooling. The data is available for different climate zones in California and electricity use from cooling alone can be extracted. The methodology for using RASS and CEUS to calculate $GHG_{baseline}$ is described in the baseline document.

Mitigation Method:

The electricity savings from reduced cooling demand are based on the location of the building. Table 4 of the LBNL study provides a list of cities and their HDD and CDD values. If a project's location is not listed, the Project Applicant should choose a representative city with climate similar to that of the project. Alternatively, the Project Applicant could determine the HDD and CDD of the project location from local meteorological data.

Tables 6 through 16 of the LBNL study show the expected electricity savings (in kWh per 1000 sqft of roof) based on the following parameters:

- Building type (residential, office, or retail store)
- Climate method (HDD or CDD – either can be used)
- Heating method (Gas heated-buildings or electric-heated buildings)

The Project Applicant should select data based on the appropriate parameters above. The entry corresponding to the "Indirect Savings" row and "1980+" column will provide the electricity savings in kWh per 1000 sqft of roof for the specified building type, climate method, and heating method. Note that value is an overestimate of savings for buildings which were manufactured under Title 24 standards.

Then the reduction in GHG emissions is calculated as follows:

$$GHG_{reduction} = SF \times ElecSavings \times Utility$$

Where

$GHG_{reduction}$	=	Reduction in GHG emissions from implementing heat island effect reduction strategies on a city-wide scale (MT)
SF	=	Sqft of roof Provided by Applicant
ElecSavings	=	Electricity savings (kWh / sqft roof) From Tables 6 through 16 of LBNL study
Utility	=	Carbon intensity of local utility (MT CO_2e / kWh)

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MP# **LU-6.1**

GP-5

From Table below

Power Utility	Carbon-Intensity (lbs CO_2e/MWh)
LADW&P	1,238
PG&E	456
SCE	641
SDGE	781
SMUD	555

Therefore:

$$\text{Percent reduction in GHG emissions} = GHG_{reduction} / GHG_{baseline}$$

Since the Utility term is a factor of both $GHG_{reduction}$ and $GHG_{baseline}$, the percent reduction in GHG emissions does not depend on the value of Utility.

City-Wide GHG reductions
The LBNL study estimates that city-wide reductions in electricity use (and associated GHG emissions) range from about 10-20%. This range is based on the percent indirect savings modeled for five pilot cities: Houston, Baton Rouge, Chicago, Sacramento, and Salt Lake City, as reported in Figure 2 of the LBNL study.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions
CO_2e	The following per-building emissions reductions reflect the implementation of three heat island reduction strategies (installing reflective roofs, planting shade trees, and using high-albedo pavements) for the 1980+ stock buildings. Actual savings are expected to be lower for new buildings due to the Title 24 standards. • 20% for residential buildings • 5-12% for office buildings • 10-17% for retail buildings
All other pollutants	Same as above[116]

[116] Criteria air pollutant emissions may also be reduced due to the reduction in energy use; however, the reduction may not be in the same air basin as the project.

Assumptions:

Data based upon the following reference:

- H. Akbari, S. Konopacki. Lawrence Berkeley National Laboratory. 2005. Calculating Energy-Saving-Potentials of Heat-Island Reduction Strategies. Journal of Energy Policy. Volume 33, p. 721-756.
- S. Konopacki, H. Akbari. Lawrence Berkeley National Laboratory. 2000. Energy Savings Calculations for Heat Island Reduction Strategies in Baton Rouge, Sacramento, and Salt Lake City. LBNL 42890.

Preferred Literature:

The LBNL study conducted by Akbari and Konopacki of the Heat Island Group modeled energy savings from shade trees for residential, office, and retail building types. The model accounted for differences in climate by modeling in a range of heating-degree-days and cooling-degree days, and compared a basecase (building with no external shading) to a mitigated case (building with 4, 8, and 10 shade trees, depending on the building type). However, the study is based on pre-2001 data and does not account for updates to California's Title 24 standards. Furthermore, the model assumes a specific number of shade trees planted at specific orientations.

Alternative Literature:

None

Other Literature Reviewed:

Lawrence Berkeley National Laboratory. Heat Island Group: Benefits of Cooler Pavements. Available online at: http://eetd.lbl.gov/HeatIsland/Pavements/Overview/Pavements99-01.html. Accessed March 2010.

Lawrence Berkeley National Laboratory. Heat Island Group: The Cost of Hot Pavements. Available online at: http://heatisland.lbl.gov/Pavements/Cost.html. Accessed March 2010.

USEPA. Draft. Reducing Urban Heat Islands: Compendium of Strategies, Cool Pavements. Available online at: http://epa.gov/heatisland/resources/pdf/CoolPavesCompendium.pdf

Appendix A

List of Acronyms and Glossary of Terms

List of Acronyms

ACM	alternative calculation method
AF	acre feet
B20	biodiesel (20%)
BOD	biochemical oxygen demand
BMP	best management practice
C	carbon
CAFE	corporate average fuel economy
CAPCOA	California Air Pollution Control Officers Association
CAR	Climate Action Registry
CARB	California Air Resources Board
CCAR	California Climate Action Registry
CDWR	California Department of Water Resources
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CEUS	California Commercial End-Use Survey
CGBSC	California Green Building Standards Code
CH_4	methane
CHP	combined heat and power
CIWMB	California Integrated Waste Management Board
CNG	compressed natural gas
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
DE	destruction efficiency
DEIR	Draft Environmental Impact Report
DU	dwelling unit
EF	emission factor
EIA	United States Energy Information Administration
EIR	Environmental Impact Report
EMFAC	on-road vehicle emission factors model
ET_0	reference evapotranspiration
ETWU	estimated total water use
FCZ	forecasting climate zone
GHG	greenhouse gas
GP	General Plan
GRP	General Reporting Protocol
GWP	global warming potential
HA	hydrozone area
HHV	higher heating value
hp	horsepower
HVAC	heating, ventilating, and air conditioning
IE	irrigation efficiency
IPCC	Intergovernmental Panel on Climate Change
ITE	Institute of Transportation Engineers
ITS	intelligent transportation systems
kBTU	thousand British thermal units
kW	kilowatt
kWh	kilowatt-hour
kWh/yr	kilowatt-hours/year
lbs	pounds

LA	landscape area
LADWP	Los Angeles Department of Water and Power
LCA	life cycle assessment
LDA	light-duty auto
LDT	light-duty truck
LED	light-emitting diode
LFM	landfill methane
LNG	liquefied natural gas
LPG	liquefied petroleum gas
MAWA	maximum applied water allowance
MMBTU	million British thermal units
MSW	mixed solid waste
MTCE	metric tonnes carbon equivalent
N_2O	nitrous oxide
NOx	nitrogen oxides
NRDC	Natural Resources Defense Council
NREL	National Renewable Energy Laboratory
OLED	organic light-emitting diode
OFFROAD	off-road vehicle emission factors model
PF	plant factor
PG&E	Pacific Gas and Electric
PM	particulate matter
PUP	Power/Utility Protocol
RASS	Residential Appliance Saturation Survey
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
SDGE	San Diego Gas and Electric
SLA	special landscape area
SMAQMD	Sacramento Metropolitan Air Quality Management District
SMUD	Sacramento Municipal Utility District
scf	standard cubic feet
SHP	separate heat and power
SO_2	sulfur dioxide
sqft	square feet
TDM	transportation demand management
TDV	time dependent valuation
TOD	transit-oriented development
tonnes	metric tonnes; 1,000 kilograms
TRU	truck refrigeration unit
URBEMIS	Urban Emissions Model
US	United States
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
VCAPCD	Ventura County Air Pollution Control District
VTPI	Victoria Transport Policy Institute
VMT	vehicle miles traveled
VTR	vehicle trip reduction
WARM	Waste Reduction Model
WMO	World Meteorological Organization
yr	year

Glossary of Terms

Alternative Calculation Method
Software used to demonstrate compliance with the California Building Energy Efficiency Standards (Title 24). The software must comply with the requirements listed in the Alternative Calculation Method Approval Manual.

Additionality[a]
The reduction in emissions by sources or enhancement of removals by sinks that is additional to any that would occur in the absence of the project. The project should not subsidize or take credit for emissions reductions which would have occurred regardless of the project.

Albedo[a]
The fraction of solar radiation reflected by a surface or object, often expressed as a ratio or fraction. Snow covered surfaces have a high albedo; the albedo of soils ranges from high to low; vegetation covered surfaces and oceans have a low albedo. The Earth's albedo varies mainly through varying cloudiness, snow, ice, leaf area, and land cover changes. Paved surfaces with high albedos reflect solar radiation and can help reduce the urban heat island effect.

Below Market Rate Housing
Housing rented at rates lower than the market rate. Below market rate housing is designed to assist lower-income families. When below market rate housing is provided near job centers or transit, it provides lower income families with desirable job/housing match or greater opportunities for commuting to work through public transit.

Biochemical Oxygen Demand
Represents the amount of oxygen that would be required to completely consume the organic matter contained in wastewater through aerobic decomposition processes. Under the same conditions, wastewater with higher biochemical oxygen demand (BOD) concentrations will generally yield more methane than wastewater with lower BOD concentrations. BOD_5 is a measure of BOD after five days of decomposition.

Biogenic Emissions[b]
Carbon dioxide emissions produced from combusting a variety of biofuels, such as biodiesel, ethanol, wood, wood waste and landfill gas.

Carbon Dioxide Equivalent
A measure for comparing carbon dioxide with other greenhouse gases. Tonnes carbon dioxide equivalent is calculated by multiplying the tonnes of a greenhouse gas by its associated global warming potential.

California Environmental Quality Act
A statute passed in 1970 that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible.

Carbon Neutral Power
A power generation system which has net zero carbon emissions. Examples of existing carbon neutral power systems are photovoltaics, wind turbines, and hydropower systems.

Carbon Sink
Any process or mechanism that removes carbon dioxide from the atmosphere. A forest is an example of a carbon sink, because it sequesters carbon dioxide from the atmosphere.

"Carrot"
The purpose of a carrot is to provide an incentive which encourages a particular action. Parking cash-out would be considered a "carrot" since the employee receives a monetary incentive for not driving to work, but is not punished for maintaining status quo.

Combined Heat and Power
Also known as cogeneration. Combined heat and power is the generation of both heat and electricity from the same process, such as combustion of fuel, with the purpose of utilizing or selling both simultaneously. In combined heat and power systems, the thermal energy byproducts of a process are captured and used, where they would be wasted in a separate heat and power system. Examples of combined heat and power systems include gas turbines, reciprocating engines, and fuel cells.

Compact Infill
A Project which is located within or contiguous with the central city. Examples may include redevelopment areas, abandoned sites, or underutilized older buildings/sites.

Climate Zone
Geographic area of similar climatic characteristics, including temperature, weather, and other factors which affect building energy use. The California Energy Commission identified 16 Forecasting Climate Zones (FCZs) for use in the CEUS and RASS analyses. The designation of these FCZs was based in part on the utility service area.

Cordon Pricing
Tolls charged for entering a particular area (a "cordon"), such as a downtown.

Density
The amount of persons, jobs, or dwellings per unit of land area. This is an important metric for determining traffic-related parameters.

Destination Accessibility
A measure of the number of jobs or other attractions reachable within a given travel time. Destination accessibility tends to be highest at central locations and lowest at peripheral ones.

Efficacy
The capacity to produce a desired effect.

ENERGY STAR
A joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy which sets national standards for energy efficient consumer products. ENERGY STAR certified products are guaranteed to meet the efficiency standards specified by the program.

Elasticity
The percentage change of one variable in response to a percentage change in another variable. Elasticity = percent change in variable A / percent change in variable B (where the

change in B leads to the change in A). For example, if the elasticity of VMT with respect to density is -0.12, this means a 100% increase in density leads to a 12% decrease in VMT.

Evapotranspiration[c]
The loss of water from the soil both by evaporation and by transpiration from the plants growing in the soil.

General Plan
A set of long-term goals and policies that guide local land use decisions. The 2003 *General Plan Guidelines* developed by the California Office of Planning and Research provides advice on how to write a general plan that expresses a community's long-term vision, fulfills statutory requirements, and contributes to creating a great community.

Global Warming Potential[b]
The ratio of radiative forcing that would result from the emission of one kilogram of a greenhouse gas to that from the emission of one kilogram of carbon dioxide over a fixed period of time.

Graywater
Non-drinkable water that can be collected and reused onsite for irrigation, flushing toilets, and other purposes. This water has not been processed through a waste water treatment plant.

Greenhouse Gas
For the purposes of this report, greenhouse gases are the six gases identified in the Kyoto Protocol: carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

Headway
The amount of time (in minutes) that elapses between two public transit vehicles servicing a given route and given line. Headways for buses and rail are generally shorter during peak periods and longer during off-peak periods. Headway is the inverse of frequency (headway = 1/frequency), where frequency is the number of arrivals over a given time period (i.e. buses per hour).

Intelligent Transportation System
A broad range of communications-based information and electronics technologies integrated into transportation system infrastructure and vehicles to relieve congestion and improve travel safety.

Job Center
An area with a high degree and density of employment.

Kilowatt Hour
A unit of energy. In the U.S., the kilowatt hour is the unit of measure used by utilities to bill consumers for energy use.

Land Use Index
Measures the degree of land use mix of a development. An index of 0 indicates a single land use while 1 indicates a full mix of uses.

Lumen
A unit of luminous flux. A measure of the brilliance of a source of visible light, or the power of light perceived by the human eye.

Master Planned Community
Large communities developed specifically incorporating housing, office parks, recreational area, and commercial centers within the community. Master planned communities tend to encompass a large land area with the intent of being self-sustaining. Many master planned communities may have lakes, golf courses, and large parks.

Mixed Use
A development that incorporates more than one type of land use. For example, a small mixed use development may have buildings with ground-floor retail and housing on the floors above. A larger mixed use development will locate a variety of land uses within a short proximity of each other. This may include integrating office space, shopping, parks, and schools with residential development. The mixed-use development should encourage walking and other non-auto modes of transport from residential to office/commercial/institutional locations (and vice versa).

Ordinance
A local law usually found in municipal code.

Parking Spillover
A term used to describe the effects of implementing a parking management strategy in a sub-area that has unintended consequences of impacting the surrounding areas. For example, assume parking meters are installed on all streets in a commercial/retail block with no other parking strategies implemented. Customers will no longer park in the metered spots and will instead “spillover” to the surrounding residential neighborhoods where parking is still unrestricted.

Photovoltaic[c]
A system that converts sunlight directly into electricity using cells made of silicon or other conductive materials (solar cells). When sunlight hits the cells, a chemical reaction occurs, resulting in the release of electricity.

Recycled Water
Non-drinkable water that can be reused for irrigation, flushing toilets, and other purposes. It has been processed through a wastewater treatment plant and often needs to be redistributed.

Ride Sharing
Any form of carpooling or vanpooling where additional passengers are carried on the trip. Ride-sharing can be casual and formed independently or be part of an employer program where assistance is provided to employees to match up commuters who live in close proximity of one another.

Renewable Energy[a]
Energy sources that are, within a short time frame relative to the Earth's natural cycles, sustainable, and include non-carbon technologies such as solar energy, hydropower, and wind, as well as carbon-neutral technologies such as biomass.

Self Selection
When an individual selects himself into a group.

Separate Heat and Power
The typical system for acquiring heat and power. Thermal energy and electricity are generated and used separately. For example, heat is generated from a boiler while electricity is acquired from the local utility. Separate heat and power systems are used as the baseline of comparison for combined heat and power systems.

Sequestration[a]
The process of increasing the carbon content of a carbon reservoir other than the atmosphere. Biological approaches to sequestration include direct removal of carbon dioxide from the atmosphere through afforestation, reforestation, and practices that enhance soil carbon in agriculture. Physical approaches include separation and disposal of carbon dioxide from flue gases or from processing fossil fuels to produce hydrogen- and carbon dioxide-rich fractions and longterm storage in underground in depleted oil and gas reservoirs, coal seams, and saline aquifers.

"Stick"
The purpose of a stick is to establish a penalty for a status quo action. Workplace parking pricing would be considered a "stick" since the employee is now monetarily penalized for driving to work.

Suburban
An area characterized by dispersed, low-density, single-use, automobile dependent land use patterns, usually outside of the central city (a suburb).

Suburban Center
The suburban center serves the population of the suburb with office, retail and housing which is denser than the surrounding suburb.

Title 24
Title 24 Part 6 is also known as the California Building Energy Efficiency Standard, which regulates building energy efficiency standards. Regulated energy uses include space heating and cooling, ventilation, domestic hot water heating, and some hard-wired lighting. Title 24 determines compliance by comparing the modeled energy use of a 'proposed home' to that of a minimally Title 24 compliant 'standard home' of equal dimensions. Title 24 focuses on building energy efficiency per square foot; it places no limits upon the size of the house or the actual energy used per dwelling unit. The current Title 24 standards were published in 2008.

Transit-Oriented Development
A development located near and specifically designed around a rail or bus station. Proximity alone does not characterize a development as transit-oriented. The development and surrounding neighborhood should be designed for walking and bicycling and parking management strategies should be implemented. The development should be located within a short walking distance to a high-quality, high frequency, and reliable bus or rail service.

Transportation Demand Management
Any transportation strategy which has an intent to increase the transportation system efficiency and reduce demand on the system by discouraging single-occupancy vehicle travel and encouraging more efficient travel patterns, alternative modes of transportation such as walking, bicycling, public transit, and ridesharing. TDM measures should also shift travel patterns from peak to off-peak hours and shift travel from further to closer destinations.

Transit Ridership
The number of passengers who ride in a public transportation system, such as buses and subways.

Tree and Grid Network
Describes the layout of streets within and surrounding a project. Streets that are characterized as a tree network actually look like a tree and its branches. Streets are not laid out in any uniform pattern, intersection density is low, and the streets are less connected. In a grid network, streets are laid out in a perpendicular and parallel grid pattern. Streets tend to intersect more frequently, intersection density is higher, and the streets are more connected.

Urban
An area which is located within the central city with higher density of land uses than you would find in the suburbs. It may be characterized by multi-family housing and located near office and retail.

Urban Heat Island Effect
The phenomenon in which a metropolitan area is warmer than its surrounding rural areas due to increased land surface which retains heat, such as concrete, asphalt, metal, and other materials found in buildings and pavements.

Vehicle Miles Traveled
The number of miles driven by vehicles. This is an important traffic parameter and the basis for most traffic-related greenhouse gas emissions calculations.

Vehicle Occupancy
The number of persons in a vehicle during a trip, including the driver and passengers.

Notes:

[a] Definition adapted from: IPCC. 2001. Third Assessment Report: Climate Change 2001 (TAR). Annex B: Glossary of Terms. Available online at: http://www.ipcc.ch/pdf/glossary/tar-ipcc-terms-en.pdf

[b] Definition adapted from: CCAR. 2009. General Reporting Protocol, Version 3.1. Available online at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

[c] Definition adapted from: USEPA. 2010. Greening EPA Glossary. Available online at: http://www.epa.gov/oaintrnt/glossary.htm

Appendix B

Greenhouse Gas Mitigation Measures Task 0:
Standard Approach to Calculate Unmitigated Emissions

Greenhouse Gas Mitigation Measures Task 0: Standard Approach to Calculate Unmitigated Emissions

Prepared for:
California Pollution Control Officers Association (CAPCOA)

Prepared by:
ENVIRON International Corporation
San Francisco, California

And

Fehr & Peers
San Francisco & Walnut Creek, California

Date:
August 2010

FEHR & PEERS
TRANSPORTATION CONSULTANTS

ENVIRON

Contents

1 Introduction

ENVIRON International Corporation (ENVIRON) and Fehr & Peers worked with the California Air Pollution Control Officers Association (CAPCOA) to quantify reductions associated with greenhouse gas (GHG) mitigation measures that can be applied to California Environmental Quality Act (CEQA) Environmental Impact Report (EIR) analyses. The first part of this overall task defines a standard approach to calculate the baseline emissions before mitigation. This report contains the recommendations for methodologies and approaches to assess the baseline GHG emissions.

This report and its methodologies form the basis for the subsequent tasks associated with quantification of GHG mitigation measures. To the extent possible, default values are included with this report and in the mitigation measure Fact Sheets.

This report presents methods to be used to calculate short-term and one-time emissions sources as well as emissions that will occur annually after construction (operational emissions). The one-time emission sources include changes in carbon sequestration due to vegetation changes and emissions associated with construction. The annual operational emissions include the emissions associated with building energy use including natural gas and electricity, emissions associated with mobile sources, emissions associated with water use and wastewater treatment, emissions associated with area sources such as natural gas fired hearths , landscape maintenance equipment, swimming pools, and golf courses.

2 GHG Equivalent Emissions

The term "GHGs" includes gases that contribute to the greenhouse effect, such as carbon dioxide (CO_2,) methane (CH_4), and nitrous oxide (N_2O), as well as gases that are only man-made and that are emitted through the use of modern industrial products, such as hydrofluorocarbons (HFCs), chlorinated fluorocarbons (CFCs), and sulfurhexafluoride (SF_6). These last three families of gases, while not naturally present in the atmosphere, have properties that also cause them to trap infrared radiation when they are present in the atmosphere, thus making them GHGs. These six gases comprise the major GHGs that are recognized by the Kyoto Accords (water is not included).[1] There are other GHGs that are not recognized by the Kyoto Accords, due either to the smaller role that they play in climate change or the uncertainties surrounding their effects. Atmospheric water vapor is not recognized by the Kyoto Accords because there is not an obvious correlation between water concentrations and specific human activities. Water appears to act in a positive feedback manner; higher temperatures lead to higher water vapor concentrations in the atmosphere, which in turn can cause more global warming.[2] California has recently recognized nitrogen trifluoride as another regulated greenhouse gas.

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[1] This Kyoto Protocol sets legally binding targets and timetables for cutting the greenhouse gas emissions of industrialized countries. The US has not approved the Kyoto treaty.

[2] From the IPCC Third Assessment Report: http://www.grida.no/climate/ipcc_tar/wg1/143.htm and http://www.grida.no/climate/ipcc_tar/wg1/268.htm

Residents and the employees and patrons of commercial and municipal buildings and services use electricity, heating, water, and are transported by motor vehicles. These activities directly or indirectly emit GHGs. The most significant GHG emissions resulting from such residential and commercial developments are emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). GHG emissions are typically measured in terms of MT of CO_2 equivalents (CO_2e), calculated as the product of the mass emitted of a given GHG and its specific global warming potential (GWP).

The effect that each of these gases can have on global warming is a combination of the mass of their emissions and their global warming potential (GWP). GWP indicates, on a MT for MT basis, how much a gas is predicted to contribute to global warming relative to how much warming would be predicted to be caused by the same mass of CO_2. CH_4 and N_2O are substantially more potent GHGs than CO_2, with GWPs of 21 and 310, respectively according to the IPCC's Second Assessment Report (SAR).[3] In emissions inventories, GHG emissions are typically reported in terms of pounds (lbs) or MT[4] of CO_2 equivalents (CO_2e). CO_2e are calculated as the product of the mass emitted of a given GHG and its specific GWP. While CH_4 and N_2O have much higher GWPs than CO_2, CO_2 is emitted in such vastly higher quantities that it accounts for the majority of GHG emissions in CO_2e, both from developments and human activity in general. Since most regulatory agencies and protocols use the SAR GWP values as a basis, this assessment will also use SAR GWP values even though more recent values exist. However, SAR did not consider nitrogen trifluoride, however there are no sources of nitrogen trifluoride that would typically need to be quantified.

3 Units of measurement: MT of CO_2 and CO_2e

In many sections of this report, including the final summary sections, emissions are presented in units of CO_2e either because the GWPs of CH_4 and N_2O were accounted for explicitly, or the CH_4 and N_2O are assumed to contribute a negligible amount of GWP when compared to the CO_2 emissions from that particular emissions category.

Emissions and reductions are calculated in terms of metric tons. As such, "MT" will be used to refer to metric tons (1,000 kilograms). "Tons" will be used to refer to short tons (2,000 pounds [lbs]).

4 Indirect GHG Emissions from Electricity Use

As noted above, indirect GHG emissions are created as a result of electricity use. When electricity is used in a building, the electricity generation typically takes place offsite at the power plant; electricity use in a building generally causes emissions in an indirect manner. The project should use information specific for each local utility provider for different parts of

[3] GWP values from IPCC's Second Assessment Report (SAR, 1996) are still used by international convention and are used in this protocol, even though more recent (and slightly different) GWP values were developed in the IPCC's Fourth Assessment Report (FAR, 2007)

[4] In this report, "MT" will be used to refer to metric MT (1,000 kilograms). "Tons" will be used to refer to short tons (2,000 pounds).

California. Accordingly, indirect GHG emissions from electricity usage are calculated using the utility specific carbon-intensity factor based Power/Utility Protocol (PUP) report from California Climate Action Registry (CCAR)[5] for the 2006 baseline year. ENVIRON does not recommend using the 2004 PUP reports since this year was one of the first year's utilities reported emissions, as such, the data is likely less accurate than subsequent years since utilities had a chance to refine data collection methods for the later years. Furthermore, a large coal burning power plant in Mojave was going offline in 2005 which was factored into the Scoping Plan analysis. Therefore, ENVIRON suggests using the 2006 PUP reports since it likely represents a more accurate dataset year. This emission factor takes into account the baseline year's mix of energy sources used to generate electricity for a specific utility and the relative carbon intensities of these sources. The emission factor will be determined as a CO_2e incorporating the CO_2, CH_4, and N_2O emissions.

Power Utility	Carbon-Intensity (lbs CO_2e/MWh)
LADW&P	1,238
PG&E	456
SCE	641
SDGE	781
SMUD	555

5 Short-Term Emissions

Short-term or one-time emissions from the development of a Project are associated with vegetation removal and re-vegetation on the Project site and construction-related activities.

5.1 Construction Activities

Construction activities occur during the early stage of a project. Construction activities include any demolition, site grading, building construction, and paving. These construction activities have several main sources of GHG emissions. Off-road construction equipment such as dozers, pavers, and backhoes are used on-site during construction. These pieces of equipment typically are diesel fueled although other fuels are occasionally used. Besides the off-road construction, there are on-road vehicles. These vehicles are used for worker commuting, delivering of material to the site, and hauling material away from the site. The methodology to calculate these sources of emissions is described in the next sections.

5.1.1 Estimating GHG Emissions from Off-Road Construction Equipment

This section describes how emissions from off-road equipment used during demolition, site grading, building construction and paving are calculated. This section can be used for any fuel

[5] California Climate Action Registry (CCAR) Database. PUP Report.

burning equipment such as diesel, gasoline, or compressed natural gas (CNG). For electric equipment please see the method in the next section.

First, the number and type of equipment that will be used in the construction, as well as the duration of the entire construction project, is needed. Absent other data, ENVIRON recommends that each piece of equipment will operate for 8 hours a day, five days a week throughout the construction duration. An equipment hour is defined as one hour of a piece of equipment being used. Specifications for each type of construction equipment (horsepower, load factor, and GHG emission factor) are provided by OFFROAD2007[6]. CO_2 and CH_4 emissions for each type of construction equipment are calculated as follows:

$$\begin{array}{c} \textit{Equipment} \\ \textit{Emissions [grams]} \end{array} = \begin{array}{c} \textit{Total} \\ \textit{equipment} \\ \textit{hours} \end{array} \times \begin{array}{c} \textit{emission factor} \\ \textit{[grams per brake} \\ \textit{horsepower-hour]} \end{array} \times \begin{array}{c} \textit{equipment} \\ \textit{horsepower} \end{array} \times \textit{load factor}^{7}$$

The grams of CO_2 and CH_4 are multiplied by their respective GWP and then the two emissions are summed to derive the final CO_2e emissions from the piece of off-road equipment. Since OFFROAD2007 does not provide an emission factor for N_2O which is a minor subset of nitrogen oxides (NO_x) emissions and the contribution to the overall GHG emissions is likely small, it is therefore not included in calculations that used OFFROAD2007. These were accounted for with alternative fuels since they have a larger proportion of N_2O and CH_4.

5.1.2 Estimating GHG emissions from Electric Off-Road Construction Equipment

In order to estimate the indirect GHG emissions associated with electricity consumption of electrical powered equipment, the following inputs are required. First, the total operating hours of the electrical piece of equipment is needed. Secondly, the amount of kilowatts the equipment uses per time is needed. These two pieces are used along with the carbon intensity factor for the local utility provider as follows:

$$\begin{array}{c} \textit{Equipment} \\ \textit{Emissions} \end{array} = \begin{array}{c} \textit{Total} \\ \textit{equipment hours} \end{array} \times \begin{array}{c} \textit{average power} \\ \textit{draw (kW/hr)} \end{array} \times \begin{array}{c} \textit{Utility EF} \\ \textit{(g } CO_2e \textit{ per kWhr)} \end{array}$$

5.1.3 GHG Emissions from On-Road Vehicles Associated with Construction

Emissions from on-road vehicles associated with construction include workers commuting to the site, vendors delivering materials, and hauling away of materials. GHGs are emitted from these vehicles in two ways: running emissions, produced by driving the vehicle, and startup emissions, produced by turning the vehicle on. Idling emissions will not be considered since

[6] OFFROAD2007 is a model developed by the Air Resources Board which contains emission factors for off-road equipment. It is available at : http://www.arb.ca.gov/msei/offroad/offroad.htm

[7] Load factor is the percentage of the maximum horsepower rating at which the equipment normally operates.

regulations exist which limit idling[8] and they would represent a small contribution to the GHG emissions. The majority of these on-road vehicle emissions are running emissions.

Running emissions are calculated using the same method for all trip types. The total Vehicle Miles Traveled (VMT) for the trip type category is estimated, and then multiplied by the representative GHG emission factors for the vehicles expected to be driven. The total VMT for a given trip type is calculated as follows:

$$VMT \quad = \quad Number\ of\ round\ trips \quad x \quad average\ round\ trip\ length\ (miles)$$

The number of trips should be based on project specific information. Default values associated with each land use type can be obtained construction cost estimators or default values in emission estimator programs. Average round trip length should be based on project specific information or county specific default values. After total VMT is calculated, GHG emissions for on-road vehicles associated with construction can be calculated from the following equation:

$$CO_2\ emissions \quad = \quad VMT \quad x \quad EF_{running}$$

Where:

VMT = vehicle miles traveled
$EF_{running}$ = running emission factor for vehicle fleet for trip type

The CO_2 calculation involves the following assumptions:

a. Vehicle Fleet Defaults:

    a. Workers commute half with light duty trucks (LDTs) and half commute in light duty autos (LDAs). Half of the LDTs are type 1 and the other half type 2.

    b. Vendors are all heavy-heavy duty vehicles.

    c. Hauling is all heavy-heavy duty vehicles.

b. The emission factor depends upon the speed of the vehicle. A default value of 35 miles per hour will be used.

c. EMFAC emission factors from the construction year will be used for $EF_{running}$.

[8] The Air Resources Board adopted in 2004 and modified in 2005 an Air Toxic Control Measure that limits idling in diesel vehicles to 5-minutes. http://www.arb.ca.gov/msprog/truck-idling/truck-idling.htm

The emissions associated with CH_4 and N_2O are calculated in a similar manner or assumed to represent 5% of the total CO_2e emissions. They are then converted to CO_2e by multiplying by their respective global warming potential.

Startup emissions are CO_2 emitted from starting a vehicle. For the various trips during all phases, the startup emissions are calculated using the following assumptions:

a. The same vehicle fleet assumptions as used in running emissions.

b. Two engine startups per day with a 12 hour wait before each startup.[9]

The USEPA recommends assuming that CH_4, N_2O, and HFCs account for 5% of GHG emissions from on-road vehicles, taking into account their GWPs.[10] To incorporate these additional GHGs into the calculations, the total GHG footprint is calculated by dividing the CO_2 emissions by 0.95.

5.2 Vegetation Change

ENVIRON suggests following the IPCC protocol for vegetation since it has default values that work well with the information typically available for development projects. This method is similar to the CCAR Forest Protocol[11] and the Center for Urban Forest Research Tree Carbon Calculator[12], but it has more general default values available that will generally applicable to all areas of California without requiring detailed site-specific information[13].

5.2.1 Quantifying the One-Time Release by Changes in Carbon Sequestration Capacity

The one-time release of GHGs due to permanent changes in carbon sequestration capacity is calculated using the following four steps:[14]

1. *Identify and quantify the change in area of various land types due to the development (i.e. alluvial scrub, non-native grassland, agricultural, etc.).* These area changes include not only the area of land that will be converted to buildings, but also areas disrupted by the construction of utility corridors, water tank sites, and associated borrow and grading areas.

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9 The emission factor grows with the length of time the engine is off before each ignition.

10 USEPA. 2005. *Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle.* Office of Transportation and Air Quality. February.

11 CCAR. 2007. Forest Sector Protocol Version 2.1. September. Available at: http://www.climateregistry.org/resources/docs/protocols/industry/forest/forest_sector_protocol_version_2.1_sept2007.pdf

12 Available at: http://www.fs.fed.us/ccrc/topics/urban-forests/ctcc/

13 The CCAR Forest Protocol and Urban Forest Research Tree Carbon Calculator are not used since their main focus is annual emissions for carbon offset considerations. As such they are designed to work with very specific details of the vegetation that is not available at a CEQA level of analysis.

14 This section follows the IPCC guidelines, but has been adapted for ease of use for these types of Projects.

Areas temporarily disturbed that will eventually recover to become vegetated will not be counted as vegetation removed as there is no net change in vegetation or land use.[15]

2. *Estimate the biomass associated with each land type.* For the purposes of this report, ENVIRON suggests using the available general vegetation types found in the IPCC publication Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines).[16]

   California vegetation is heavily dominated by scrub and chaparral vegetation which may not be accurately characterized by default forest land properties. Consequently, ecological zones and biomass based subdivisions identified in the IPCC Guidelines were used to sub-categorize the vegetation as scrub dominated. These subcategories should be used to determine the CO_2 emissions resulting from land use impacts.

3. *Calculate CO_2 emissions from the net change of vegetation.* When vegetation is removed, it may undergo biodegradation,[17] or it may be combusted. Either pathway results in the carbon (C) present in the plants being combined with oxygen (O_2) to form CO_2. To estimate the mass of carbon present in the biomass, biomass weight is multiplied by the mass carbon fraction, 0.5.[18] The mass of carbon is multiplied by 3.67[19] to calculate the final mass of CO_2, assuming all of this carbon is converted into CO_2.

4. Calculate the overall change in sequestered CO_2. – For all types of land that change from one type of land to another,[20] initial and final values of sequestered CO_2 are calculated using the equation below.

   Overall Change in Sequestered CO_2 [MT CO_2]

$$= \sum_i \left(SeqCO_2\right)_i \times \left(area\right)_i - \sum_j \left(SeqCO_2\right)_j \times \left(area\right)_j$$

   Where:

$SeqCO_2$	=	mass of sequestered CO_2 per unit area [MT CO_2/acre]
area	=	area of land for specific land use type [acre]
i	=	index for final land use type
j	=	index for initial land use type

[15] This assumption facilitates the calculation as a yearly growth rate and CO_2 removal rate does not have to be calculated. As long as the disturbed land will indeed return to its original state, this assumption is valid for time periods over 20 years.

[16] Available online at http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.htm

[17] Cleared vegetation may also be deposited in a landfill or compost area, where some anaerobic degradation which will generate CH_4 may take place. However, for the purposes of this section, we are assuming that only aerobic biodegradation will take place which will result in CO_2 emissions only.

[18] The fraction of the biomass weight that is carbon. Here, a carbon fraction of 0.5 is used for all vegetation types from CCAR Forest Sector Protocol.

[19] The ratio of the molecular mass of CO_2 to the molecular mass of carbon is 44/12 or 3.67.

[20] For example from forestland to grassland, or from cropland to permanently developed.

5.2.2 Calculating CO_2 Sequestration by Trees

Planting individual trees will sequester CO_2. Changing vegetation as described above results in a one-time carbon-stock change. Planting trees is also considered to result in a one-time carbon-stock change. Default annual CO_2 sequestration rates on a per tree basis, based on values provided by the IPCC are used[21]. An average of 0.035 MT CO_2 per year per tree can be used for trees planted, if the tree type is not known.

Urban trees are only net carbon sinks when they are actively growing. The IPCC assumes an active growing period of 20 years. Thereafter, the accumulation of carbon in biomass slows with age, and will be completely offset by losses from clipping, pruning, and occasional death. Actual active growing periods are subject to, among other things, species, climate regime, and planting density. In this report, the IPCC default value of 20 years is recommended. For large tree sequestration projects, the Project may consider using the Forest or Urban tree planting protocols developed by Climate Action Registry (CAR). These protocols have slightly different assumptions regarding steady state, tree growth, and replacement of trees..

5.3 Built Environment

The amount of energy used, and the associated GHG emissions emitted per square foot of available space vary with the type of building. For example, food stores are far more energy intensive than warehouses, which have little climate-conditioned space. Therefore, this analysis is specific to the type of building.

GHGs are emitted as a result of activities in buildings for which electricity and natural gas are used as energy sources. Combustion of any type of fuel emits CO_2 and other GHGs directly into the atmosphere; when this occurs within a building (such as by natural gas consumption) this is a direct emission source[22] associated with that building. GHGs are also emitted during the generation of electricity from fossil fuels. When electricity is used in a building, the electricity generation typically takes place offsite at the power plant; electricity use in a building generally causes emissions in an indirect manner.

Energy use in buildings is divided into energy consumed by the built environment and energy consumed by uses that are independent of the construction of the building such as plug-in appliances. In California, Title 24 part 6 governs energy consumed by the built environment, mechanical systems, and some fixed lighting. This includes the space heating, space cooling, water heating, and ventilation systems. Non-building energy use, or “plug-in” energy use can be further subdivided by specific end-use (refrigeration, cooking, office equipment, etc.). The following two steps are performed to quantify the energy use due to buildings:

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[21] The Center for Urban Forest Research Tree Carbon Calculator is not suggested since it requires knowledge on specific tree species to estimate carbon sequestered. This information is typically not available during the preparation of CEQA documents.

[22] California Climate Action Registry (CCAR) General Reporting Protocol (GRP), Version 3.1 (January). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf, Chapter 8

1. Calculate energy use from systems covered by Title 24[23] (HVAC system, water heating system, and the lighting system).
2. Calculate energy use from office equipment, plug-in lighting, and other sources not covered by Title 24.

The resulting energy use quantities are then converted to GHG emissions by multiplying by the appropriate emission factors obtained by incorporating information on local electricity providers for electricity, and by natural gas emission factors for natural gas combustion.

ENVIRON recommends using default values for Title 24 and non-Title 24 energy use for various building types. These will take into account the building size and climate zone. There are several sources of information that can be used to obtain building energy intensity. Each is described briefly below.

The *California Commercial Energy Use Survey* (CEUS) data is provided by the California Energy Commission (CEC). It is based on a survey conducted in 2002 for existing commercial buildings in various climate zones. Electricity and natural gas use per square foot for each end use in each building type and climate zone is extracted from the CEUS data. Since the data is provided by end use, it is straightforward to calculate the Title 24 and non-Title 24 regulated energy intensity for each building type.

Commercial Buildings Energy Consumption Survey (CBECS) is a survey of non-residential buildings that was conducted in 2003 by the Energy Information Administration (EIA). Electricity and natural gas use per square foot can be extracted from this data. The energy use estimates are assumed to represent 2001 Title 24 compliant buildings. Using CBECS, the percent of electricity and natural gas used for each end use can be calculated. It is then straightforward to calculate the Title 24 and non-Title 24 electricity and natural gas intensity for each building type. Similar surveys exist for manufacturing and residential energy use.

The *Residential Appliance Saturation Survey* (RASS) refers to the California Energy Commission Consultant Report entitled "California Statewide Residential Appliance Saturday Study". Data from RASS is used to calculate the total electricity and natural gas use for residential buildings on a per dwelling unit. The RASS study estimates the unit energy consumption (UEC) values for individual households surveyed and also provides the saturation number for each type of end use. The saturation number indicates the proportion of households that have a demand for each type of end-use category. As the data is provided by end use, it is straightforward to calculate the Title 24 and non-Title 24 electricity and natural gas intensity for each building type.

Alternative Calculation Method (ACM) software is available that makes estimates of the energy consumption by a model Title 24 compliant building. These programs provide

[23] Title 24, Part 6, of the California Code of Regulations: California's Energy Efficiency Standards for Residential and Nonresidential Buildings. http://www.energy.ca.gov/title24/

annual energy use for the heating, ventilation, and air conditioning (HVAC) system in each building; therefore, estimates from ACM software represent Title 24-regulated energy use. These do not calculate the non-Title 24 energy use for the buildings.

The Department of Energy produced the *Building America Research Benchmark Definition* (BARBD) technical manual, which presents empirical equations for electricity and natural gas usage. As the data is provided by end use, it is straightforward to calculate the Title 24 and non-Title 24 electricity and natural gas intensity for each building type.

Literature surveys may also be used for building and land use types not well represented by the above sources.

ENVIRON suggests using the CEUS and RASS datasets for these calculations since the data is available for several land use categories in different climate zones in California.

The Title 24 standards have been updated twice (in 2005 and 2008) since some of these data were compiled. CEC has published reports estimating the percentage deductions in energy use resulting from these new standards. Based on CEC's discussion on average savings for Title 24 improvements, these CEC savings percentages by end use can be used to account for reductions in electricity use due to updates to Title 24. Since energy use for each different system type (ie, heating, cooling, water heating, and ventilation) as well as appliances is defined, this method will easily allow for application of mitigation measures aimed at reducing the energy use of these devices in a prescriptive manner.

Based on the electricity intensity, CO_2e intensity values (CO_2e emissions per square foot or dwelling unit, as applicable, per year) for each building type can be calculated. Electricity intensity data is multiplied by an electricity emission factor to generate CO_2e intensity values. The total CO_2e emissions from each building type are calculated by multiplying the CO_2e intensity values by the appropriate metric (building square footage for non-residential buildings or number of dwelling units for residential buildings). Summing the CO_2e emissions from all building types gives the total CO_2e emissions from electricity use in Title 24 and non-Title 24 sources in buildings.

Based on the natural gas intensity, CO_2e intensity values (CO_2e emissions per square foot or dwelling unit, as applicable, per year) for each building type can be calculated. Natural gas intensity data is multiplied by a natural gas emission factor to generate CO_2e intensity values. The total CO_2e emissions from each building type are calculated by multiplying the CO_2 intensity values by the appropriate metric (building square footage for non-residential buildings or number of dwelling units for residential buildings). Summing the CO_2e emissions from all building types gives the total CO_2e emissions from natural gas use in Title 24 and non-Title 24 sources in buildings.

5.3.1 Natural Gas Boilers

GHG emissions from the combustion of natural gas are calculated as the product of natural gas consumption, natural gas heat content, and carbon-intensity factor. The Project Applicant has to determine the natural gas consumption, while the heat content and carbon-intensity factor can obtained from the CCAR General Reporting Protocol.

5.4 Area Sources

Area sources are local combustion of fuel. The area sources covered in this section include natural gas fireplaces/stoves and landscape maintenance equipment. Natural gas usage from the primary building heating is not included in this category since it is already included with building energy use. Each of these area sources is discussed further.

5.4.1 Natural Gas Fireplaces/Stoves

GHG emissions associated with natural gas fired fireplaces are calculated using emission factors from CCAR. The average BTU per hour for fireplaces in homes needs to be specified. Default values for annual fireplace usage varies for each County. Natural gas is assumed to have 1,020 BTU per standard cubic foot[24].

5.4.2 Landscape Maintenance

Landscape maintenance includes fuel combustion emissions from equipment such as lawn mowers, roto tillers, shredders/grinders, blowers, trimmers, chain saws, and hedge trimmers, as well as air compressors, generators, and pumps.

Similar to construction off-road equipment, emission factors are based on the OFFROAD2007 model. These are combined with the hours of operation for each equipment piece as well as the horsepower and load factors. The GHG emissions will be calculated based on the emission factors for the equipment and fuel reported from OFFROAD2007 and the appropriate GWP. Default usages (hours of operation) should be determined for the landscape equipment based on the Project needs.

5.5 Water

Delivering and treating water for use at the project site requires energy. This embodied energy associated with the distribution of water to the end user is associated with the electricity to pump and treat the water. GHG emissions due to water use are related to the energy used to convey, treat and distribute water. Thus, these emissions are indirect emissions from the production of electricity to power these systems.

The amount of electricity required to treat and supply water depends on the volume of water involved. Three processes are necessary to supply water to users: (1) supply and conveyance of the water from the source; (2) treatment of the water to potable standards; and (3) distribution of the water to individual users.

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[24] USEPA. 1998. AP-42 Emission Factors. Chapter 1.4 Natural Gas Combustion.

Therefore, to quantify the GHG emissions associated with the distribution of water to an end user, the carbon intensity of electricity is used along with the amount of electricity used in pumping and treating the water. Since consumption of water varies greatly for each land use type, default values need to be determined with several listed in the mitigation measure fact sheets. Since buildings may have different percentages of water associated with indoor and outdoor water usage, the water usage is quantified separately. In addition since mitigation measures associated with water use may be directed separately toward indoor and outdoor water usage, this will be beneficial for this task.

5.5.1 Indoor

Indirect emissions resulting from electricity use are determined by multiplying electricity use by the CO_2e emission factor provided by the local electricity supplier. Energy use per unit of water for different aspects of water treatment (e.g. source water pumping and conveyance, water treatment, distribution to users) is determined using the stated volumes of water and energy intensities values (i.e., energy use per unit volume of water) provided by reports from the California Energy Commission (CEC) on energy use for California's water systems.[25] The CEC report estimates the electricity required to extract and convey one million gallons of water. Using this energy intensity factor, the expected indoor water demand, and the utility-specific carbon-intensity factor, GHG emissions from indoor water supply and conveyance may be calculated.

The amount of electricity required to treat and distribute one million gallon of potable water is estimated in the CEC report. Based on the estimated indoor water demand, these energy intensity factors, and the utility-specific carbon intensity factor, GHG emissions from indoor water treatment and distribution may be calculated.

The sum of emissions due to supplying, conveying, treating, and distributing indoor water gives the total emissions due to indoor water use.

5.5.2 Outdoor

Indirect emissions resulting from electricity use are determined by multiplying electricity use by the CO_2 emission factor provided by the local electricity supplier. Energy use per unit of water for different aspects of water treatment (e.g. source water pumping and conveyance, water treatment, distribution to users) is determined using the stated volumes of water and energy intensities values (i.e., energy use per unit volume of water) provided by reports from the California Energy Commission (CEC) on energy use for California's water systems.[26] The

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[25] CEC 2005. California's Water-Energy Relationship. Final Staff Report. CEC-700-2005-011-SF,

CEC 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.

[26] CEC 2005. California's Water-Energy Relationship. Final Staff Report. CEC-700-2005-011-SF,

CEC 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.

energy needed to supply and convey the water will be used to pump this water from the sources and distribute it throughout the development. The CEC report estimates the electricity required to extract and convey one million gallons of water. Using this energy intensity factor, the expected outdoor water demand, and the utility-specific carbon-intensity factor, GHG emissions from outdoor water supply and conveyance may be calculated.

The amount of electricity required to treat and distribute one million gallon of potable water (see recycled water for non-potable water) is estimated in the CEC report. Based on the estimated outdoor water demand, these energy intensity factors, and the utility-specific carbon intensity factor, GHG emissions from outdoor water treatment and distribution may be calculated.

The sum of emissions due to supplying, conveying, treating, and distributing outdoor water gives the total emissions due to outdoor water use.

5.5.2.1 Landscape Watering – Turf Grass

The amount of outdoor water used in the landscape watering of turf grass is calculated based on the California Department of Water Resources (CDWR) 2009 Model Water Efficient Landscape Ordinance[27] and the CDWR 2000 report "A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California: The Landscape Coefficient Method and WUCOLS III."[28] Using this methodology, the amount of water required to support the baseline turf water demand ($Water_{baseline}$) is calculated as follows:

$$ETC = Kc \times ET_0$$

Where:

ETC	=	Crop Evapotranspiration, the total amount of water the baseline turf loses during a specific time period due to evapotranspiration[29] (inches water/day)
KC	=	Crop Coefficient, factor determined from field research, which compares the amount of water lost by the crop (e.g. turf) to the amount of water lost by a reference crop (unitless). Species-specific; provided in CDWR 2000
ET_0	=	Reference Evapotransporation, the amount of water lost by a reference crop (inches water/day) Region-specific; provided in Appendix A of CDWR 2009

[27] California Department of Water Resources. 2009. Model Water Efficient Landscape Ordinance. Available online at: http://www.water.ca.gov/wateruseefficiency/docs/MWELO09-10-09.pdf

[28] California Department of Water Resources. 2000. A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California: The Landscape Coefficient Method and WUCOLS III. Available online at: http://www.water.ca.gov/pubs/conservation/a_guide_to_estimating_irrigation_water_needs_of_landscape_plantings_in_california__wucols/wucols00.pdf

[29] Evapotranspiration is water lost to the atmosphere due to evaporation from soil and transpiration from plant leaves. For a more detailed definition, see this California Irrigation Management Information System (CIMIS) website: http://wwwcimis.water.ca.gov/cimis/infoEtoOverview.jsp;jsessionid=91682943559928B8A9A243D2A2665E19

Then:

$$Water_{baseline} = ETC \times Areabaseline \times 0.62 \times 365$$

Where:

$Water_{baseline}$	=	Volume of water required to support the baseline turf (gallons/year)
$Area_{baseline}$	=	Area of existing or standard turf (square feet)
0.62	=	conversion factor (gallons/squarefoot.inches water)
365	=	conversion factor (days/year)

Based on the estimated outdoor water demand for watering turf grass, the outdoor water energy intensity factors described above, and the utility-specific carbon intensity factor, GHG emissions from watering turf grass in lawns may be calculated.

5.5.2.2 Landscape Watering – General

The amount of outdoor water used in the landscape watering of landscapes and lawns is calculated based on the California Department of Water Resources (CDWR) 2009 Model Water Efficient Landscape Ordinance.[30] Using this methodology, the amount of water required to support the baseline lawn water demand ($Water_{baseline}$) is defined as the Maximum Applied Water Allowance (MAWA) and is calculated as follows:

$$Water_{baseline} = MAWA = ET_0 \times 0.62 \times [(0.7 \times LA) + (0.3 \times SLA)]$$

Where:

$Water_{baseline}$	=	Volume of water required to support the baseline lawn (gallons/year)
MAWA	=	Maximum Applied Water Allowance (gallons/year)
ET_0	=	Annual Reference Evapotranspiration[31] from Appendix A of CDWR 2009 (inches per year)
0.7	=	ET Adjustment Factor (ETAF)
LA	=	Landscape Area[32] includes Special Landscape Area[33] (square feet)

[30] California Department of Water Resources. 2009. Model Water Efficient Landscape Ordinance. Available online at: http://www.water.ca.gov/wateruseefficiency/docs/MWELO09-10-09.pdf

[31] Evapotranspiration is water lost to the atmosphere due to evaporation from soil and transpiration from plant leaves. For a more detailed definition, see this California Irrigation Management Information System (CIMIS) website: http://wwwcimis.water.ca.gov/cimis/infoEtoOverview.jsp;jsessionid=91682943559928B8A9A243D2A2665E19

[32] § 491 Definitions in CDWR 2009: "Landscape Area (LA) means all the planting areas, turf areas, and water features in a landscape design plan subject to the Maximum Applied Water Allowance calculation. The landscape area does not include footprints of buildings or structures, sidewalks, driveways, parking lots, decks, patios, gravel or stone walks, other pervious or non-pervious hardscapes, and other non-irrigated areas designed fro non-development (e.g., open spaces and existing native vegetation)."

[33] § 491 Definitions in CDWR 2009: "Special Landscape Area (SLA) means an area of the landscape dedicated

0.62	=	Conversion factor (to gallons per square foot)
SLA	=	Portion of the landscape area identified as Special Landscape Area (square feet)
0.3	=	the additional ETAF for Special Landscape Area

Based on the estimated outdoor water demand for watering lawns, the outdoor water energy intensity factors described above, and the utility-specific carbon intensity factor, GHG emissions from watering lawns may be calculated.

5.5.3 Recycled Water

After use, wastewater is treated and reused as reclaimed water. Any reclaimed water produced is generally redistributed to users via pumping. An estimate of the non-potable water demand to be met through the distribution of recycled water is needed. Estimates of the amount of energy needed to redistribute and, if necessary, treat reclaimed water is 400 kW-hr per acre foot.[34] Based on the estimated demand for reclaimed water, the estimated electricity demand and the utility-specific carbon-intensity factor, non-potable reclaimed water redistribution emissions are calculated.

5.5.4 Process

Industrial land uses can use a large amount of water for their processes. The water used for this will not be quantified since there is not sufficient water use data for this type of land use for the development of a default value. Water use is highly dependent on the specific industry..

5.6 Wastewater

Emissions associated with wastewater treatment include indirect emissions necessary to power the treatment process and direct emissions from degradation of organic material in the wastewater.

5.6.1 Direct Emissions

Direct emissions from wastewater treatment include emissions of CH_4 and biogenic CO_2. The method described by the Local Government Operations Protocol developed by the California Air Resources Board is suggested with default values assigned since detailed plant specific data will typically not be available.[35] The assumed daily 5-day carbonaceous biological oxygen

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solely to edible plants, areas irrigated with recycled water, water features using recycled water and areas dedicated to active play such as parks, sports fields, golf courses, and where turf provides a playing surface."

[34] CEC 2005. California's Water-Energy Relationship. Final Staff Report. CEC-700-2005-011-SF.

[35] California Air Resources Board. 2008. *Local Government Operations Protocol - for the quantification and reporting of greenhouse gas emissions inventories*. Version 1.0. September 2008. Developed in partnership by California Air Resources Board, California Climate Action Registry, ICLEI - Local Governments for Sustainability, The Climate Registry

demand (BOD_5) of 200 mg/L-wastewater is multiplied by the protocol defaults for maximum CH_4-producing capacity (0.6 kg-CH_4/kg-BOD_5) and other default values to obtain the direct CH_4 emission. The amount of digester gas produced per volume of wastewater, and amount of N_2O per volume of wastewater needs to be determined. These values are then multiplied by the Global Warming Potential factor[36] of 21 for CH_4 or 310 for the GWP of N_2O that would be generated otherwise to obtain the annual CO_2 equivalent emissions.

5.6.2 Indirect Emissions

Indirect GHG emissions result from the electricity necessary to power the wastewater treatment process. The electricity required to operate a wastewater treatment plant is estimated to be 1,911 kW-hr per million gallons.[37] Based on the expected amount of wastewater requiring treatment, which will be assumed to be equal to the indoor potable water demand absent other data, the energy intensity factor and the utility-specific carbon-intensity factor, indirect emissions due to wastewater treatment are calculated.

5.7 Public Lighting

Lighting sources contribute to GHG emissions indirectly, via the production of the electricity that powers these lights. Lighting sources considered in this source category include streetlights, traffic lights, and parking lot lights. The annual electricity use may be estimated using the number of heads, the power requirements of each head, and the assumption that they operate for 12 hours a day on average for 365 days per year or 24 hours for traffic lights. The emission factor for public lighting is the utility-specific carbon-intensity factor. Multiplying the electricity usage by the emission factor gives an estimate of annual CO_2e emissions from public lighting.

5.8 Municipal Vehicles

GHG emissions from municipal vehicles are due to direct emissions from the burning of fossil fuels. Municipal vehicles considered in this source category include vehicles such as police cars, fire trucks, and garbage trucks. Data from reports by Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, California[38] show that the CO_2 emissions from municipal

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[36] Intergovernmental Panel on Climate Change. IPCC Second Assessment - Climate Change 1995.

[37] CEC 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.

[38] City of Medford. 2001. Climate Action Plan. October. http://www.massclimateaction.org/pdf/MedfordPlan2001.pdf

City of Northampton. 2006. Greenhouse Gas Emissions Inventory. Cities for Climate Protection Campaign. June. http://www.northamptonma.gov/uploads/listWidget/3208/NorthamptonInventoryClimateProtection.pdf

City of Santa Rosa. Cities for Climate Protection: Santa Rosa. http://ci.santa-rosa.ca.us/City_Hall/City_Manager/CCPFinalReport.pdf

Skoog., C. 2001. Greenhouse Gas Inventory and Forecast Report. City of Duluth Facilities Management and The International Council for Local Environmental Initiatives. October.http://www.ci.duluth.mn.us/city/information/ccp/GHGEmissions.pdf vehicles would be approximately[39] 0.05 MT per capita per year. Using these studies and the expected population, emissions from municipal vehicles may be calculated.

5.9 On-Road Mobile Sources

This section estimates GHG emissions from on-road mobile sources. The on-road mobile source emissions considered a project will be from the typical daily operation of motor vehicles by project residents and non-residents. The GHG emissions based upon all vehicle miles traveled associated with residential and non-residential trips regardless of internal or external destinations or purpose of trip are estimated. Traffic patterns, trip rates, and trip lengths are based upon the methods discussed below.

The CCAR GRP[40] recommends estimating GHG emissions from mobile sources at an individual vehicle level, assuming knowledge of the fuel consumption rate for each vehicle as well as the miles traveled per car. Since these parameters are not known for a future development, the CCAR guidance can not be used as recommended.

Estimating Trip Rates

The majority of transportation impact analysis conducted for CEQA documents in California apply trip generation rates provided by the Institute of Transportation Engineers (ITE) in their regularly updated report *Trip Generation*. The report is based on traffic counts data collected over four decades at built developments throughout the United States. This data is typically based on single-use developments, in suburban locations with ample free parking and with minimal transit service and demand management strategies in place. As a result, the ITE trip generation rates represent upper bound trip generation rates for an individual land use type. This represents a good basis against which to measure the trip-reducing effects of any one or more of the mitigation strategies that will be quantified in subsequent tasks. Therefore, we recommend ITE trip rates as the baseline condition against which the effectiveness of CAPCOA's mitigation measures is applied.

There are some CEQA traffic studies that use data other than ITE trip generation rates. Below we briefly discuss the possible use of these alternative datasets. These traffic studies typically use trip generation data from one of the following sources:

SANDAG Traffic Generators. In the San Diego region, most studies use data from the SANDAG *Traffic Generators* report. This report is similar to the ITE *Trip Generation* in that it uses primarily suburban, single use developments, except that this dataset is based on traffic counts conducted in the San Diego region rather than throughout the United States. In studies where the SANDAG data is used, CAPCOA reviewers should apply the trip reduction estimates presented in subsequent tasks directly to the SANDAG trip generation rates.

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[39] In an effort to be conservative, the largest per capita number from these four reports was used.

[40] California Climate Action Registry (CCAR). 2009. *General Reporting Protocol*. Version 3.1. January.

Travel Forecast Models. For some large development projects or general plans, the local or regional travel model is used to estimate the number of trips generated as well as trip lengths and vehicle speeds at which the individual trips occur. These models account for whether the trip segment occurs on a freeway or local streets as well as the degree of congestion. The values for trip generation rates and trip lengths using ITE and average trip lengths can be to assess the model estimates of vehicle trip generation and VMT. These comparisons should recognize that the travel models explicitly account for various factors that reduce trip-making and VMT, including the demographic characteristics of the site occupants, location and accessibility of the development site relative to other destinations in the region, the mix of land uses within the site and its surrounding area, and possibly the availability of effective transit service. When performing a comparison using the ITE trip rates and average trip lengths, the reviewer should take into consideration that these factors have already been accounted for in the modeling. Therefore, we recommend applying ITE trip rates and lengths along with the adjustments recommended elsewhere in this document (accounting for site location, design and demographics) as a means of reality-checking transportation model results.

Traffic counts at comparable developments. Some traffic assessments elect to conduct traffic counts at existing developments that are similar to the proposed development. When reviewing impact assessments produced using such information, the reviewer should take into account the extent to which the surveyed development(s) already contain trip generation and trip length reducing measures. Care needs to be used to avoid double-counting reductions.

Estimating VMT from Mobile Sources

Data on average trip lengths are used to translate trip generation rates into vehicle miles of travel (VMT). These trip lengths should be obtained from published sources of average trip lengths for different types of trip types (i.e., commute trips, shopping trips, and others) for each region within the state. Vehicle miles traveled (VMT) are calculated by multiplying ITE trip rates by the typical trip lengths.

Some mechanisms that reduce trip generation rates and trip lengths below these standard ITE-trip rates and current average trip lengths might be considered to be intrinsic parts of the development proposal rather than mitigation measures, such as project location (e.g., infill or transit oriented development [TOD]), density, mix of uses, and urban design. These are not considered part of the baseline condition, but are recognized and quantified as project design features (PDFs). This approach has the following advantages: 1) it creates a consistent basis of analysis for all development projects regardless of location and self-mitigating features already included in the project proposal, and 2) it highlights all elements of a project that reduce trip generation rates and vehicle miles traveled.

Other Factors Influencing Mobile Source GHG Emissions

Beyond trip generation, trip length and VMT, other factors that affect GHG emissions include traffic flow, vehicle fuel consumption rates, and fuel type.

Traffic speed and efficiency profiles are largely influenced by: a) the project location and degree of prevailing congestion in its vicinity, b) the degree to which the project implements traffic level-of-service mitigation measures often triggered by CEQA review, and c) actions taken by local, regional governments and Caltrans to reduce corridor or area-wide congestion.

The simplified mitigation assessment methods developed for this study use several categories of emissions factors per VMT that account for a) the generalized project location (core infill, inner ring suburbs, outer suburbs, rural), and b) and region-specific fleet and emissions rate if available.

While it is beyond the scope of this document to provide CAPCOA the ability to perform traffic speed and efficiency analysis, the study report advises CAPCOA on the type of analysis to expect to see in CEQA documents on development projects. CEQA impact and mitigation assessment methods should continue to perform air quality analysis using tools such as EMFAC that reference prevailing traffic speed profiles, especially for infill development and congested corridors, while applying appropriate credit for congestion reducing measures included in the project mitigation requirements, funded capital improvements plans, and fiscally constrained Regional Transportation Plans (RTPs.)

5.9.1 Estimating GHG Emissions from Mobile Sources

The CO_2 emissions from mobile sources were calculated with the trip rates, trip lengths and emission factors for running and starting emissions from EMFAC2007 as follows:

$$CO_2\ emissions = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled
$EF_{running}$ = emission factor for running emissions

The CO_2e calculation involves the following assumptions:

- The emission factor depends upon the speed of the vehicle.
- EMFAC emission factors from the baseline year will be used for $EF_{running}$ based on County specific fleet mix for different trip types and adjusted to account for applicable regulations that are not currently incorporated yet into EMFAC.

Startup emissions are CO_2 emitted from starting a vehicle. Startup emissions are calculated using the following assumptions:

- The number of starts is equal to the number of trips made annually.
- The breakdown in vehicles is EMFAC fleet mix for County specific fleet mix.
- The emission factor for startup is calculated based on a weighted average of time between starts for each trip type (commute trips versus all other types).

Fleet distribution types will be based on EMFAC2007 or the most recent EMFAC version available. For mobile sources, the USEPA recommends assuming that CH_4, N_2O, and HFCs account for 5% of GHG emissions from on-road vehicles, taking into account their GWPs.[41] To incorporate these additional GHGs into the calculations, the total GHG footprint is calculated by dividing the CO_2 emissions by 0.95.

Emission factors for alternative fuel can be obtained from the CCAR General Reporting Protocol. For comparison with alternative fuel, N_2O and CH_4 emissions should be calculated separately as their emissions from alternative fuel are generally higher than from gasoline or diesel.

Low-emission-vehicle programs, such as neighborhood electric vehicles (NEV) or car sharing programs, will only be considered in accounting for GHG reductions if included in project-specific design or mitigation measures.

5.10 GHG Emissions from Specialized Land Uses

Below are methods to quantify GHG emissions from some additional land use categories that may be commonly found in development projects. These include golf courses and swimming pools. The methods proposed to determine GHG emissions associated with these sources is discussed in the following sections. The GHG emissions will typically fall into other categories such as landscape maintenance, water usage, and buildings, but since the data sources are different, they are explicitly described.

5.10.1 Golf Courses

Emission flux resulting from the construction of the golf course is not discussed, nor is the sequestration of CO_2 into the turf, trees, or lakes of the golf course. Operational CO_2 emissions were calculated for three areas: irrigation, maintenance (mowing), and on-site buildings' energy use. All three components are discussed in this section.

5.10.2 Calculating CO_2 Emissions from Irrigation of the Golf Course

The release of GHGs due to irrigation practices was calculated in two steps:

1. Identify the quantity of water needed.
2. Calculate the emissions associated with pumping the water.

1. *Identify the quantity of water needed.* Standard water use for an 18-hole golf course ranges from 250 to 450 acre-ft yearly. A survey of golf course superintendents conducted in the summer of 2003 by the Northern and Southern California Golf Associations revealed an annual average California usage of 345 acre-ft.[42] Numerous factors will affect the actual water usage

[41] USEPA. 2005. *Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle.* Office of Transportation and Air Quality. February.

[42] Northern California Golf Association. Improving California Golf Course Water Efficiency, pg 14. http://www.owue.water.ca.gov/docs/2004Apps/2004-079.pdf

of a specific golf course, and it is likely to vary by year. ENVIRON recommends using the average usage of 345 acre-ft per year annually.

2. Calculate the associated emissions. Using the information identified above, ENVIRON calculates total emissions from irrigation of an 18-hole golf course as follows:

Estimate total dynamic head: This is the combination of lift (300 feet) and desired pressure. Standard athletic field sprinklers require a base pressure of approximately 65 psi.[43]

$$
\begin{array}{lcl}
60 \text{ psi} \times 2.31 \text{ ft/psi}^{[44]} & = & 139 \text{ ft} \\
\underline{+ \text{ lift}} & = & \underline{300 \text{ ft}} \\
\text{Total dynamic head} & = & 439 \text{ ft}
\end{array}
$$

Identify fuel unit and multiply by head: Possible pumping fuels include electricity, natural gas, diesel, and propane. In these calculations, ENVIRON assumes that all pumps will use electricity. Based on the literature, ENVIRON recommends using a pumping energy use of 1.551 kW-hr/acre-ft/ft.[45]

$$1.551 \text{ kW-hr/acre-ft/ft} \times 439 \text{ ft} = 681 \text{ kW-hr/acre-foot}$$

Multiply energy demand by emission factor and convert to MT: The energy demand per acre-ft calculated above is multiplied by the emission factor for the electricity generation source and converted to MT.

$$\frac{681 \text{kW-hr/acre-ft} \times 0.666 \text{ lbs } CO_2\text{/kW-hr}}{2204.62 \text{ lbs/ton}} = 0.21 \text{ MT } CO_2\text{/acre-ft}$$

The anticipated annual water demand will be multiplied by these values and then combined this with the calculated emission factor yields total annual emissions from irrigation of the golf course. Other outdoor land uses that require irrigation can follow a similar procedure.

5.10.3 Calculating CO_2 Emissions from Maintenance of the Golf Course

Maintenance emissions include the emissions resulting from the mowing of turf grass. The release of GHGs due to mowing was calculated in three steps:

1. Identify the area of turf and frequency of mowing.
2. Identify the efficiency of a typical mower.

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[43] Full Coverage Irrigation. Partial List of Customers Using FCI Nozzles. http://www.fcinozzles.com/clients.asp.

[44] Conversion factor: 1 psi = 2.31 feet of head. Kele & Associates Technical Reference: Liquid Level Measurement. http://www.kele.com/tech/monitor/Pressure/LiqLevMs.pdf

[45] Kansas State University Irrigation Management Series. Comparing Irrigation Energy Costs. Table 4. http://www.oznet.ksu.edu/library/ageng2/mf2360.pdf

3. Calculate the emissions associated with mowing.

1. *Identify the area of turf and frequency of mowing*: An Arizona State economic analysis of golf courses reports that on average 2/3 of the land within a golf course is maintained.[46] ENVIRON suggests assuming that the course will be mowed twice weekly, although high maintenance areas such as greens will be mowed more frequently.[47] ENVIRON recommends a growing season of 52 weeks/year.[48]

2. *Identify the efficiency of a typical mower*. Typical mower calculations are based on the specifications for a lightweight fairway mower (model 3235C) reported by John Deere's Golf & Turf division.[49] A typical mower will use one tank (18 gallons) of diesel per day (assumed to be 8 hours). Given the size specifications of the mower and assuming an average speed of 5.5 mph, such a mower can cover 44 acres on 18 gallons of diesel.

3. *Calculate the emissions associated with mowing*. Using the information collected above and a CO_2 emission factor for diesel combustion[50], ENVIRON calculates the emission factor for mowing the golf course:

$$\frac{2 \text{ mowings/}}{\text{week}} \times \frac{52 \text{ weeks/}}{\text{year}} \times \frac{18 \text{ gallons diesel/}}{44 \text{ acre-mowing}} \times \frac{22.4 \text{ lbs } CO_2\text{/ gallon diesel}}{2204 \text{ lbs/ton}} = 0.43 \text{ MT } CO_2\text{/ acre-year}$$

5.10.4 Calculating CO_2 Emissions from Building Energy Use at the Golf Course

Any of the non-residential building energy use data sources described in the Buildings section may be used to estimate energy intensity at the golf course.

5.11 Pools

Recreation centers may include various pools, spas, and restroom buildings; ENVIRON assumes that pools are the main consumers of energy in recreation centers. This section describes the methods used to estimate the GHGs associated with pools in recreation centers.

The energy used to heat and maintain a swimming pool depends on several factors, including (but not limited to): whether the pool is indoors or outdoors, size of the pool (surface area and depth), water temperature, and energy efficiency of pool pump and water heater, and whether

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[46] Total acreage divided by total acreage maintained. Arizona State University, Dr. Troy Schmitz. Economic Impacts and Environmental Aspects of the Arizona Golf Course Industry. http://agb.poly.asu.edu/workingpapers/0501.pdf.

[47] Based on Best Practices video. http://buckeyeturf.osu.edu/podcast/?p=51

[48] Based on 95% of Southern California Survey respondents report an irrigation season greater than 9-10 months. http://www.owue.water.ca.gov/docs/2004Apps/2004-079.pdf

[49] John Deere Product Specifications. 3235C Lightweight Fairway Mower. http://www.deere.com/en_US/ProductCatalog/GT/series/gt_lwfm_c_series.html

[50] EIA. Fuel and Energy Source Codes and Emission Coefficients. http://www.eia.doe.gov/oiaf/1605/factors.html

solar heating is used. By making assumptions for these parameters and using known or predicted values for energy use, ENVIRON estimates the electricity and natural gas use of an outdoor pool.

5.11.1 Recreation Center Characterization

In the calculations described below, ENVIRON assumes that the proposed pools will be outdoor pools with dimensions 50 meters by 22.9 meters (a typical, competition-size pool). ENVIRON bases electricity calculations on a pool that ran its standard water filter for 24 hours per day, 365 days per year. As there is little data publicly available on the energy use of commercial swimming pools, ENVIRON extrapolates energy consumption from information obtained from two sources: 1) Data on electricity used by pool pumps from Pacific Gas and Electric (PG&E),[51] and 2) Data on the annual cost to heat a commercial pool located in Carlsbad, CA.[52]

5.11.2 Electricity Use of Pools

A PG&E study on energy efficiency of a pool pump at the Lyons Pool in Oakland, CA, found an annual electricity use of 110,400 kilowatt hours per year (kWh per yr).[53] The study pool is smaller than the assumed size of the proposed pool (actual size of the Lyons Pool is 35 yards by 16 yards). Accordingly, ENVIRON scales the electricity use to reflect the larger size of the proposed pool.

5.11.3 Natural Gas Use of Pools

The estimated annual cost of heating a standard competition-size pool is $184,400 (or 72% of the total cost of pool operations).[54] ENVIRON used the average PG&E commercial rate for natural gas of $0.95 per therm to convert this cost into annual natural gas use (hundred cubic feet per year [ccf/year]).[55] The commercial rate averages the variable cost due to energy usage and time of year. This corresponds to approximately 184,400 ccf per year.[56]

This value is comparable to that obtained from the pool industry.[57] The estimated cost of heating a residential pool using a natural gas heater is about one dollar per square foot of water

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[51] PG&E. 2006. Energy Efficient Commercial Pool Program, Preliminary Facility Report. Lyons Pool, "City of Oakland/Oakland Unified School District." October.

[52] Mendioroz, R. 2006. Fueling Change: A Number of Design Schemes and Alternative-Energy Strategies Can Help Operators Beat the Price of Natural Gas. Athletic Business. March.

[53] PG&E. 2006. Energy Efficient Commercial Pool Program, Preliminary Facility Report. Lyons Pool, "City of Oakland/Oakland Unified School District." October.

[54] Mendioroz, R. 2006. Fueling Change: A Number of Design Schemes and Alternative-Energy Strategies Can Help Operators Beat the Price of Natural Gas. Athletic Business. March.

[55] Pacific Gas and Electric (PG&E). 2007. Gas Rate Finder. Vol 36-G, No. 9. September. http://www.pge.com/tariffs/GRF0907.pdf

[56] At the commercial rate given 1 ccf costs $1.

[57] SolarCraft Services Inc. 2007. Phone conversation with Chris Bumas on September 18, 2007. Novato, CA http://www.solarcraft.com/

surface area per month ($/sqft-month) in residential therms.[58] Applying this value to a competition-size pool yields an annual natural gas use of 147,600 ccf/year.

5.11.4 Conversion of Electricity and Natural Gas Use to Greenhouse Gas Emissions

ENVIRON used utility-specific electricity and natural gas emission factors to calculate the total CO_2 emissions for each pool. A summary of the calculations is shown below:

$$Emissions\ from\ Electricity\left(\frac{Tonnes\,CO_2 / yr}{1{,}000\,sqft}\right) = \frac{Energy\,Use\,(ccf / yr) \times Emission\,Factor\,(lbs\,CO_2e / ccf) \times Conversion\,Factor\,(tonne / 2205\,lbs)}{Surface\ Area\ of\ Pool\,(1{,}000\,sqft)}$$

$$Emissions\ from\ Natural\,Gas\left(\frac{Tonnes\,CO_2 / yr}{1{,}000\,sqft}\right) = \frac{Energy\,Use\,(ccf / yr) \times Emission\,Factor\,(lbs\,CO_2e / ccf) \times Conversion\,Factor\,(tonne / 2205\,lbs)}{Surface\ Area\ of\ Pool\,(1{,}000\,sqft)}$$

[58] The residential price for one therm of natural gas.

Appendix C

Transportation Appendices

Appendix C.1

Transportation Calculations

Appendix C.1 – Transportation Calculations

Table C-1 provides further detail into the calculations of percent reduction in vehicle miles traveled (VMT) for each of the fact sheets (that have references to the appendix). Many of the strategies in the table below do not provide the full equations for percent reduction in vehicle miles traveled. Only the equations or variables which require further detail are outlined here. The table also provides detail on any assumptions which are made to perform the calculations and the basis of such assumptions. An additional section below Table C-1 provides a detailed discussion of the calculations made for the transit accessibility strategy.

Table C-1
Transportation Calculations

Strategy	T#	Equation	Variable	Value	Source/Notes
Increase Density (Land Use/Location)	A2	A = Percentage increase in housing units per acre = (number of housing units per acre – number of housing units per acre for typical ITE development) / (number of housing units per acre for typical ITE development)	number of housing units per acre for typical ITE development	7.6 = blended average density of residential development in the US in 2003	A.C. Nelson. “Leadership in a New Era.” *Journal of the American Planning Association,* Vol. 72, Issue 4, 2006, pp. 393-407 – as cited in *Growing Cooler*
		A = Percentage increase in jobs per job acre = (number of jobs per job acre – number of jobs per job acre for typical ITE development) / (number of jobs per job acre for typical ITE development)	number of jobs per job acre for typical ITE development	20 = average jobs per job acre	Year 2005 Land Use, Sacramento County Travel Demand Model, 2008
Improve Design of Development (Land Use/Location)	A3	A = Percentage increase in intersections versus a typical ITE suburban development = (intersections per square mile of project – intersections per square mile of typical ITE suburban development) / (intersections per square mile of typical ITE suburban development)	intersections per square mile of typical ITE suburban development	36 = ITE site average intersection density	Based on Fehr & Peers methodology for analysis in the report: *Proposed Trip Generation, Distribution, and Transit Mode Split Forecasts for the Bayview Waterfront Project Transportation Study*, Fehr & Peers, 2009

Table C-1 Transportation Calculations					
Strategy	**T#**	**Equation**	**Variable**	**Value**	**Source/Notes**
Increase Diversity (Mixed Use) (Land Use/Location)	A5	A = Percentage increase in land use index versus single use development = (project land use index – single land use index) / single land use index	single land use index	0.15 = - [1*(ln 1) + 0.01*(ln 0.01)+…+0.01*(ln 0.01)]/ ln(6)	--
Increase Destination Accessibility (Land Use/Location)	A6	A = Percentage decrease in distance to downtown or major job center = (distance to downtown/job center for typical ITE development – distance to downtown/job center for project) / (distance to downtown/job center for typical ITE development)	distance to downtown/job center for typical ITE development	12 miles (average work trip length from NHTS)	2000-2001 California Statewide Travel Survey, 2001 NHTS Summary of Travel Trends, p.15 (Table 5)
Increase Transit Accessibility (Land Use/Location)	A7	A = Increase in transit mode share = % transit mode share for project - % transit mode share for typical ITE development	% transit mode share for typical ITE development	1.3%	NHTS, 2001 http://www.dot.ca.gov/hq/tsip/tab/documents/travelsurveys/Final2001_StwTravelSurveyWkdayRpt.pdf, p.150 (Suburban – SCAG, SANDAG, Fresno County.)
		B = Adjustment from transit mode share to VMT = 1 / average vehicle occupancy * conversion from VT to VMT = 0.67	Divide by average vehicle occupancy to translate to VT	1 / average vehicle occupancy = 1 / 1.5 = 0.67	NHTS, http://www.dot.ca.gov/hq/tsip/tab/documents/travelsurveys/2000_Household_Survey.pdf, p.iii
			conversion from VT to VMT	1	Assume all trip lengths are equal (vehicle trips to VMT) [1]

[1] To convert to vehicle miles traveled, we assume that all vehicle trips will average out to typical trip length ("assume all trip lengths are equal"). Thus, we can assume that a percentage reduction in vehicle trips will equal the same percentage reduction in vehicle miles traveled.

Table C-1 Transportation Calculations					
Strategy	**T#**	**Equation**	**Variable**	**Value**	**Source/Notes**
Unbundle Parking Cost from Property Cost (Parking Pricing/Policy)	C3	A = Adjustment from Vehicle Ownership to VMT = average trips per 2 vehicles * 1 vehicle per average trips =(9.8 trips/ 2 vehicles) * (1 vehicle / 5.7 trips) = 0.85	Average trips per X vehicles	Households with 2 vehicles take 9.8 trips while households with 1 vehicle take 5.7 trips per day	i.e. A reduction of 1 vehicle leads to an 0.85 reduction in vehicle trips http://www.dot.ca.gov/hq /tsip/tab/documents/travel surveys/2000_Household _Survey.pdf, table 8.7
Expand Transit Network (Transit System Improvements)	D2	D = Adjustment for Transit Ridership Increase to VMT	--	0.67	see Increase Transit Accessibility
Enhance Transit Service Frequency/Speed (Transit System Improvements)	D3	E = Adjustment for Transit Ridership Increase to VMT	--	0.67	see Increase Transit Accessibility
Implement Bus Rapid Transit (Transit System Improvements)	D4	D = Adjustment for Transit Ridership Increase to VMT	--	0.67	see Increase Transit Accessibility
Implement Required Trip Reduction Programs (Trip Reduction Programs)	E2	C = Adjustment from vehicle mode share to commute VMT	--	1	Assume all trip lengths are equal (vehicle mode share to vehicle trips to VMT) [i]
Provide a Transit Fare Subsidy (Trip Reduction Programs)	E3	C = Adjustment from commute VT to commute VMT	--	1	Assume all trip lengths are equal (vehicle trips to VMT) [i]
Implement Commute Trip Reduction Marketing (Trip Reduction Programs)	E7	C = Adjustment from commute VT to commute VMT	--	1	Assume all trip lengths are equal (vehicle trips to VMT) [i]

Table C-1 Transportation Calculations					
Strategy	**T#**	**Equation**	**Variable**	**Value**	**Source/Notes**
Provide Employer-Sponsored Vanpool/Shuttle (Trip Reduction Programs)	E8	C = Adjustment from vanpool mode share to commute VMT	--	0.67	see Increase Transit Accessibility
Implement Bike-Sharing Programs (Trip Reduction Programs)	E10	% VMT Reduction = A * B * C = 2% * 7% * 20% = 0.03%	--	--	--
		A = 2% = Net new bicycle mode share = (existing mode share * % increase in bicycle mode share) – existing mode share	Existing mode share	Estimate at 1%	Pucher et al., 2010
			% increase in bicycle mode share	135 – 300%	Pucher et al., 2010, Table 4 (see fact sheet for calculations)
		B = % of new bicycle trips shifting from vehicles (from literature)	--	6-7%	Pucher et al., 2010 and Bike-Share in NYC, 2009, Table 4, p.45
		C = adjustments to convert from vehicle mode share to VMT * adjustment for shorter than average trip lengths = 1*20%	adjustments to convert from vehicle mode share to VMT	1	Assume all trip lengths are equal (vehicle mode share to vehicle trips to VMT) [i]
			adjustment for shorter than average trip lengths	1.94/9.9 = 20%	Adjustment to reflect ratio of bike trip length to average trip length (this strategy will only replace the shorter vehicle trips that can be reasonably replaced by a bicycle). [1.94 miles (average bike trip length from Moving Cooler Appendices B-28 referencing NHTS) / 9.9 miles (average household trip length from NHTS Transferability, 2001 NHTS, http://nhts-gis.ornl.gov/transferability/Default.aspx)]

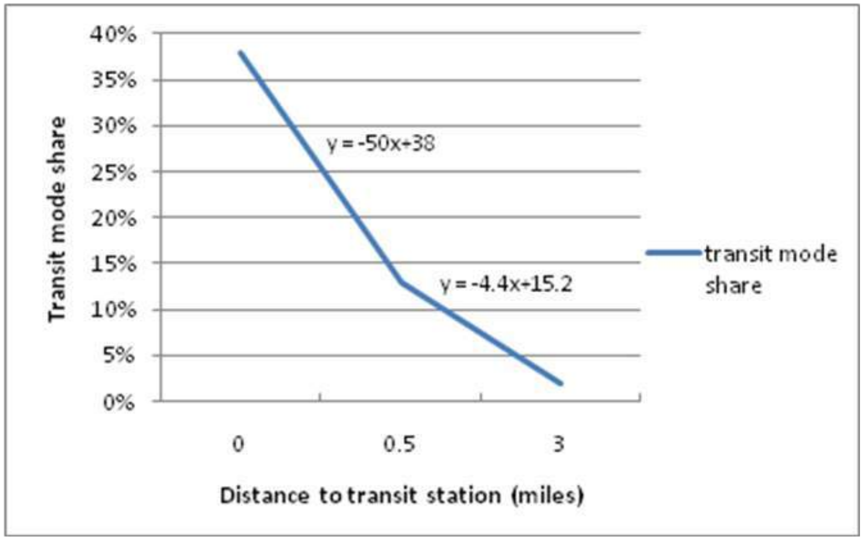
Table C-1 Transportation Calculations					
Strategy	**T#**	**Equation**	**Variable**	**Value**	**Source/Notes**
Provide End of Trip Facilities (Trip Reduction Programs)	E11	*utilizing the same equation in bike sharing program section, set A = 1.3% = (7.1% - 5.8%) % VMT Reduction = A * B * C = 1.3% * 7% * 20% = 0.02%	--	--	--
Establish Schoolpool (Trip Reduction Programs)	E13	B = Adjustments to convert from participation to daily VMT to annual school VMT = [(avg # of families per carpool - 1) / avg # of families per carpool] *% of school days	avg # of families per carpool	2.5	TDM Case Studies, DRCOG, p.13
			% of school days	75% = 39 school weeks/ 52 weeks	TDM Case Studies, DRCOG, p.13
Provide School Buses (Trip Reduction Programs)	E14	B = Adjustments to convert from participation to daily VMT to annual school VMT = % of school days	% of school days	75% = 39 school weeks/ 52 weeks	TDM Case Studies, DRCOG, p.13
Cordon Pricing (Road Pricing Management)	F2	A = % increase in pricing for passenger vehicles to cross cordon	--	100 – 500%	*Moving Cooler* uses peak hour price per mile instead of crossing price. The percentage change can still be calculated to provide a general estimate for a high range % change. Assuming a baseline of $0.10, calculated percentage increase to $0.49 - $0.65 (*Moving Cooler*) and adjusted with rounding
		C = % of VMT Impacted by Cordon Pricing and Mode Shift Adjustments = %VMT impacted by congestion pricing * Mode shift adjustment = 8.8% (peak period) and 21% (all day)	--	--	--

Table C-1 Transportation Calculations					
Strategy	**T#**	**Equation**	**Variable**	**Value**	**Source/Notes**
		Peak period = 25% * 35% = 8%	%VMT impacted by congestion pricing	25%	20% of trips are work trips (NHTS Transferability, 2001 NHTS, http://nhts-gis.ornl.gov/transferability/Default.aspx) and round up assuming other trips travel during peak periods
			Mode shift adjustment	35% = 20% + 30%/2	Of the estimated trips affected to the increase in price, assume 50% is either a time of day shift/route shift/no change, 30% convert to HOV trips (with average 2 ppl per HOV), and 20% are trip reductions/shift to transit, walk or bike
		Static all day price (London) = 60% * 35% = 21%	% VMT impacted by congestion pricing	60%	Conservatively assume 60% of trips fall in the peak periods and mid-day
			Mode shift adjustment	35%= 20% + 30%/2	Of the estimated reduced trips due to the increase in price, assume 50% is either a time of day shift/route shift/no change, 30% convert to HOV trips (with average 2 people per HOV), and 20% are trip reductions/shift to transit, walk or bike

Increase Transit Accessibility (Land Use/Location)

Distance to transit	Transit mode share calculation equation (where x = distance of project to transit)
0 – 0.5 miles	-50*x + 38

0.5 to 3 miles	-4.4*x + 15.2
> 3 miles	no impact
Source: Lund et al, 2004; Fehr & Peers 2010	



Data was taken from Table 5-25 of Lund et al, 2004. The table provided transit commute mode shares for those living with ½ mile of a rail station for 5 sites surveyed within California. Removing the extreme low and high percentages, this provided a range of transit commute mode share of 13% to 38%. A simple linear extrapolation was conducted to provide a relationship for distance to transit (between 0 and ½ mile) to transit mode share, via the equation: transit mode share = -50 * distance to transit + 38. The table also provided transit mode shares for those living from ½ to 3 miles from a station, a range from 2% to 13%. Using the same methodology, a relationship for distance to transit (between ½ mile and 3 miles) to transit mode share is provided via the equation: transit mode share = -4.4x + 15.2.

Appendix C.2

Trip Adjustment Factors

Appendix C.2 – Trip Adjustment Factors

The trip adjustment factors are not explicitly used for calculations of reduction in vehicle miles traveled (VMT) but serve as an added resource point for users of this document. For example, we report all commute trip reduction (CTR) program strategies as a percentage reduction in commute VMT. If the user would like to translate this to project level VMT (assuming the project is NOT an office park), and the user does not have statistics about the project area readily available, then the trip adjustment factors table can be utilized.

Example: Assume the user is providing a 15% reduction in commute VMT for a implementation of a ride share program. To calculate an estimated reduction in project level VMT, the user can multiple 15% by 20% (NHTS average % of work trips) and again multiply by 12.0 / 9.9 (average work trip length/average trip length) to adjust for both the portion of trips which are work related and that work trips tend to be longer than average trips.

TABLE C-2. TRIP ADJUSTMENT FACTORS

	NHTS[1]	Sacramento Region[2]	San Diego Region[3]	Rural (Kings County, CA)[4]
Average Work Trip Length (vehicle)	12.0	10.4	8.4	-
Average Trip Length (vehicle)	9.9	6.8	6.9	8.7
Average % of Work Trips	20%	20%	-	12%
Average % of School Trips	9.8%	-	-	-
Average Length of School Trips (Vehicle)	6.0	-	4.2	-
Average Vehicle Occupancy (All Trips)	1.5	1.4	1.5	-

Source:
1. 2000-2001 California Statewide Travel Survey, 2001 NHTS Summary of Travel Trends
2. SACMET model, Fehr & Peers, 2010.
3. SANDAG Brief Guide of Vehicular Traffic Generation Rates for the San Diego Region (April 2002)
4. NHTS Transferability, 2001 NHTS, http://nhts-gis.ornl.gov/transferability/Default.aspx

Appendix C.3

Induced Travel Memo

MEMORANDUM

Date: February 3, 2010

To: CAPCOA Team

From: Tien-Tien Chan, Jerry Walters, and Meghan Mitman

Subject: Induced Travel Material

SF10-0475

Induced travel is a term used to describe how travel demand responds to roadway capacity expansion and roadway improvements. Consistent with the theory of supply and demand, the general topic of research concerning induced travel is that reducing the cost of travel (i.e., reduced travel time due to a new road improvement) will increase the amount of travel. In other words, road improvements alone can prompt traffic increases. To what degree and under what circumstances these increases occur is a matter of debate and the key subject of most induced travel research. We have attached the following documents which represent research on induced travel effects:

- *Comparative Evaluations on the Elasticity of Travel Demand* – study conducted for the Utah DOT which included national literature review of induced travel studies
- *Are Induced-Travel Studies Inducing Bad Investments?* – article by Cervero in Access Magazine: Transportation Research at the University of California
- *Road Expansion, Urban Growth, Growth, and Induced Travel: A Path Analysis* – APA Journal paper by Cervero, also discusses the impacts of induced growth and induced investments

The reader should be aware that conditions may vary considerably and the extent of induced travel depends on a variety of factors, including: the degree of prior congestion in the corridor, its duration over hours of the day, its extent over lane miles of the corridor, the degree to which un-served traffic diverts to local streets and the degree of congestion on those routes, the availability of alternate modes within the corridor, whether corridor is radial and oriented toward downtown with high parking cost and limited availability or circumferential, planned level of growth in the corridor, whether the corridor is interstate or interregional, whether it is a truck route, and other factors.

GHG reduction strategies such as transportation system management (e.g. signal coordination, adaptive signal control) may also have the potential for inducing travel. For such strategies, if the estimated improvement exceeds 10% benefit in travel time reduction, we recommend conducting project specific analysis on induced travel prior to establishing GHG reduction benefits.

332 Pine Street, 4th Floor, San Francisco, CA 94104 (415) 348-0300 Fax (415) 773-1790

www.fehrandpeers.com

Appendix D

Building Mitigation Measure Quantification Methods

This Appendix summarizes the steps and assumptions used in two of the mitigation strategies – exceed Title 24 energy efficiency standards (BE-1) and installing energy efficient appliances (BE-4).

Background

GHGs are emitted as a result of activities in residential and commercial buildings when electricity and natural gas are used as energy sources. New California buildings must be designed to meet the building energy efficiency standards of Title 24, also known as the California Building Standards Code. Title 24 Part 6 regulates energy uses including space heating and cooling, hot water heating, ventilation, and hard-wired lighting. By committing to a percent improvement over Title 24, a development reduces its energy use and resulting GHG emissions.

The Title 24 standards have been updated twice (in 2005 and 2008)[1] since some of these data used to estimate energy use were compiled. California Energy Commission (CEC) has published reports estimating the percentage deductions in energy use resulting from these new standards. Based on CEC's discussion on average savings for Title 24 improvements, these CEC savings percentages by end use can be used to account for reductions in electricity and natural gas use due to the two most recent updates to Title 24. Since energy use for each different system type (ie, heating, cooling, water heating, and ventilation) as well as appliances is defined in this survey, the use of survey data with updates for Title 24 will easily allow for application of mitigation measures aimed at reducing the energy use of these devices in a prescriptive manner.

Another mitigation measure to reduce a building's energy consumption as well as the associated GHG emissions from natural gas combustion and electricity production is to use energy-efficient appliances. For residential dwellings, typical builder-supplied appliances include refrigerators and dishwashers. Clothes washers and ceiling fans would be applicable if the builder supplied them. For commercial land uses, only energy-efficient refrigerators have been evaluated for grocery stores.

1 California Energy Commission. 2003. Impact Analysis: 2005 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2005standards/archive/rulemaking/documents/2003-07-11_400-03-014.PDF
California Energy Commission. 2006. California Commercial End-Use Survey. Prepared by Itron Inc. Available at: http://www.energy.ca.gov/ceus/

Methodology

Datasets

The Residential Appliance Saturation Survey (RASS)[2] and California Commercial Energy Use Survey (CEUS)[3] datasets were used to estimate the energy intensities of residential and non-residential buildings, respectively, since the data is available for several land use categories in different climate zones in California. The RASS dataset further differentiates the energy use intensities between single-family, multi-family and townhome residences.

The Energy Star and Other Climate Protection Partnerships 2008 Annual Report[4] and subsequent Annual Reports were reviewed for typical reductions for energy-efficient appliances. ENERGY STAR residential refrigerators, clothes washers, dishwashers, and ceiling fans use 15%, 25%, 40%, and 50% less electricity than standard appliances, respectively. ENERGY STAR commercial refrigerators use 35% less electricity than standard appliances.

Calculations

Exceeding Title 24 Energy Efficiency Standards (BE-1)

RASS and CEUS datasets were used to obtain the energy intensities of different end use categories for different building types in different climate zones. Energy intensities from CEUS are given per square foot per year and used as presented. RASS presents Unit Energy Consumption (UEC) per dwelling unit per year and saturation values; the energy intensities used in this analysis are products of the UEC and saturation values.

Data for some climate zones is not presented in the CEUS and RASS studies. However, data from adjacent climate zones is assumed to be representative and substituted as follows:

For non-residential building types:
Climate Zone 11 used Climate Zone 9 data.
Climate Zone 12 used Climate Zone 9 data.
Climate Zone 14 used Climate Zone 1 data.
Climate Zone 15 used Climate Zone 10 data.

For residential building types:
Climate Zone 6 used Climate Zone 2 data.
Climate Zone 14 used Climate Zone 1 data.
Climate Zone 15 used Climate Zone 10 data.

RASS and CEUS data are based on 2002 consumption data. Because older buildings tend to be less energy efficient, and the majority of the buildings in the survey were likely constructed

2 California Statewide Residential Appliance Saturation Study Reporting Center. Available at: http://websafe.kemainc.com/RASSWEB/DesktopDefault.aspx

3 California Energy Commission. 2006. California Commercial End-Use Survey. Prepared by Itron Inc. Available at: http://www.energy.ca.gov/ceus/

4 United States Environmental Protection Agency 2009. ENERGY STAR and Other Climate Protection Partnerships: 2008 Annual Report. Available at: http://www.epa.gov/cpd/pdf/2008AnnualReportFinal.pdf

before 2001, the RASS and CEUS data likely overestimate energy use for a 2001 Title 24-compliant building.

To account for updates since the 2001 Title 24 standards, percentage reductions for each end use category taken directly from the CEC's "Impact Analysis for 2005 Energy Efficiency Standards" and "Impact Analysis 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings" reports were applied to the CEUS and RASS datasets for improvements from 2001 to 2005, and 2005 to 2008, respectively (see Tables D-1 and D-2). For the CEUS data, exterior lighting was assumed to be covered by Title 24 lighting and therefore has the full percentage reductions taken. Interior lighting was assumed to be 50% Title 24 and 50% non-Title 24 uses. Therefore only half of the reduction for lighting was applied. The resulting 2008 numbers were then used as baseline energy intensities for this mitigation strategy. The total baseline energy intensities are calculated as follows:

$$\text{Baseline} = \sum\left[T24_{2001} \times \left(1 - R_{2001\text{-}2005}\right) \times \left(1 - R_{2005\text{-}2008}\right)\right] + \sum NT24$$

Where:

Baseline	=	Total baseline energy intensities of building category
$T24_{2001}$	=	Energy intensities of Title 24 regulated end use from RASS or CEUS
$R_{2001\text{-}2005}$	=	Reduction from 2001 to 2005
$R_{2005\text{-}2008}$	=	Reduction from 2005 to 2008
NT24	=	Non-Title 24 regulated end use energy intensities

Table D-1

Reduction in Title 24 Regulated End Use for Non-Residential Buildings

Energy Source	End Use	Reduction from 2001 to 2005	Reduction from 2005 to 2008
Electricity	Heating	4.9%	37.2%
	Ventilation	5.0%	1.5%
	Refrigeration	0.0%	0.0%
	Process	0.0%	0.0%
	Office Equipment	0.0%	0.0%
	Motors	0.0%	0.0%
	Miscellaneous	0.0%	0.0%
	Interior Lighting	4.9%	5.9%
	Water Heating	0.0%	0.0%
	Cooking	0.0%	0.0%
	Air Compressors	0.0%	0.0%
	Cooling	6.7%	8.3%
	Exterior Lighting	9.8%	11.7%
Natural Gas	Cooking	0.0%	0.0%
	Cooling	10.4%	9.3%
	Heating	3.1%	15.9%
	Water Heating	0.0%	0.0%
	Process	0.0%	0.0%
	Miscellaneous	0.0%	0.0%

Table D-2
Reduction in Title 24 Regulated End Use for Residential Buildings

Energy Source	End Use (As presented in RASS Dataset)	Reduction from 2001 to 2005			Reduction from 2005 to 2008		
		Multi-family	Single family	Town home	Multi-family	Single family	Town home
Electricity	Conv. Electric heat	24.3%	19.8%	24.3%	19.7%	22.7%	19.7%
	HP Eheat	24.3%	19.8%	24.3%	19.7%	22.7%	19.7%
	Aux Eheat	24.3%	19.8%	24.3%	19.7%	22.7%	19.7%
	Furnace Fan	24.3%	19.8%	24.3%	19.7%	22.7%	19.7%
	Central A/C	24.3%	19.8%	24.3%	19.7%	22.7%	19.7%
	Room A/C	24.3%	19.8%	24.3%	19.7%	22.7%	19.7%
	Evap Cooling	24.3%	19.8%	24.3%	19.7%	22.7%	19.7%
	Water Heat	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Solar Water Heater	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Dryer	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Clothes Washer	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Dish Washer	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	First Refrigerator	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Second Refrigerator	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Freezer	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Pool Pump	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Spa	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Outdoor Lighting	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Range/Oven	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	TV	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Spa Electric Heat	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Microwave	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Home Office	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	PC	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Water Bed	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Well Pump	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Miscellaneous	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Natural Gas	Primary Heat	15.7%	6.7%	15.7%	7.0%	10.0%	7.0%
	Auxiliary Heat	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Conv. Gas Water Heat	15.7%	6.7%	15.7%	7.0%	10.0%	7.0%
	Solar Water Heat w/Gas Backup	15.7%	6.7%	15.7%	7.0%	10.0%	7.0%
	Dryer	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Range/Oven	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Pool Heat	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Spa Heat	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Miscellaneous	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

The same approach was used to quantify GHGs emission reduction from exceeding Title 24 energy efficiency standards by 1%. The 1% reduction was applied to only energy use intensities for Title 24 regulated end use categories. For the CEUS data, the reduction was not applied to any portion of interior lighting. The reduced energy use intensities were added to the unadjusted energy use intensities for non-Title 24 regulated end use categories to obtain the total energy use intensities for exceeding Title 24 energy efficiency standards by 1% for each building category. These were then compared to the baseline line energy intensities for the overall percentage reduction as follows:

$$\text{Percentage Reduction} = 1 - \frac{\sum\left[\mathrm{T24}_{2001} \times \left(1 - \mathrm{R}_{2001\text{-}2005}\right) \times \left(1 - \mathrm{R}_{2005\text{-}2008}\right) \times 99\%\right] + \sum \mathrm{NT24}}{\mathrm{Baseline}}$$

Where:

Baseline	=	Total baseline energy intensities of building category
$T24_{2001}$	=	Energy intensities of Title 24 regulated end use from RASS or CEUS
$R_{2001\text{-}2005}$	=	Reduction from 2001 to 2005
$R_{2005\text{-}2008}$	=	Reduction from 2005 to 2008
NT24	=	Non-Title 24 regulated end use energy intensities

Installing Energy Efficient Appliances

The same baseline line energy use intensities from the Exceeding Title 24 Energy Efficiency Standards mitigation were used for this mitigation strategy. For all appliances except ceiling fan, the reductions as presented in the ENERGY STAR 2008 annual report were applied to the energy use intensities of the corresponding energy end use categories. All other end use categories were kept unadjusted. The percentage reductions were calculated as follows:

$$\text{Percentage Reduction} = 1 - \frac{\text{Appliance Intensity} \times \left(1 - \mathrm{ESR}\right) + \sum \text{Other End Use}}{\mathrm{Baseline}}$$

Where:

Baseline	=	Total baseline energy intensities of building category
Appliance Intensity	=	2008 baseline energy intensity of appliance in consideration
ESR	=	Reduction from ENERGY STAR appliance
Other End Use	=	2008 baseline energy intensity of all other end uses

RASS does not specify a ceiling fan end-use; rather, electricity use from ceiling fans is accounted for in the “Miscellaneous” category which includes interior lighting, attic fans, and other miscellaneous plug-in loads. Since the electricity usage of ceiling fans alone is not specified, a value from the National Renewable Energy Laboratory (NREL) Building American Research Benchmark Definition (BARBD)[5] was used. BARBD reported that the average energy use per ceiling fan is 84.1 kWh per year. In this mitigation measure, it was assumed that each multi-family, single-family, and townhome residence has one ceiling fan. Therefore, the 50% reduction from ENERGY STAR for ceiling fan was applied to 84.1 kWh of the electricity attributed to the Miscellaneous RASS category. In other words, 42.05 kWh was subtracted from the electricity end use intensities of the “Miscellaneous RASS” category in evaluating the GHGs emission reduction from installing energy efficient ceiling fans.

The total energy use intensities with reduction from each appliance in consideration were then compared to the baseline line energy intensities for the overall percentage reduction as follows:

$$\text{Percentage Reduction} = 1 - \frac{(\text{Misc} - 42.05) + \sum \text{Other End Use}}{\text{Baseline}}$$

Where:

Baseline = Total baseline energy intensities of building category
Misc = 2008 energy intensity in Miscellaneous category for electricity
Other End Use = 2008 baseline energy intensity of all other end uses

5 NREL. 2010. Building America Research Benchmark Definition. Available online at: http://www.nrel.gov/docs/fy10osti/47246.pdf

Appendix E

Carbon, Water and CO_2 Sequestration Intensity Factors

Table E-1: Carbon Intensity

Utility	CO_2 intensity (lb/MWh)[1]								
	2000	2001	2002	2003	2004	2005	2006	2007	Suggested Value[2]
Anaheim Public Utilities						1,399.80	1,416.74	1,543.28	1,416.74
Austin Energy						1,127.37	1,077.97	1,117.37	1,077.97
City and County of San Francisco						76.28			76.28
City of Palo Alto Public Utilities						320.94	39.02	426.82	39.02
Glendale Water & Power						1,065.00			1,065.00
Los Angeles Department of Water & Power	1,407.44	1,403.39	1,348.48	1,360.07	1,360.60	1,303.58	1,238.52	1,227.89	1,238.52
Pacific Gas & Electric Company					566.2	489.16	455.81	635.67	455.81
PacifiCorp					1,811.00	1,812.22	1,747.30	1,775.28	1,747.30
Pasadena Water & Power						1,409.65	1664.14		1,664.14
Platte River Power Authority						1,970.93	1,955.66	1,847.88	1,955.66
Riverside Public Utilities						1,333.45	1,346.15	1,325.65	1,346.15
Roseville Electric							565.52	793.8	565.52
Sacramento Municipal Utility District					769	616.07	555.26	714.31	555.26
Salt River Project							1,546.28	1,469.90	1,546.28
San Diego Gas & Electric					613.75	546.46	780.79	806.27	780.79
Seattle City Light								17.77	17.77
Sierra Pacific Resources								1,442.78	1,442.78
Southern California Edison					678.88	665.72	641.26	630.89	641.26
Turlock Irrigation District							682.48	807	682.48

Notes:
1. Based on Table G6 of Local Government Operation Protocol version 1.1
2. The suggested values are based on 2006. If no 2006 value was available, 2005 was used followed by 2007.

Table E-2: Water Intensity

	Indoor Water Uses		Outdoor Water Uses	
	Northern California	Southern California	Northern California	Southern California
	kWh/MG			
Water Supply and Conveyance	2,117	9,727	2,117	9,727
Water Treatment	111	111	111	111
Water Distribution	1,272	1,272	1,272	1,272
Wastewater Treatment	1,911	1,911	0	0
Regional Total	5,411	13,022	3,500	11,111

Note: Based on Table ES-1 from CEC. 2006. Refining Estimates of Water-Related Energy Use in California, CEC-500-2006-118.

Table E-3: Default CO_2 Sequestration Accumulation

Land Use	Sub-Category	Default annual CO_2 accumulation per acre[1] (tonnes CO_2/year)
Forest Land	Scrub	14.3
	Trees	
Cropland		111
Grassland	--	6.2
Wetlands	--	4.31

Note: Based on Tables 4.3, 4.7 and 6.4 from IPCC. 2006. Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines). Available online at http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.htm

CLIMATOLOGY

Unprecedented 21st century drought risk in the American Southwest and Central Plains

10.1126/sciadv.1400082

Benjamin I. Cook,[1,2]* Toby R. Ault,[3] Jason E. Smerdon[2]

In the Southwest and Central Plains of Western North America, climate change is expected to increase drought severity in the coming decades. These regions nevertheless experienced extended Medieval-era droughts that were more persistent than any historical event, providing crucial targets in the paleoclimate record for benchmarking the severity of future drought risks. We use an empirical drought reconstruction and three soil moisture metrics from 17 state-of-the-art general circulation models to show that these models project significantly drier conditions in the later half of the 21st century compared to the 20th century and earlier paleoclimatic intervals. This desiccation is consistent across most of the models and moisture balance variables, indicating a coherent and robust drying response to warming despite the diversity of models and metrics analyzed. Notably, future drought risk will likely exceed even the driest centuries of the Medieval Climate Anomaly (1100–1300 CE) in both moderate (RCP 4.5) and high (RCP 8.5) future emissions scenarios, leading to unprecedented drought conditions during the last millennium.

INTRODUCTION

Millennial-length hydroclimate reconstructions over Western North America (*1*–*4*) feature notable periods of extensive and persistent Medieval-era droughts. Such "megadrought" events exceeded the duration of any drought observed during the historical record and had profound impacts on regional societies and ecosystems (*2*, *5*, *6*). These past droughts illustrate the relatively narrow view of hydroclimate variability captured by the observational record, even as recent extreme events (*7*–*9*) highlighted concerns that global warming may be contributing to contemporary droughts (*10*, *11*) and will amplify drought severity in the future (*11*–*15*). A comprehensive understanding of global warming and 21st century drought therefore requires placing projected hydroclimate trends within the context of drought variability over much longer time scales (*16*, *17*). This would also allow us to establish the potential risk (that is, likelihood of occurrence) of future conditions matching or exceeding the severest droughts of the last millennium.

Quantitatively comparing 21st century drought projections from general circulation models (GCMs) to the paleo-record is nevertheless a significant technical challenge. Most GCMs provide soil moisture diagnostics, but their land surface models often vary widely in terms of parameterizations and complexity (for example, soil layering and vegetation). There are few large-scale soil moisture measurements that can be easily compared to modeled soil moisture, and none for intervals longer than the satellite record. Instead, drought is typically monitored in the real world using offline models or indices that can be estimated from more widely measured data, such as temperature and precipitation.

One common metric is the Palmer Drought Severity Index (PDSI) (*18*), widely used for drought monitoring and as a target variable for proxy-based reconstructions (*1*, *2*). PDSI is a locally normalized index of soil moisture availability, calculated from the balance of moisture supply (precipitation) and demand (evapotranspiration). Because PDSI is normalized on the basis of local average moisture conditions, it can be used to compare variability and trends in drought across regions. Average moisture conditions (relative to a defined baseline) are denoted by PDSI = 0; negative PDSI values indicate drier than average conditions (droughts), and positive PDSI values indicate wetter than normal conditions (pluvials). PDSI is easily calculated from GCMs using variables from the atmosphere portion of the model (for example, precipitation, temperature, and humidity) and can be compared directly to observations. However, whereas recent work has demonstrated that PDSI is able to accurately reflect the surface moisture balance in GCMs (*19*), other studies have highlighted concerns that PDSI may overestimate 21st century drying because of its relatively simple soil moisture accounting and lack of direct CO2 effects that are expected to reduce evaporative losses (*12*, *20*, *21*). We circumvent these concerns by using a more physically based version of PDSI (*13*) (based on the Penman-Monteith potential evapotranspiration formulation) in conjunction with soil moisture from the GCMs to demonstrate robust drought responses to climate change in the Central Plains (105°W–92°W, 32°N–46°N) and the Southwest (125°W–105°W, 32°N–41°N) regions of Western North America.

RESULTS

We calculate summer season [June-July-August (JJA)] PDSI and integrated soil moisture from the surface to ~30-cm (SM-30cm) and ~2- to 3-m (SM-2m) depths from 17 GCMs (tables S1 and S2) in phase 5 of the Coupled Model Intercomparison Project (CMIP5) database (*22*). We focus our analyses and presentation on the RCP 8.5 "business-as-usual" high emissions scenario, designed to yield an approximate top-of-atmosphere radiative imbalance of +8.5 W m^{-2} by 2100. We also conduct the same analyses for a more moderate emissions scenario (RCP 4.5).

Over the calibration interval (1931–1990), the PDSI distributions from the models are statistically indistinguishable from the North American Drought Atlas (NADA) (two-sided Kolmogorov-Smirnov test, $p \geq 0.05$), although there are some significant deviations in some models during other historical intervals. North American drought variability during the historical period in both models and observations is driven primarily by ocean-atmosphere teleconnections,

[1]NASA Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025, USA. [2]Ocean and Climate Physics, Lamont-Doherty Earth Observatory of Columbia University, 61 Route 9W, Palisades, NY 10964, USA. [3]Earth and Atmospheric Sciences, Cornell University, Ithaca, NY 14853, USA.
*Corresponding author. E-mail: benjamin.i.cook@nasa.gov

internal variability in the climate system that is likely to not be either consistent across models or congruent in time between the observations and models, and so such disagreements are unsurprising. In the multimodel mean, all three moisture balance metrics show markedly consistent drying during the later half of the 21st century (2050–2099) (Fig. 1; see figs. S1 to S4 for individual models). Drying in the Southwest is more severe (RCP 8.5: PDSI = −2.31, SM-30cm = −2.08, SM-2m = −2.98) than that over the Central Plains (RCP 8.5: PDSI = −1.89, SM-30cm = −1.20, SM-2m = −1.17). In both regions, the consistent cross-model drying trends are driven primarily by the forced response to increased greenhouse gas concentrations (*13*), rather than by any fundamental shift in ocean-atmosphere dynamics [indeed, there is a wide disparity across models regarding the strength and fidelity of the simulated teleconnections over North America (*23*)]. In the Southwest, this forcing manifests as both a reduction in cold season precipitation (*24*) and an increase in potential evapotranspiration (that is, evaporative demand increases in a warmer atmosphere) (*13*, *25*) acting in concert to reduce soil moisture. Even though cold season precipitation is actually expected to increase over parts of California in our Southwest region (*24*, *26*), the increase in evaporative demand is still sufficient to drive a net reduction in soil moisture. Over the Central Plains, precipitation responses during the spring and summer seasons (the main

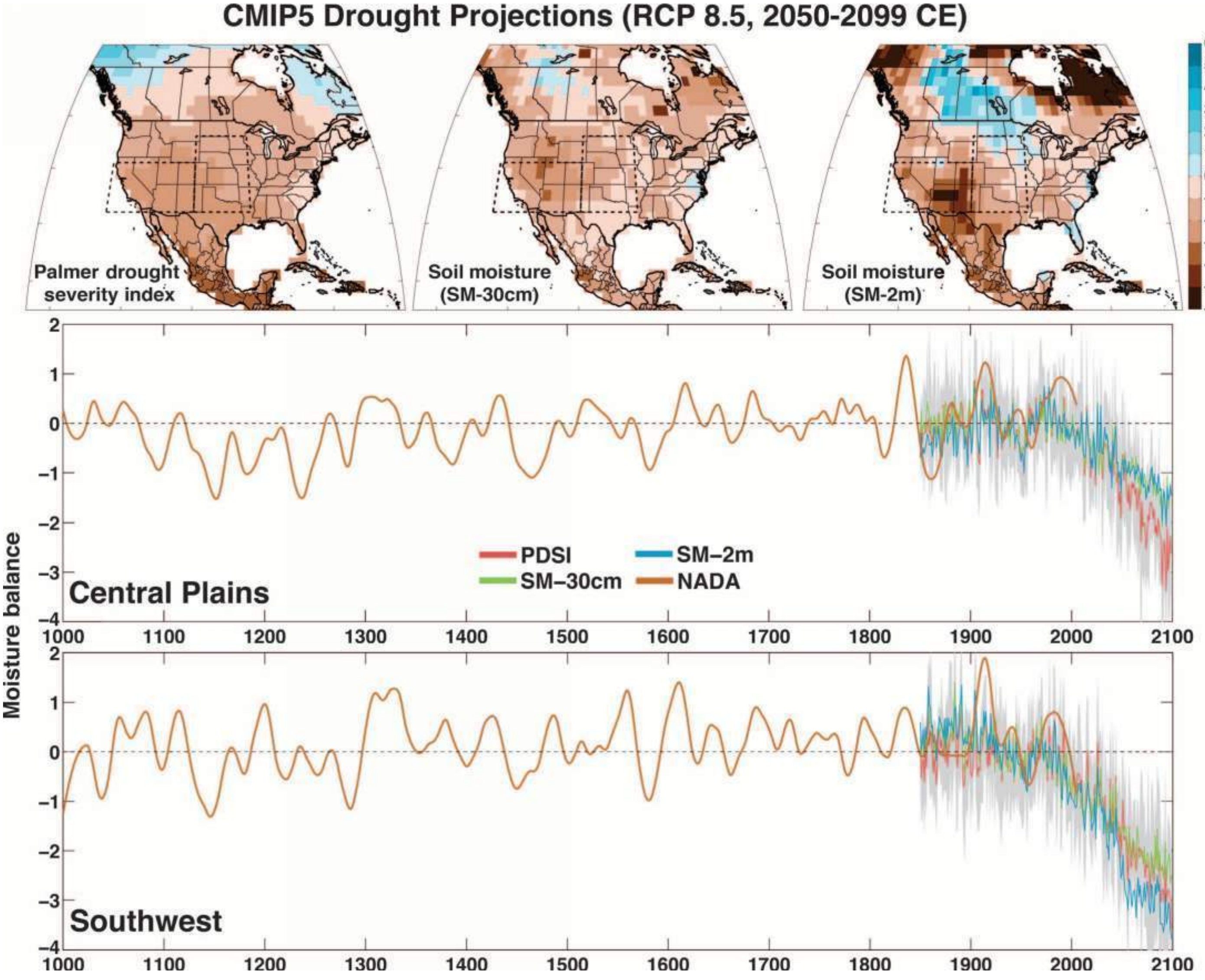


Fig. 1. Top: Multimodel mean summer (JJA) PDSI and standardized soil moisture (SM-30cm and SM-2m) over North America for 2050–2099 from 17 CMIP5 model projections using the RCP 8.5 emissions scenario. SM-30cm and SM-2m are standardized to the same mean and variance as the model PDSI over the calibration interval from the associated historical scenario (1931–1990). Dashed boxes represent the regions of interest: the Central Plains (105°W–92°W, 32°N–46°N) and the Southwest (125°W–105°W, 32°N–41°N). Bottom: Regional average time series of the summer season moisture balance metrics from the NADA and CMIP5 models. The observational NADA PDSI series (brown) is smoothed using a 50-year loess spline to emphasize the low-frequency variability in the paleo-record. Model time series (PDSI, SM-30cm, and SM-2m) are the multimodel means averaged across the 17 CMIP5 models, and the gray shaded area is the multimodel interquartile range for model PDSI.

seasons of moisture supply) are less consistent across models, and the drying is driven primarily by the increased evaporative demand. Indeed, this increase in potential evapotranspiration is one of the dominant drivers of global drought trends in the late 21st century, and previous work with the CMIP5 archive demonstrated that the increased evaporative demand is likely to be sufficient to overcome precipitation increases in many regions (*13*). In the more moderate emissions scenario (RCP 4.5), both the Southwest (RCP 4.5: PDSI = −1.49, SM-30cm = −1.63, SM-2m = −2.39) and Central Plains (RCP 4.5: PDSI = −1.21, SM-30cm = −0.89, SM-2m = −1.17) still experience significant, although more modest, drying into the future, as expected (fig. S5).

In both regions, the model-derived PDSI closely tracks the two soil moisture metrics (figs. S6 and S7), correlating significantly for most models and model intervals (figs. S8 and S9). Over the historical simulation, average model correlations (Pearson's r) between PDSI and SM-30cm are +0.86 and +0.85 for the Central Plains and Southwest, respectively. Correlations weaken very slightly for PDSI and SM-2m: +0.84 (Central Plains) and +0.83 (Southwest). The correlations remain strong into the 21st century, even as PDSI and the soil moisture variables occasionally diverge in terms of long-term trends. There is no evidence, however, for systematic differences between the PDSI and modeled soil moisture across the model ensemble. For example, whereas the PDSI trends are drier than the soil moisture condition over the Southwest in the ACCESS1-0 model, PDSI is actually less dry than the soil moisture in the MIROC-ESM and NorESM1-M simulations over the same region (fig. S7). These outlier observations, showing no consistent bias, in conjunction with the fact that the overall comparison between PDSI and modeled soil moisture is markedly consistent, provide mutually consistent support for the characterization of surface moisture balance by these metrics in the model projections.

For estimates of observed drought variability over the last millennium (1000–2005), we use data from the NADA, a tree-ring based reconstruction of JJA PDSI. Comparisons between the NADA and model moisture are shown in the bottom panels of Fig. 1. In the NADA, both the Central Plains (Fig. 2) and Southwest (Fig. 3) are drier during the Medieval megadrought interval (1100–1300 CE) than either the Little

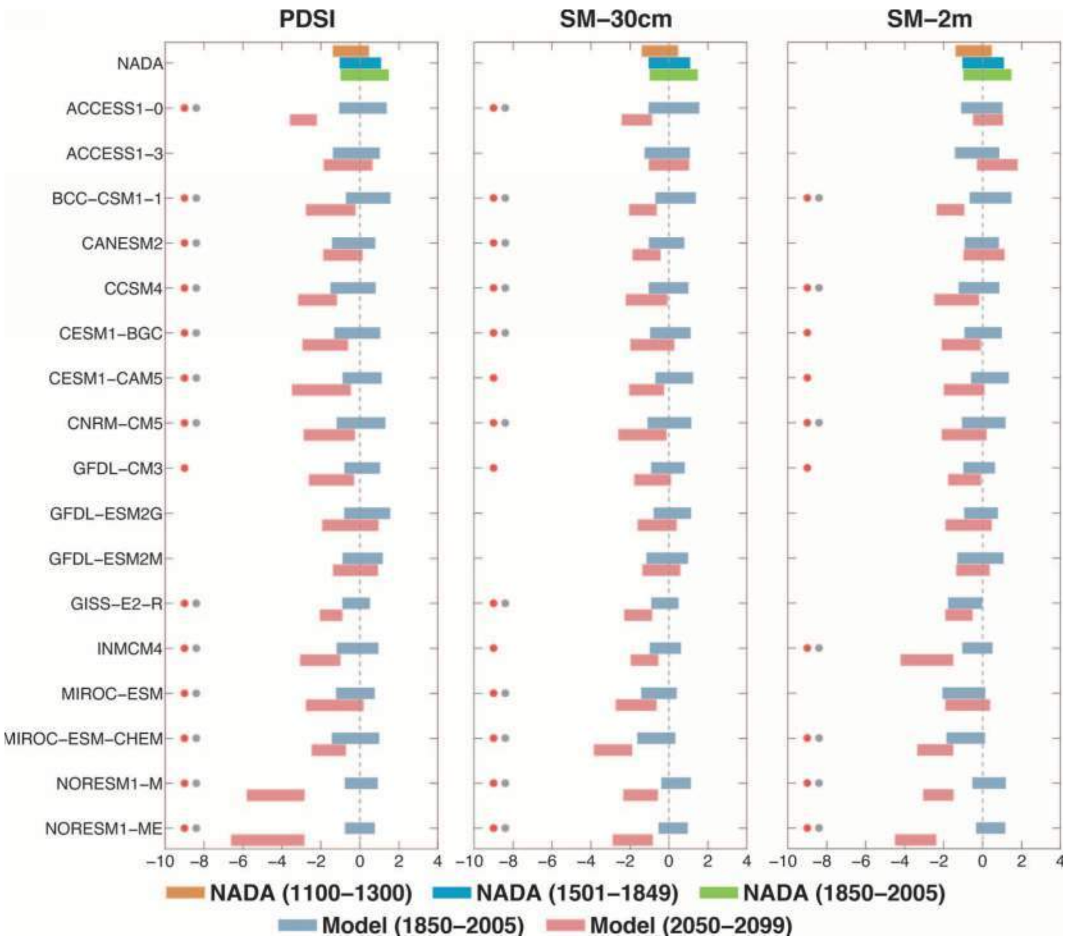


Fig. 2. Interquartile range of PDSI and soil moisture from the NADA and CMIP5 GCMs, calculated over various time intervals for the Central Plains. The groups of three stacked bars at the top of each column are from the NADA PDSI: 1100–1300 (the time of the Medieval-era megadroughts, brown), 1501–1849 (the Little Ice Age, blue), and 1850–2005 (the historical period, green). Purple and red bars are for the modeled historical period (1850–2005) and late 21st century (2050–2099) period, respectively. Red dots indicate model 21st century drought projections that are significantly drier than the model simulated historical periods. Gray dots indicate model 21st century drought projections that are significantly drier than the Medieval-era megadrought period in the NADA.

Ice Age (1501–1849) or historical periods (1850–2005). For nearly all models, the 21st century projections under the RCP 8.5 scenario reveal dramatic shifts toward drier conditions. Most models (indicated with a red dot) are significantly drier (one-sided Kolmogorov-Smirnov test, $p \leq 0.05$) in the latter part of the 21st century (2050–2099) than during their modeled historical intervals (1850–2005). Strikingly, shifts in projected drying are similarly significant in most models when measured against the driest and most extreme megadrought period of the NADA from 1100 to 1300 CE (gray dots). Results are similar for the more moderate RCP 4.5 emissions scenario (figs. S10 and S11), which still indicates widespread drying, albeit at a reduced magnitude for many models. Although there is some spread across the models and metrics, only two models project wetter conditions in RCP 8.5. In the Central Plains, SM-2m is wetter in ACCESS1-3, with little change in SM-30cm and slightly wetter conditions in PDSI. In the Southwest, CanESM2 projects markedly wetter SM-2m conditions; PDSI in the same model is slightly wetter, whereas SM-30cm is significantly drier.

When the RCP 8.5 multimodel ensemble is pooled together (Fig. 4), projected changes in the Central Plains and Southwest (2050–2099 CE) for all three moisture balance metrics are significantly drier compared to both the modern model interval (1850–2005 CE) and 1100–1300 CE in the NADA (one-sided Kolmogorov-Smirnov test, $p \leq 0.05$). In the case of SM-2m in the Southwest, the density function is somewhat flattened, with an elongated right (wet) tail. This distortion arises from the disproportionate contribution to the density function from the wetting in the five CanESM2 ensemble members. Even with this contribution, however, the SM-2m drying in the multimodel ensemble is still significant. Results are nearly identical for the pooled RCP 4.5 multimodel ensemble (fig. S12), which still indicates a significantly drier late 21st century compared to either the historical interval or Medieval megadrought period.

With this shift in the full hydroclimate distribution, the risk of decadal or multidecadal drought occurrences increases substantially. We calculated the risk (*17*) of decadal or multidecadal drought occurrences for two periods in our multimodel ensemble: 1950–2000 and 2050–2099 (Fig. 5). During the historical period, the risk of a multidecadal megadrought is quite small: <12% for both regions and all moisture metrics. Under RCP 8.5, however, there is ≥80% chance of a multidecadal drought during 2050–2099 for PDSI and SM-30cm in the Central Plains and for all three moisture metrics in the Southwest. Drought risk is reduced slightly in RCP 4.5 (fig. S13), with largest reductions in multidecadal drought risk over the Central Plains. Ultimately, the consistency of our results suggests an exceptionally high risk of a multidecadal megadrought occurring over the Central Plains and Southwest regions during the late 21st century, a level of aridity exceeding even the persistent megadroughts that characterized the Medieval era.

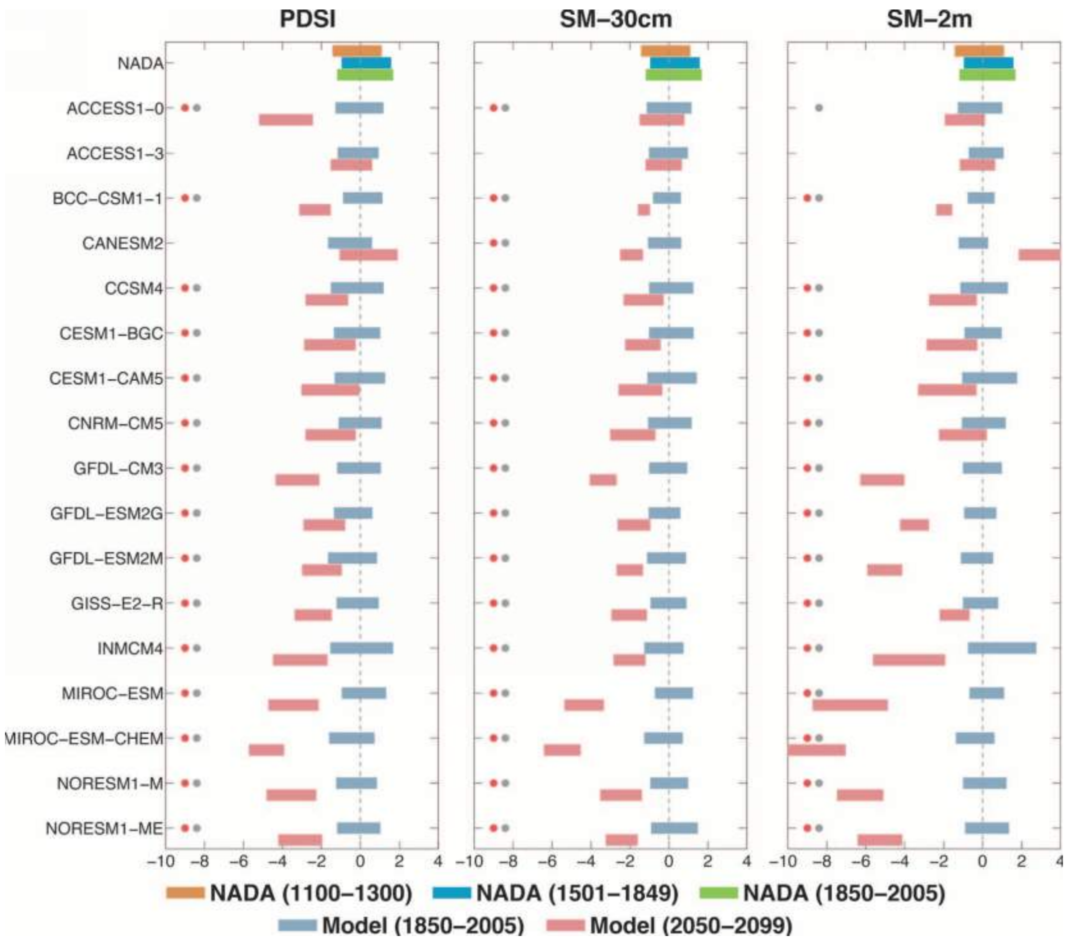


Fig. 3. Same as Fig. 2, but for the Southwest.

DISCUSSION

Within the body of literature investigating North American hydroclimate, analyses of drought variability in the historical and paleoclimate records are often separate from discussions of global warming–induced changes in future hydroclimate. This disconnection has traditionally made it difficult to place future drought projections within the context of observed and reconstructed natural hydroclimate variability. Here,

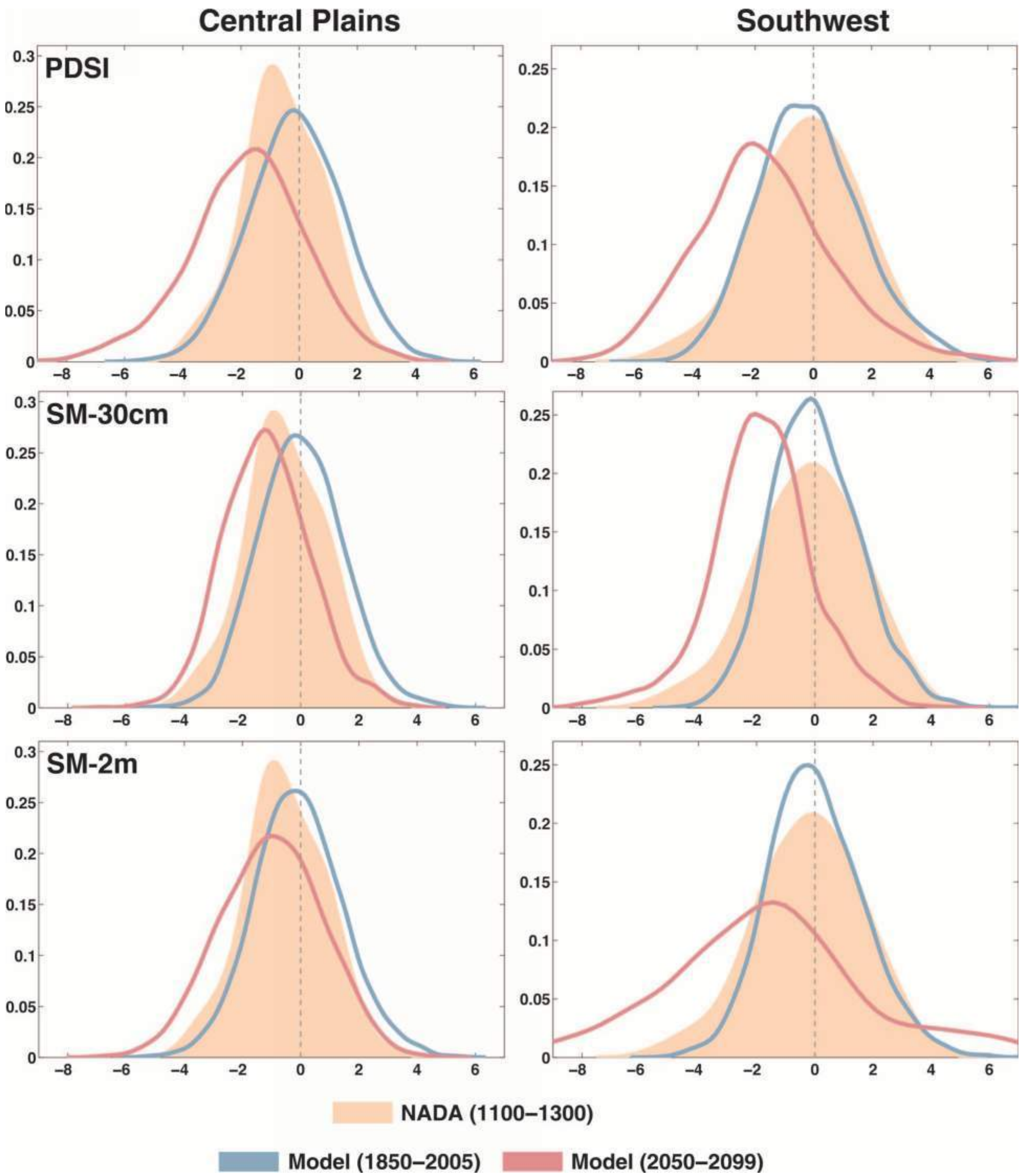


Fig. 4. Kernel density functions of PDSI, SM-30cm, and SM-2m for the Central Plains and Southwest, calculated from the NADA and the GCMs. The NADA distribution (brown shading) is from 1100–1300 CE, the timing of the medieval megadroughts. Blue lines represent model distributions calculated from all years from all models pooled over the historical scenario (1850–2005 CE). Red lines are for all model years pooled from the RCP 8.5 scenario (2050–2099 CE).

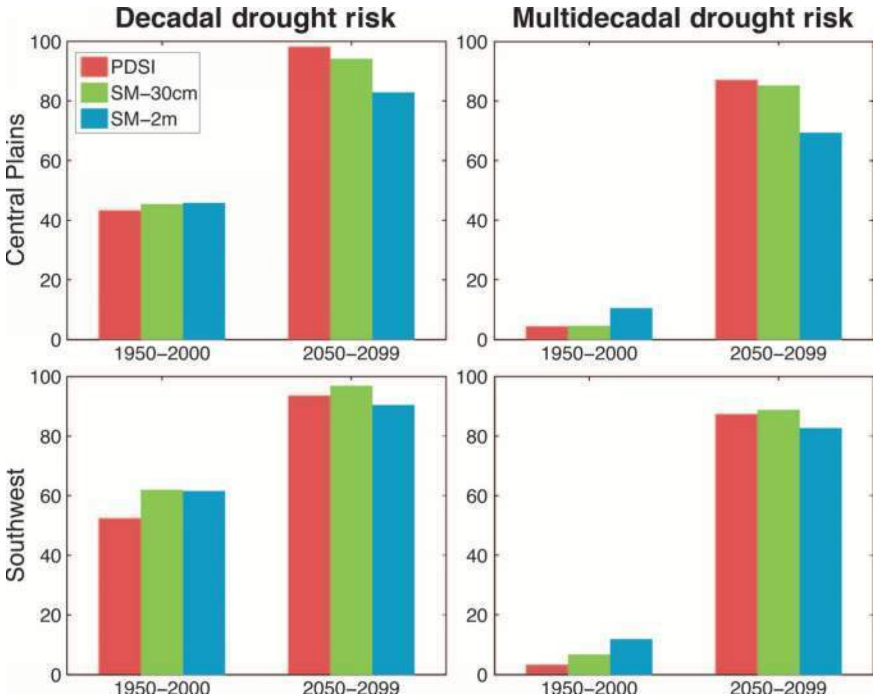


Fig. 5. Risk (percent chance of occurrence) of decadal (11-year) and multidecadal (35-year) drought, calculated from the multimodel ensemble for PDSI, SM-30cm, and SM-2m. Risk calculations are conducted for two separate model intervals: 1950–2000 (historical scenario) and 2050–2099 (RCP 8.5). Results for the Central Plains are in the top row, and those for the Southwest are in the bottom row.

we have demonstrated that the mean state of drought in the late 21st century over the Central Plains and Southwest will likely exceed even the most severe megadrought periods of the Medieval era in both high and moderate future emissions scenarios, representing an unprecedented fundamental climate shift with respect to the last millennium. Notably, the drying in our assessment is robust across models and moisture balance metrics. Our analysis thus contrasts sharply with the recent emphasis on uncertainty about drought projections for these regions (*21*, *27*), including the most recent Intergovernmental Panel on Climate Change assessment report (*28*).

Our results point to a remarkably drier future that falls far outside the contemporary experience of natural and human systems in Western North America, conditions that may present a substantial challenge to adaptation. Human populations in this region, and their associated water resources demands, have been increasing rapidly in recent decades, and these trends are expected to continue for years to come (*29*). Future droughts will occur in a significantly warmer world with higher temperatures than recent historical events, conditions that are likely to be a major added stress on both natural ecosystems (*30*) and agriculture (*31*). And, perhaps most importantly for adaptation, recent years have witnessed the widespread depletion of nonrenewable groundwater reservoirs (*32*, *33*), resources that have allowed people to mitigate the impacts of naturally occurring droughts. In some cases, these losses have even exceeded the capacity of Lake Mead and Lake Powell, the two major surface reservoirs in the region (*34*, *35*). Combined with the likelihood of a much drier future and increased demand, the loss of groundwater and higher temperatures will likely exacerbate the impacts of future droughts, presenting a major adaptation challenge for managing ecological and anthropogenic water needs in the region.

MATERIALS AND METHODS

Estimates of drought variability over the historical period and the last millennium used the latest version of the NADA (*1*), a tree ring–based reconstruction of summer season (JJA) PDSI. All statistics were based on regional PDSI averages over the Central Plains (105°W–92°W, 32°N–46°N) and the Southwest (125°W–105°W, 32°N–41°N). We restricted our analysis to 1000–2005 CE; before 1000 CE, the quality of the reconstruction in these regions declines.

The 21st century drought projections used output from GCM simulations in the CMIP5 database (*22*) (table S1). All models represent one or more continuous ensemble members from the historical (1850–2005 CE) and RCP 4.5 (15 models available) and 8.5 (17 models available) emissions scenarios (2006–2099 CE). We used the same methodology as in (*13*) to calculate model PDSI for the full interval (1850–2099 CE), using the Penman-Monteith formulation of potential evapotranspiration. The baseline period for calibrating and standardizing the model PDSI anomalies was 1931–1990 CE, the same baseline period as the NADA PDSI. Negative model PDSI values therefore indicate drier conditions than the average for 1931–1990.

To augment the model PDSI calculations and comparisons with observed drought variability in the NADA, we also calculated standardized soil moisture metrics from the GCMs for two depths: ~30 cm (SM-30cm) and ~2 to 3 m (SM-2m) (table S2). For these soil moisture metrics, the total soil moisture from the surface was integrated to these depths and averaged over JJA. At each grid cell, we then standardized SM-30cm and SM-2m to match the same mean and interannual SD for the model PDSI over 1931–1990. This allows for direct comparison of variability and trends between model PDSI and model soil moisture and between the model metrics (PDSI, SM-30cm, and SM-2m) and the NADA (PDSI) while still independently preserving any low-frequency variability or trends in the soil moisture that may be distinct from the PDSI calculation. The soil moisture standardization does not impose any artificial constraints that would force the three metrics to agree in terms of variability or future trends, allowing SM-30cm and SM-2m to be used as indicators of drought largely independent of PDSI.

Risk of decadal and multidecadal megadrought occurrence in the multimodel ensemble is estimated from 1000 Monte Carlo realizations of each moisture balance metric (PDSI, SM-30cm, and SM-2m), as in (*17*). This method entails estimating the mean and SD of a given drought index (for example, PDSI or soil moisture) over a reference period (1901–2000), then subtracting that mean and SD from the full record (1850–2100) to produce a modified z score. The differences between the reference mean and SD are then used to conduct (white noise) Monte Carlo simulations of the future (2050–2100) to emulate the statistics of that era. The fraction of Monte Carlo realizations exhibiting a decadal or multidecadal drought are then calculated from each Monte Carlo simulation of each experiment in both regions considered here. Finally, these risks from each model are averaged together to yield the overall risk estimates reported here. Additional details on the methodology can be found in (*17*).

SUPPLEMENTARY MATERIALS

Supplementary material for this article is available at http://advances.sciencemag.org
Fig. S1. For the individual models, ensemble mean soil moisture balance (PDSI, SM-30cm, and SM-2m) for 2050–2099: ACCESS1.0, ACCESS1.3, BCC-CSM1.1, and CanESM2.
Fig. S2. Same as fig. S1, but for CCSM4, CESM1-BGC, CESM-CAM5, and CNRM-CM5.
Fig. S3. Same as fig. S1, but for GFDL-CM3, GFDL-ESM2G, GFDL-ESM2M, and GISS-E2-R.
Fig. S4. Same as fig. S1, but for INMCM4.0,MIROC-ESM, MIROC-ESM-CHEM, NorESM1-M, and NorESM1-ME models.
Fig. S5. Same as Fig. 1, but for the RCP 4.5 scenario.
Fig. S6. Regional average moisture balance time series (historical + RCP 8.5) from the first ensemble member of each model over the Central Plains.
Fig. S7. Same as fig. S6, but for the Southwest.
Fig. S8. Pearson's correlation coefficients for three time intervals from the models over the Central Plains: PDSI versus SM-30cm, PDSI versus SM-2m, and SM-30cm versus SM-2m.
Fig. S9. Same as fig. S8, but for the Southwest.
Fig. S10. Same as Fig. 2, but for the RCP 4.5 scenario.
Fig. S11. Same as Fig. 3, but for the RCP 4.5 scenario.
Fig. S12. Same as Fig.4, but for the RCP 4.5 scenario.
Fig. S13. Same as Fig. 5, but for the RCP 4.5 scenario.
Table S1. Continuous model ensembles from the CMIP5 experiments (1850–2099, historical + RCP8.5 scenario) used in this analysis, including the modeling center or group that supplied the output, the number of ensemble members, and the approximate spatial resolution.
Table S2. The number of soil layers integrated for our CMIP5 soil moisture metrics (SM-30cm and SM-2m), and the approximate depth of the bottom soil layer.

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Acknowledgments: We thank H. Liu and N. Henderson for invaluable computing support at Lamont-Doherty Earth Observatory and E. Cook for providing the NADA data. All model data are freely available on the CMIP5 archive. Finally, we thank two anonymous reviewers who provided comments that greatly improved the manuscript. Lamont contribution #7865. **Funding:** Funding for B.I.C. for this work was provided by the NASA Modeling, Analysis, and Prediction Program and NASA Strategic Science. Support for J.E.S. came from NSF Awards AGS-1243204 ("Collaborative Research: EaSM2–Linking Near Term Future Changes in Weather and Hydroclimate in Western North America to Adaptation for Ecosystem and Water Management") and AGS-1401400 ("P2C2: Continental Scale Droughts in North America: Their Frequency, Character and Causes Over the Past Millenium and Near Term Future"), and NOAA Award NAOR4310137 ("Global Decadal Hydroclimate Variability, Predictability and Change: A Data-Enriched Modeling Study"). Funding for T.R.A. was provided by startup funds from Cornell University's College of Agriculture and Life Sciences (CALS). **Author contributions:** B.I.C., T.R.A., and J.E.S. conceived of the study. B.I.C. conducted all the analyses except the risk calculations and wrote the paper. T.R.A. conducted the risk calculations. T.R.A. and J.E.S. contributed feedback to the analyses and writing.

Submitted 17 November 2014
Accepted 15 January 2015
Published 12 February 2015
10.1126/sciadv.1400082

Citation: B. I. Cook, T. R. Ault, J. E. Smerdon, Unprecedented 21st century drought risk in the American Southwest and Central Plains. *Sci. Adv.* **1**, e1400082 (2015).

Anthropogenic warming has increased drought risk in California

Noah S. Diffenbaugh[a,b,1], Daniel L. Swain[a], and Danielle Touma[a]

[a]Department of Environmental Earth System Science and [b]Woods Institute for the Environment, Stanford University, Stanford, CA 94305

Edited by Jane Lubchenco, Oregon State University, Corvallis, OR, and approved January 30, 2015 (received for review November 22, 2014)

California is currently in the midst of a record-setting drought. The drought began in 2012 and now includes the lowest calendar-year and 12-mo precipitation, the highest annual temperature, and the most extreme drought indicators on record. The extremely warm and dry conditions have led to acute water shortages, groundwater overdraft, critically low streamflow, and enhanced wildfire risk. Analyzing historical climate observations from California, we find that precipitation deficits in California were more than twice as likely to yield drought years if they occurred when conditions were warm. We find that although there has not been a substantial change in the probability of either negative or moderately negative precipitation anomalies in recent decades, the occurrence of drought years has been greater in the past two decades than in the preceding century. In addition, the probability that precipitation deficits co-occur with warm conditions and the probability that precipitation deficits produce drought have both increased. Climate model experiments with and without anthropogenic forcings reveal that human activities have increased the probability that dry precipitation years are also warm. Further, a large ensemble of climate model realizations reveals that additional global warming over the next few decades is very likely to create ∼100% probability that any annual-scale dry period is also extremely warm. We therefore conclude that anthropogenic warming is increasing the probability of co-occurring warm–dry conditions like those that have created the acute human and ecosystem impacts associated with the "exceptional" 2012–2014 drought in California.

drought | climate extremes | climate change detection | event attribution | CMIP5

The state of California is the largest contributor to the economic and agricultural activity of the United States, accounting for a greater share of population (12%) (1), gross domestic product (12%) (2), and cash farm receipts (11%) (3) than any other state. California also includes a diverse array of marine and terrestrial ecosystems that span a wide range of climatic tolerances and together encompass a global biodiversity "hotspot" (4). These human and natural systems face a complex web of competing demands for freshwater (5). The state's agricultural sector accounts for 77% of California water use (5), and hydroelectric power provides more than 9% of the state's electricity (6). Because the majority of California's precipitation occurs far from its urban centers and primary agricultural zones, California maintains a vast and complex water management, storage, and distribution/conveyance infrastructure that has been the focus of nearly constant legislative, legal, and political battles (5). As a result, many riverine ecosystems depend on mandated "environmental flows" released by upstream dams, which become a point of contention during critically dry periods (5).

California is currently in the midst of a multiyear drought (7). The event encompasses the lowest calendar-year and 12-mo precipitation on record (8), and almost every month between December 2011 and September 2014 exhibited multiple indicators of drought (Fig. S1). The proximal cause of the precipitation deficits was the recurring poleward deflection of the cool-season storm track by a region of persistently high atmospheric pressure, which steered Pacific storms away from California over consecutive seasons (8–11). Although the extremely persistent high pressure is at least a century-scale occurrence (8), anthropogenic global warming has very likely increased the probability of such conditions (8, 9).

Despite insights into the causes and historical context of precipitation deficits (8–11), the influence of historical temperature changes on the probability of individual droughts has—until recently—received less attention (12–14). Although precipitation deficits are a prerequisite for the moisture deficits that constitute "drought" (by any definition) (15), elevated temperatures can greatly amplify evaporative demand, thereby increasing overall drought intensity and impact (16, 17). Temperature is especially important in California, where water storage and distribution systems are critically dependent on winter/spring snowpack, and excess demand is typically met by groundwater withdrawal (18–20). The impacts of runoff and soil moisture deficits associated with warm temperatures can be acute, including enhanced wildfire risk (21), land subsidence from excessive groundwater withdrawals (22), decreased hydropower production (23), and damage to habitat of vulnerable riparian species (24).

Recent work suggests that the aggregate combination of extremely high temperatures and very low precipitation during the 2012–2014 event is the most severe in over a millennium (12). Given the known influence of temperature on drought, the fact that the 2012–2014 record drought severity has co-occurred with record statewide warmth (7) raises the question of whether long-term warming has altered the probability that precipitation deficits yield extreme drought in California.

Significance

California ranks first in the United States in population, economic activity, and agricultural value. The state is currently experiencing a record-setting drought, which has led to acute water shortages, groundwater overdraft, critically low streamflow, and enhanced wildfire risk. Our analyses show that California has historically been more likely to experience drought if precipitation deficits co-occur with warm conditions and that such confluences have increased in recent decades, leading to increases in the fraction of low-precipitation years that yield drought. In addition, we find that human emissions have increased the probability that low-precipitation years are also warm, suggesting that anthropogenic warming is increasing the probability of the co-occurring warm–dry conditions that have created the current California drought.

Author contributions: N.S.D., D.L.S., and D.T. designed research, performed research, contributed new reagents/analytic tools, analyzed data, and wrote the paper.

The authors declare no conflict of interest.

This article is a PNAS Direct Submission.

Freely available online through the PNAS open access option.

[1]To whom correspondence should be addressed. Email: diffenbaugh@stanford.edu.

This article contains supporting information online at www.pnas.org/lookup/suppl/doi:10.1073/pnas.1422385112/-/DCSupplemental.

Results

We analyze the "Palmer" drought metrics available from the US National Climatic Data Center (NCDC) (25). The NCDC Palmer metrics are based on the Palmer Drought Severity Index (PDSI), which uses monthly precipitation and temperature to calculate moisture balance using a simple "supply-and-demand" model (26) (*Materials and Methods*). We focus on the Palmer Modified Drought Index (PMDI), which moderates transitions between wet and dry periods (compared with the PDSI) (27). However, we note that the long-term time series of the PMDI is similar to that of other Palmer drought indicators, particularly at the annual scale (Figs. S1 and S2).

Because multiple drought indicators reached historic lows in July 2014 (Figs. S1–S3), we initially focus on statewide PMDI, temperature, and precipitation averaged over the August–July 12-mo period. We find that years with a negative PMDI anomaly exceeding –1.0 SDs (hereafter "1-SD drought") have occurred approximately twice as often in the past two decades as in the preceding century (six events in 1995–2014 = 30% of years; 14 events in 1896–1994 = 14% of years) (Fig. 1*A* and Fig. S4). This increase in the occurrence of 1-SD drought years has taken place without a substantial change in the probability of negative precipitation anomalies (53% in 1896–2014 and 55% in 1995–2014) (Figs. 1*B* and 2 *A* and *B*). Rather, the observed doubling of the occurrence of 1-SD drought years has coincided with a doubling of the frequency with which a negative precipitation year produces a 1-SD drought, with 55% of negative precipitation years in 1995–2014 co-occurring with a –1.0 SD PMDI anomaly, compared with 27% in 1896–1994 (Fig. 1 *A* and *B*).

Most 1-SD drought years have occurred when conditions were both dry (precipitation anomaly < 0) and warm (temperature anomaly > 0), including 15 of 20 1-SD drought years during 1896–2014 (Fig. 2*A* and Fig. S4) and 6 of 6 during 1995–2014 (Fig. 2*B* and Fig. S4). Similarly, negative precipitation anomalies are much more likely to produce 1-SD drought if they co-occur with a positive temperature anomaly. For example, of the 63 negative precipitation years during 1896–2014, 15 of the 32 warm–dry years (47%) produced 1-SD drought, compared with only 5 of the 31 cool–dry years (16%) (Fig. 2*A*). (During 1896–1994, 41% of warm–dry years produced 1-SD droughts, compared with 17% of cool–dry years.) The probability that a negative precipitation anomaly co-occurs with a positive temperature anomaly has increased recently, with warm–dry years occurring more than twice as often in the past two decades (91%) as in the preceding century (42%) (Fig. 1*B*).

All 20 August–July 12-mo periods that exhibited a –1.0 SD PMDI anomaly also exhibited a –0.5 SD precipitation anomaly (Fig. 1*B* and 2*E*), suggesting that moderately low precipitation is prerequisite for a 1-SD drought year. However, the occurrence of –0.5 SD precipitation anomalies has not increased in recent years (40% in 1896–2014 and 40% in 1995–2014) (Fig. 2 *A* and *B*). Rather, these moderate precipitation deficits have been far more likely to produce 1-SD drought when they occur in a warm year. For example, during 1896–2014, 1-SD drought occurred in 15 of the 28 years (54%) that exhibited both a –0.5 SD precipitation anomaly and a positive temperature anomaly, but in only 5 of the 20 years (25%) that exhibited a –0.5 SD precipitation anomaly and a negative temperature anomaly (Fig. 2*A*). During 1995–2014, 6 of the 8 moderately dry years produced 1-SD drought (Fig. 1*A*), with all 6 occurring in years in which the precipitation anomaly exceeded –0.5 SD and the temperature anomaly exceeded 0.5 SD (Fig. 1*C*).

Taken together, the observed record from California suggests that (*i*) precipitation deficits are more likely to yield 1-SD PMDI droughts if they occur when conditions are warm and (*ii*) the occurrence of 1-SD PMDI droughts, the probability of precipitation deficits producing 1-SD PMDI droughts, and the probability of precipitation deficits co-occurring with warm conditions have all been greater in the past two decades than in the preceding century.

These increases in drought risk have occurred despite a lack of substantial change in the occurrence of low or moderately low precipitation years (Figs. 1*B* and 2 *A* and *B*). In contrast, statewide warming (Fig. 1*C*) has led to a substantial increase in warm conditions, with 80% of years in 1995–2014 exhibiting a positive temperature anomaly (Fig. 2*B*), compared with 45% of years in 1896–2014 (Fig. 2*A*). As a result, whereas 58% of moderately dry years were warm during 1896–2014 (Fig. 2*A*) and 50% were warm during 1896–1994, 100% of the 8 moderately dry years in 1995–2014 co-occurred with a positive temperature anomaly (Fig. 2*B*). The observed statewide warming (Fig. 1*C*) has therefore substantially increased the probability that when moderate precipitation deficits occur, they occur during warm years.

The recent statewide warming clearly occurs in climate model simulations that include both natural and human forcings ("Historical" experiment), but not in simulations that include only natural forcings ("Natural" experiment) (Fig. 3*B*). In particular, the Historical and Natural temperatures are found to be different at the 0.001 significance level during the most recent 20-, 30-, and 40-y periods of the historical simulations (using the block bootstrap resampling applied in ref. 28). In contrast, although the Historical experiment exhibits a slightly higher mean annual precipitation (0.023 significance level), there is no statistically

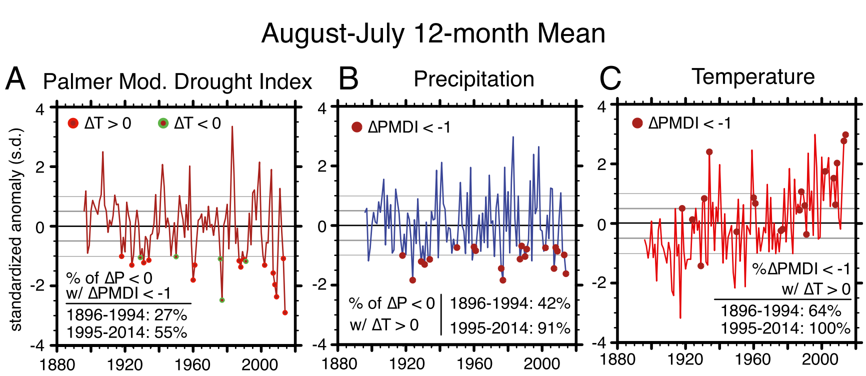

Fig. 1. Historical time series of drought (*A*), precipitation (*B*), and temperature (*C*) in California. Values are calculated for the August–July 12-mo mean in each year of the observed record, beginning in August 1895. In each year, the standardized anomaly is expressed as the magnitude of the anomaly from the long-term annual mean, divided by the SD of the detrended historical annual anomaly time series. The PMDI is used as the primary drought indicator, although the other Palmer indicators exhibit similar historical time series (Figs. S1 and S2). Circles show the years in which the PMDI exhibited a negative anomaly exceeding –1.0 SDs, which are referred to as 1-SD drought years in the text.

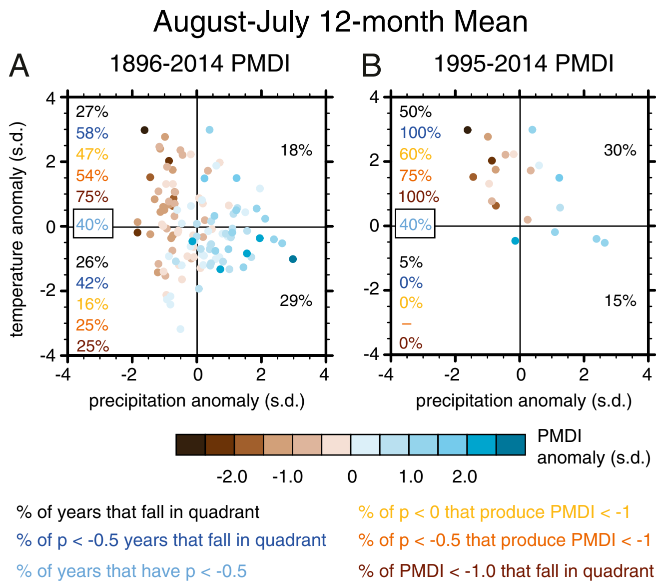

Fig. 2. Historical occurrence of drought, precipitation, and temperature in California. Standardized anomalies are shown for each August–July 12-mo period in the historical record (calculated as in Fig. 1). Anomalies are shown for the full historical record (*A*) and for the most recent two decades (*B*). Percentage values show the percentage of years meeting different precipitation and drought criteria that fall in each quadrant of the temperature–precipitation space. The respective criteria are identified by different colors of text.

significant difference in probability of a –0.5 SD precipitation anomaly (Fig. 3 *A* and *C*). However, the Historical experiment exhibits greater probability of a –0.5 SD precipitation anomaly co-occurring with a positive temperature anomaly (0.001 significance level) (Fig. 3*D*), suggesting that human forcing has caused the observed increase in probability that moderately dry precipitation years are also warm.

The fact that the occurrence of warm and moderately dry years approaches that of moderately dry years in the last decades of the Historical experiment (Fig. 3 *B* and *C*) and that 91% of negative precipitation years in 1995–2014 co-occurred with warm anomalies (Fig. 1*B*) suggests possible emergence of a regime in which nearly all dry years co-occur with warm conditions. We assess this possibility using an ensemble of 30 realizations of a single global climate model [the National Center for Atmospheric Research (NCAR) Community Earth System Model (CESM1) Large Ensemble experiment ("LENS")] (29) (*Materials and Methods*). Before ∼1980, the simulated probability of a warm–dry year is approximately half that of a dry year (Fig. 4*B*), similar to observations (Figs. 1*B* and 2). However, the simulated probability of a warm–dry year becomes equal to that of a dry year by ∼2030 of RCP8.5. Likewise, the probabilities of co-occurring 0.5, 1.0 and 1.5 SD warm–dry anomalies become approximately equal to those of 0.5, 1.0, and 1.5 SD dry anomalies (respectively) by ∼2030 (Fig. 4*B*).

The probability of co-occurring extremely warm and extremely dry conditions (1.5 SD anomaly) remains greatly elevated throughout the 21st century (Fig. 4*B*). In addition, the number of multiyear periods in which a –0.5 SD precipitation anomaly co-occurs with a 0.5 SD temperature anomaly more than doubles between the Historical and RCP8.5 experiments (Fig. 4*A*). We find similar results using a 12-mo moving average (Fig. 4*C*). As with the August–July 12-mo mean (Fig. 4*B*), the probability of a dry year is approximately twice the probability of a warm–dry year for all 12-mo periods before ∼1980 (Fig. 4*C*). However, the occurrence of warm years (including +1.5 SD temperature anomalies) increases after ∼1980, reaching 1.0 by ∼2030. This increase implies a transition to a permanent condition of ∼100% risk that any negative—or extremely negative—12-mo precipitation anomaly is also extremely warm.

The overall occurrence of dry years declines after ∼2040 (Fig. 4*C*). However, the occurrence of extreme 12-mo precipitation deficits (–1.5 SD) is greater in 2006–2080 than in 1920–2005 (<0.03 significance level). This detectable increase in extremely low-precipitation years adds to the effect of rising temperatures and contributes to the increasing occurrence of extremely warm–dry 12-mo periods during the 21st century.

All four 3-mo seasons likewise show higher probability of co-occurring 1.5 SD warm–dry anomalies after ∼1980, with the probability of an extremely warm–dry season equaling that of an extremely dry season by ∼2030 for spring, summer, and autumn, and by ∼2060 for winter (Fig. 4*D*). In addition, the probability of a –1.5 SD precipitation anomaly increases in spring ($P < 0.001$) and autumn ($P = 0.01$) in 2006–2080 relative to 1920–2005, with spring occurrence increasing by ∼75% and autumn occurrence increasing by ∼44%—which represents a substantial and statistically significant increase in the risk of extremely low-precipitation events at both margins of California's wet season. In contrast, there is no statistically significant difference in the probability of a –1.5 SD precipitation anomaly for winter.

Discussion

A recent report by Seager et al. (30) found no significant long-term trend in cool-season precipitation in California during the 20th and early 21st centuries, which is consistent with our

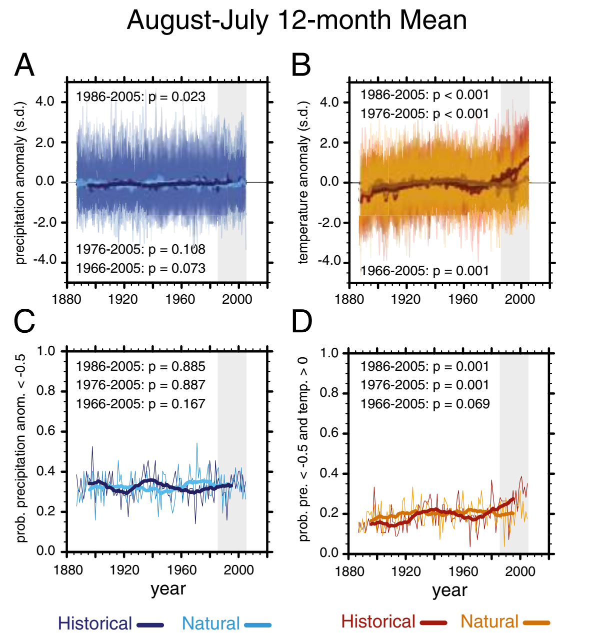

Fig. 3. Influence of anthropogenic forcing on the probability of warm–dry years in California. Temperature and precipitation values are calculated for the August–July 12-mo mean in each year of the CMIP5 Historical and Natural forcing experiments (*Materials and Methods*). The *Top* panels (*A* and *B*) show the time series of ensemble–mean standardized temperature and precipitation anomalies. The *Bottom* panels (*C* and *D*) show the unconditional probability (across the ensemble) that the annual precipitation anomaly is less than –0.5 SDs, and the conditional probability that both the annual precipitation anomaly is less than –0.5 SDs and the temperature anomaly is greater than 0. The bold curves show the 20-y running mean of each annual time series. The CMIP5 Historical and Natural forcing experiments were run until the year 2005. *P* values are shown for the difference between the Historical and Natural experiments for the most recent 20-y (1986–2005; gray band), 30-y (1976–2005), and 40-y (1966–2005) periods of the CMIP5 protocol. *P* values are calculated using the block bootstrap resampling approach of ref. 28 (*Materials and Methods*).

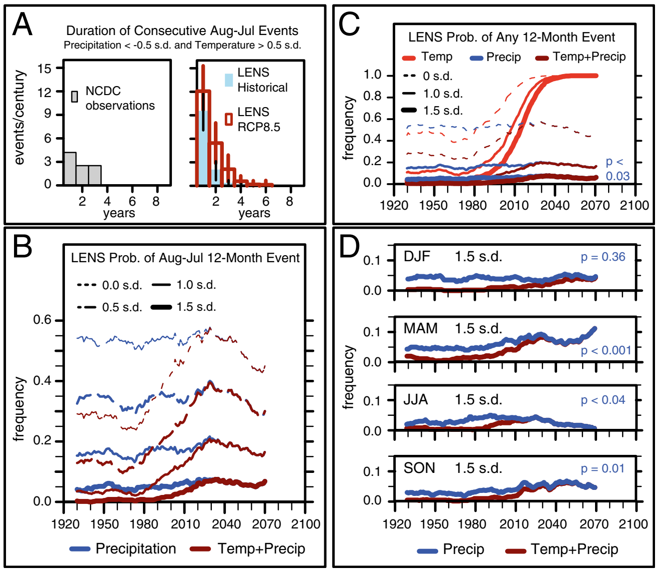

Fig. 4. Projected changes in the probability of co-occurring warm–dry conditions in the 21st century. (*A*) Histogram of the frequency of occurrence of consecutive August–July 12-mo periods in which the 12-mo precipitation anomaly is less than –0.5 SDs and the 12-mo temperature anomaly is at least 0.5 SDs, in historical observations and the LENS large ensemble experiment. (*B*) The probability that a negative 12-mo precipitation anomaly and a positive 12-mo temperature anomaly equal to or exceeding a given magnitude occur in the same August–July 12-mo period, for varying severity of anomalies. (*C*) The probability that a negative precipitation anomaly and a positive temperature anomaly equal to or exceeding a given magnitude occur in the same 12-mo period, for all possible 12-mo periods (using a 12-mo running mean; see *Materials and Methods*), for varying severity of anomalies. (*D*) The unconditional probability of a –1.5 SD seasonal precipitation anomaly (blue curve) and the conditional probability that a –1.5 SD seasonal precipitation anomaly occurs in conjunction with a 1.5 SD seasonal temperature anomaly (red curve), for each of the four 3-mo seasons. Time series show the 20-y running mean of each annual time series. *P* values are shown for the difference in occurrence of –1.5 SD precipitation anomalies between the Historical period (1920–2005) and the RCP8.5 period (2006–2080).

findings. Further, under a scenario of strongly elevated greenhouse forcing, Neelin et al. (31) found a modest increase in California mean December–January–February (DJF) precipitation associated with a local eastward extension of the mean subtropical jet stream west of California. However, considerable evidence (8–11, 31–33) simultaneously suggests that the response of northeastern Pacific atmospheric circulation to anthropogenic warming is likely to be complex and spatiotemporally inhomogeneous, and that changes in the atmospheric mean state may not be reflective of changes in the risk of extreme events (including atmospheric configurations conducive to precipitation extremes). Although there is clearly value in understanding possible changes in precipitation, our results highlight the fact that efforts to understand drought without examining the role of temperature miss a critical contributor to drought risk. Indeed, our results show that even in the absence of trends in mean precipitation—or trends in the occurrence of extremely low-precipitation events—the risk of severe drought in California has already increased due to extremely warm conditions induced by anthropogenic global warming.

We note that the interplay between the existence of a well-defined summer dry period and the historical prevalence of a substantial high-elevation snowpack may create particular susceptibility to temperature-driven increases in drought duration and/or intensity in California. In regions where precipitation exhibits a distinct seasonal cycle, recovery from preexisting drought conditions is unlikely during the characteristic yearly dry spell (34). Because California's dry season occurs during the warm summer months, soil moisture loss through evapotranspiration (ET) is typically high—meaning that soil moisture deficits that exist at the beginning of the dry season are exacerbated by the warm conditions that develop during the dry season, as occurred during the summers of 2013 and 2014 (7).

Further, California's seasonal snowpack (which resides almost entirely in the Sierra Nevada Mountains) provides a critical source of runoff during the low-precipitation spring and summer months. Trends toward earlier runoff in the Sierra Nevada have already been detected in observations (e.g., ref. 35), and continued global warming is likely to result in earlier snowmelt and increased rain-to-snow ratios (35, 36). As a result, the peaks in California's snowmelt and surface runoff are likely to be more pronounced and to occur earlier in the calendar year (35, 36), increasing the duration of the warm-season low-runoff period (36) and potentially reducing montane surface soil moisture (37). Although these hydrological changes could potentially increase soil water availability in previously snow-covered regions during the cool low-ET season (34), this effect would likely be outweighed by the influence of warming temperatures (and decreased runoff) during the warm high-ET season (36, 38), as well as by the increasing occurrence of consecutive years with low precipitation and high temperature (Fig. 4*A*).

The increasing risk of consecutive warm–dry years (Fig. 4*A*) raises the possibility of extended drought periods such as those found in the paleoclimate record (14, 39, 40). Recent work suggests that record warmth could have made the current event the most severe annual-scale drought of the past millennium (12). However, numerous paleoclimate records also suggest that the region has experienced multidecadal periods in which most years were in a drought state (14, 39, 41, 42), albeit less acute than the current California event (12, 39, 41). Although multidecadal ocean variability was a primary cause of the megadroughts of the last millenium (41), the emergence of a condition in which there is ∼100% probability of an extremely warm year (Fig. 4) substantially increases the risk of prolonged drought conditions in the region (14, 39, 40).

A number of caveats should be considered. For example, ours is an implicit approach that analyzes the temperature and precipitation conditions that have historically occurred with low PMDI years, but does not explicitly explore the physical processes that produce drought. The impact of increasing temperatures on the processes governing runoff, baseflow, groundwater, soil moisture, and land-atmosphere evaporative feedbacks over both the historical period and in response to further global warming remains a critical uncertainty (43). Likewise, our analyses of anthropogenic forcing rely on global climate models that do not resolve the topographic complexity that strongly influences California's precipitation and temperature. Further investigation using high-resolution modeling approaches that better resolve the boundary conditions and fine-scale physical processes (44–46) and/or using analyses that focus on the underlying large-scale climate dynamics of individual extreme events (8) could help to overcome the limitations of simulated precipitation and temperature in the current generation of global climate models.

Conclusions

Our results suggest that anthropogenic warming has increased the probability of the co-occurring temperature and precipitation conditions that have historically led to drought in California. In addition, continued global warming is likely to cause a transition to a regime in which essentially every seasonal, annual, and multiannual precipitation deficit co-occurs with historically warm conditions. The current warm–dry event in California—as well as historical observations of previous seasonal, annual, and multiannual warm–dry events—suggests such a regime would substantially increase the risk of severe impacts on human and natural systems. For example, the projected increase in extremely low precipitation and extremely high temperature during spring and autumn has substantial implications for snowpack water storage, wildfire risk, and terrestrial ecosystems (47). Likewise, the projected increase in annual and multiannual warm–dry periods implies increasing risk of the acute water shortages, critical groundwater overdraft, and species extinction potential that have been experienced during the 2012–2014 drought (5, 20).

California's human population (38.33 million as of 2013) has increased by nearly 72% since the much-remembered 1976–1977 drought (1). Gains in urban and agricultural water use efficiency have offset this rapid increase in the number of water users to the extent that overall water demand is nearly the same in 2013 as it was in 1977 (5). As a result, California's per capita water use has declined in recent decades, meaning that additional short-term water conservation in response to acute shortages during drought conditions has become increasingly challenging. Although a variety of opportunities exist to manage drought risk through long-term changes in water policy, management, and infrastructure (5), our results strongly suggest that global warming is already increasing the probability of conditions that have historically created high-impact drought in California.

Materials and Methods

We use historical time series of observed California statewide temperature, precipitation, and drought data from the National Oceanic and Atmospheric Administration's NCDC (7). The data are from the NCDC "nClimDiv" divisional temperature–precipitation–drought database, available at monthly time resolution from January 1895 to the present (7, 25). The NCDC nClimDiv database includes temperature, precipitation, and multiple Palmer drought indicators, aggregated at statewide and substate climate division levels for the United States. The available Palmer drought indicators include PDSI, the Palmer Hydrological Drought Index (PHDI), and PMDI.

PMDI and PHDI are variants of PDSI (25–27, 48, 49). PDSI is an index that measures the severity of wet and dry anomalies (26). The NCDC nClimDiv PDSI calculation is reported at the monthly scale, based on monthly temperature and precipitation (49). Together, the monthly temperature and precipitation values are used to compute the net moisture balance, based on a simple supply-and-demand model that uses potential evapotranspiration (PET) calculated using the Thornthwaite method. Calculated PET values can be very different when using other methods (e.g., Penman–Monteith), with the Thornthwaite method's dependence on surface temperature creating the potential for overestimation of PET (e.g., ref. 43). However, it has been found that the choice of methods in the calculation of PET does not critically influence the outcome of historical PDSI estimates in the vicinity of California (15, 43, 50). In contrast, the sensitivity of the PET calculation to large increases in temperature could make the PDSI inappropriate for calculating the response of drought to high levels of greenhouse forcing (15). As a result, we analyze the NCDC Palmer indicators in conjunction with observed temperature and precipitation data for the historical period, but we do not calculate the Palmer indicators for the future (for future projections of the PDSI, refer to refs. 15 and 40).

Because the PDSI is based on recent temperature and precipitation conditions (and does not include human demand for water), it is considered an indicator of "meterological" drought (25). The PDSI calculates "wet," "dry," and "transition" indices, using the wet or dry index when the probability is 100% and the transition index when the probability is less than 100% (26). Because the PMDI always calculates a probability-weighted average of the wet and dry indices (27), the PDSI and PMDI will give equal values in periods that are clearly wet or dry, but the PMDI will yield smoother transitions between wet and dry periods (25). In this work, we use the PMDI as our primary drought indicator, although we note that the long-term time series of the PMDI is similar to that of the PDSI and PHDI, particularly at the annual scale considered here (Figs. S1 and S2).

We analyze global climate model simulations from phase 5 of the Coupled Model Intercomparison Project (CMIP5) (51). We compare two of the CMIP5 multimodel historical experiments (which were run through 2005): (*i*) the Historical experiment, in which the climate models are prescribed both anthropogenic and nonanthropogenic historical climate forcings, and (*ii*) the Natural experiment, in which the climate models are prescribed only the nonanthropogenic historical climate forcings. We analyze those realizations for which both temperature and precipitation were available from both experiments at the time of data acquisition. We calculate the temperature and precipitation values over the state of California at each model's native resolution using all grid points that overlap with the geographical borders of California, as defined by a high-resolution shapefile (vector digital data obtained from the US Geological Survey via the National Weather Service at www.nws.noaa.gov/geodata/catalog/national/html/us_state.htm).

We also analyze NCAR's large ensemble ("LENS") climate model experiment (29). The LENS experiment includes 30 realizations of the NCAR CESM1. This large single-model experiment enables quantification of the uncertainty arising from internal climate system variability. Although the calculation of this "irreducible" uncertainty likely varies between climate models, it exists independent of uncertainty arising from model structure, model parameter values, and climate forcing pathway. At the time of acquisition, LENS results were available for 1920–2005 in the Historical experiment and 2006–2080 in the RCP8.5 (Representative Concentration Pathway) experiment. The four RCPs are mostly indistinguishable over the first half of the 21st century (52). RCP8.5 has the highest forcing in the second half of the 21st century and reaches ~4 °C of global warming by the year 2100 (52).

Given that the ongoing California drought encompasses the most extreme 12-mo precipitation deficit on record (8) and that both temperature and many drought indicators reached their most extreme historical values for California in July 2014 (7) (Fig. 1 and Figs. S1 and S2), we use the 12-mo August–July period as one period of analysis. However, because severe conditions can manifest at both multiannual and subannual timescales, we also analyze the probability of occurrence of co-occurring warm and dry conditions for multiannual periods, for all possible 12-mo periods, and for the winter (DJF), spring (March–April–May), summer (June–July–August), and autumn (September–October–November) seasons.

We use the monthly-mean time series from NCDC to calculate observed time series of statewide 12-mo values of temperature, precipitation, and PMDI. Likewise, we use the monthly-mean time series from CMIP5 and LENS to calculate simulated time series of statewide 12-mo and seasonal values of temperature and precipitation. From the time series of annual-mean values for each observed or simulated realization, we calculate (*i*) the baseline mean value over the length of the record, (*ii*) the annual anomaly from the baseline mean value, (*iii*) the SD of the detrended baseline annual anomaly time series, and (*iv*) the ratio of each individual annual anomaly value to the SD of the detrended baseline annual anomaly time series. (For the 21st-century simulations, we use the Historical simulation as the baseline.) Our time series of standardized values are thereby derived from the time series of 12-mo annual (or 3-mo seasonal) mean anomaly values that occur in each year.

For the multiannual analysis, we calculate consecutive occurrences of August–July 12-mo values. For the analysis of all possible 12-mo periods, we generate the annual time series of each 12-mo period (January–December, February–January, etc.) using a 12-mo running mean. For the seasonal analysis, we generate the time series by calculating the mean of the respective 3-mo season in each year.

We quantify the statistical significance of differences in the populations of different time periods using the block bootstrap resampling approach of ref. 28. For the CMIP5 Historical and Natural ensembles, we compare the populations of the August–July values in the two experiments for the 1986–2005, 1976–2005, and 1966–2005 periods. For the LENS seasonal analysis, we compare the respective populations of DJF, March–April–May, June–July–August, and September–October–November values in the 1920–2005 and 2006–2080 periods. For the LENS 12-mo analysis, we compare the populations of 12-mo values in the 1920–2005 and 2006–2080 periods, testing block lengths up to 16 to account for temporal autocorrelation out to 16 mo for the 12-mo running mean data. (Autocorrelations beyond 16 mo are found to be negligible.)

Throughout the text, we consider drought to be those years in which negative 12-mo PMDI anomalies exceed –1.0 SDs of the historical interannual PMDI variability. We stress that this value is indicative of the variability of the annual (12-mo) PMDI, rather than of the monthly values (compare Fig. 1 and Figs. S1 and S2). We consider "moderate" temperature and precipitation anomalies to be those that exceed 0.5 SDs ("0.5 SD") and "extreme" temperature and precipitation anomalies to be those that exceed 1.5 SDs ("1.5 SD").

ACKNOWLEDGMENTS. We thank the editor and two anonymous reviewers for insightful comments; Deepti Singh for assistance with the block bootstrap resampling; the National Oceanic and Atmospheric Administration's NCDC for access to the historical temperature, precipitation, and drought data; the World Climate Research Program and Department of Energy's Program for Climate Model Diagnosis and Intercomparison for access to the CMIP5 simulations; and NCAR for access to the LENS simulations. Our work was supported by National Science Foundation Award 0955283 and National Institutes of Health Award 1R01AI090159-01.

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(http://www.climate.gov//)

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California Facing Worst Drought on Record

January 29, 2014

The most populated state in the country is facing what may be its worst drought in a century of record-keeping. On January 20, the governor of California declared a state of emergency, urging everyone to begin conserving water. Water levels in all but a few reservoirs in the state are less than 50% of capacity, mountains are nearly bare of snow except at the highest elevations, and the fire risk is extreme. In Nevada, the situation is much the same.

(http://www.climate.gov//sites/default/files/reno_jan142014_lrg.png)

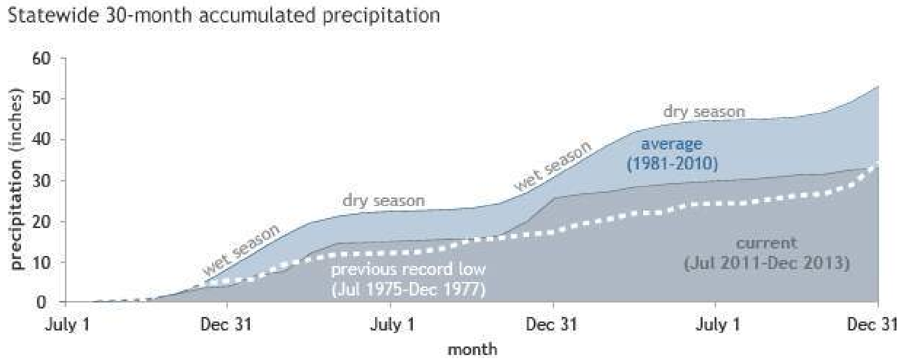
Aerial view of Reno, Nevada (foreground), and Lake Tahoe (background) on January 14, 2014. Between the city and the lake, the mountains are nearly bare of snow, an unmistakable sign of precipitation deficits. Photo by Kelly Redmond.

California has a climate like the Mediterranean region: hot, dry summers and mild, wet winters. More than half of the annual precipitation arrives via winter storms between December and February. For the third winter in a row, precipitation has been below normal across the state. The last week of January is the midway point of the winter wet season, and accumulated precipitation since July is the lowest on record.

The current conditions are the product of several poor wet seasons in succession. The past 30 months—encompassing the past two winter wet seasons and the first half of the current one—are the driest since 1895 for comparable months.

On average, California will accumulate more than 53 inches of precipitation statewide over a typical 30-month span stretching from July to December, based on NOAA Climate Division Data. (Of course, there are huge differences from place to place based on elevation.) In the 30 months preceding December 2013, the state has received closer to 33 inches, just a bit less than the previous record low for a similar period, from July 1975-December 1977.

Check back for updates on the California drought, its impacts, and the climate factors that are influencing the record dry spell.



How precipitation accumulates across California over the span of 30 months beginning in July and ending in the third following December on average (dark blue) and most recently (gray, July 2011-December 2013). Precipitation in California is sharply seasonal, with a winter wet season and a summer dry season. Graph adapted from original by Nina Oakley, based on NOAA Climate Division Data.

Author:

[Rebecca Lindsey (http://www.climate.gov//author/rebecca-lindsey)]

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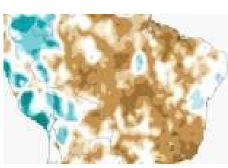 (http://www.climate.gov//news-features/event-tracker/its-supposed-be-rainy-season-brazil-so-where-has-all-water-gone)

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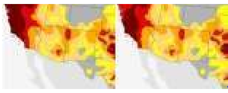 (http://www.climate.gov//news-features/event-tracker/it-poured-california-december-can-we-stop-talking-about-drought)

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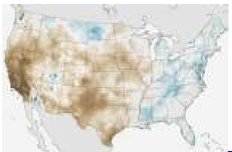 (http://www.climate.gov//news-features/event-tracker/january-precipitation-deficits-keep-california-drought-outlook-grim)

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CALIFORNIA NATURAL RESOURCES AGENCY

FINAL STATEMENT OF REASONS FOR REGULATORY ACTION

Amendments to the State CEQA Guidelines Addressing Analysis and Mitigation of Greenhouse Gas Emissions Pursuant to SB97

December 2009

CALIFORNIA NATURAL RESOURCES AGENCY
FINAL STATEMENT OF REASONS FOR REGULATORY ACTION

December 2009

INTRODUCTION

The California Natural Resources Agency ("the Resources Agency") has adopted certain amendments and additions to certain guidelines implementing the California Environmental Quality Act (Public Resources Code section 21000 *et seq*.) ("CEQA"). Specifically, these amendments implement the Legislature's directive in Public Resources Code section 21083.05 (enacted as part of SB97 (Chapter 185, Statutes 2007)). That section directs the Resources Agency to "certify and adopt guidelines prepared and developed by the Office of Planning and Research" "for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions[.]" (Pub. Resources Code, § 21083.05(a)-(b).)

CEQA generally requires public agencies to review the environmental impacts of proposed projects, and, if those impacts may be significant, to consider feasible alternatives and mitigation measures that would substantially reduce significant adverse environmental effects. Section 21083 of the Public Resources Code requires the adoption of guidelines to provide public agencies and members of the public with guidance about the procedures and criteria for implementing CEQA. The guidelines required by section 21083 of the Public Resources Code are promulgated in the California Code of Regulations, title 14, sections 15000-15387 (the "Guidelines" or "State CEQA Guidelines"). Public agencies, project proponents, and third parties who wish to enforce the requirements of CEQA, rely on the Guidelines to provide a comprehensive guide on compliance with CEQA. Subdivision (f) of section 21083 requires the Resources Agency, in consultation with the Office of Planning and Research ("OPR"), to certify, adopt and amend the Guidelines at least once every two years.

Section 21083.05, as noted above, requires the promulgation of Guidelines specifically addressing analysis and mitigation of the effects of greenhouse gas emissions. The Resources Agency has adopted the following changes to the Guidelines ("Amendments") to implement that directive:

Add sections: 15064.4, 15183.5 and 15364.5.

Amend sections: 15064, 15064.7, 15065, 15086, 15093, 15125, 15126.2, 15126.4, 15130, 15150, 15183, Appendix F and Appendix G.

In addition to guidelines implementing SB97, some of the amendments listed above are non-substantive corrections.

The Resources Agency considered reasonable alternatives to the Amendments. The Resources Agency has determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 and to update the Guidelines to reflect recent case law. Thus, the Amendments add no additional substantive requirements; rather, the Guidelines merely assist lead agencies in complying with CEQA's existing requirements. The Resources Agency rejected the no action alternative because it would not respond to the Legislature's directive in SB97. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts are due to existing requirements of CEQA and not the Amendments.

The Resources Agency also initially determined that the Amendments would not have a significant adverse economic impact on business. The Resources Agency has determined that this action would have no impacts on project proponents. However, the Resources Agency is aware that certain of the statutory changes enacted by the Legislature and judicial decisions, described in greater detail below, that are reflected in the Amendments could have an economic impact on project proponents, including businesses. Among other things, project proponents could incur additional costs in assisting lead agencies to comply with CEQA's requirement for analysis of greenhouse gas emissions. However, the Amendments to the Guidelines merely reflect these legislative and judicial requirements, and the Resources Agency knows of no less costly alternative. The Amendments clarify and update the Guidelines to be consistent with legislative enactments that have modified CEQA, and recent case law interpreting it, but does not impose any new requirements. Therefore, the Amendments would not have a significant, adverse economic impact on business.

Some comments were submitted during the public comment period and during the public hearings on the Proposed Amendments suggesting that the adverse economic impacts could result. For example, some suggested that the addition of forestry resources to the Appendix G checklist may increase the regulatory burden on the agricultural industry. Others suggested that application of the Guidelines to renewable energy projects or those implementing AB32 may be counterproductive. Despite those suggestions, no evidence was presented to the Resources Agency supporting those claims. Moreover, those comments did not provide any rationale challenging the Resources Agency's position that the Proposed Amendments implement existing requirements. Therefore, having considered all of the comments submitted on the Proposed Amendments, the Resources Agency concludes that its initial determination that the proposed action will not have a significant adverse economic impact remains correct.

The Amendments do not duplicate or conflict with any federal statutes or regulations. CEQA is similar in some respects to the National Environmental Policy Act ("NEPA"), 42 U.S.C. sections 4321-4343. Federal agencies are subject to NEPA, which requires environmental review of federal actions. State and local agencies are subject to CEQA, which requires environmental review before state and local agencies may approve or decide to undertake discretionary actions and projects in California. Although both NEPA and CEQA require an analysis of environmental impacts, the substantive and procedural requirements of the two statutes differ. Most significantly, CEQA requirements for feasible mitigation of environmental impacts exceed NEPA's mitigation provisions. A state or local agency must complete a CEQA review even for those projects for which NEPA review is also applicable, although Guidelines sections 15220-15229 allow state, local and federal agencies to coordinate review when projects are subject to both CEQA and NEPA. Because state and local agencies are subject to CEQA unless exemptions apply, and because CEQA and NEPA are not identical, guidelines for CEQA are necessary to interpret and make specific provisions of SB97 and do not duplicate the Code of Federal Regulations.

FINAL STATEMENT OF REASONS

The Administrative Procedure Act requires that an agency prepare a final statement of reasons supporting its proposed regulation. The final statement of reasons updates the information contained in the initial statement of reasons, contains final determinations as to the economic impact of the regulations, and provides summaries and responses to all comments regarding the proposed action. The initial statement of reasons, as updated and revised, are contained in full in this final statement of reasons. The summaries and responses to comments are included in the Natural Resources Agency's file of this rulemaking proceeding.

Below is a brief background on the science relating to the effects of greenhouse gas emissions, as well as the various initiatives that California is implementing to reduce those emissions. Following that background, OPR's public engagement process and the Natural Resources Agency's rulemaking process is briefly described. Next, this Final Statement of Reasons explains the purpose and necessity of each proposed change to the Guidelines. Finally, Thematic Responses, addressing the major themes that were raised in public comments, are provided.

BACKGROUND ON THE EFFECTS OF GREENHOUSE GAS EMISSIONS AND CALIFORNIA'S EFFORTS TO REDUCE THOSE EMISSIONS

This section provides a brief background on the potential effects of greenhouse gas emissions and California's efforts to reduce those emissions.

<u>What Are Greenhouse Gases?</u>

Certain gases in Earth's atmosphere naturally trap solar energy to maintain global average temperatures within a range suitable for terrestrial life. Those gases – which primarily include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride – act as a greenhouse on a global scale. (Health and Safety Code, § 38505(g).) Thus, those heat-trapping gases are known as greenhouse gases ("GHG").

The Legislature defined "greenhouse gases" to include the six gases mentioned above in California's Global Warming Solutions Act. (Health & Saf. Code, § 38500 et seq.) Similarly, the U.S. EPA has found that those same six gases could be regulated under the authority of the Clean Air Act. According to the U.S. EPA:

> (1) These six greenhouse gas share common properties regarding their climate effects; (2) these six greenhouse gases have been estimated to be the primary cause of human-induced climate change, are the best understood drivers of climate change, and are expected to remain the key driver of future climate change; (3) these six greenhouse gases are the common focus of climate change science research and policy analyses and discussions; [and] (4) using the combined mix of these gases as the definition (versus an individual gas-by-gas approach) is consistent with the science, because risks and impacts associated with greenhouse gas-induced climate change are not assessed on an individual gas approach….

(EPA, Endangerment Finding, 74 Fed. Reg. 66496, 66517 (December 15, 2009).) The United Nations Framework Convention on Climate Change also addresses these six gases. (*Id*. at p. 66519.)

What Causes Greenhouse Gas Emissions?

The incremental contributions of GHGs from innumerable direct and indirect sources result in elevated atmospheric GHG levels. (EPA, Draft Endangerment Finding, 74 Fed. Reg. 18886, 18904 (April 24, 2009) ("cumulative emissions are responsible for the cumulative change in the stock of concentrations in the atmosphere"); see also 74 Fed. Reg. 66496, 66538 (same in Final Endangerment Finding).) Some GHG emissions occur through natural processes such as plant decomposition and wildfires. One large source of GHG emissions, for example, is wildfire on forestlands and rangelands, which release carbon as a result of material being burned. (California Board of Forestry and Fire Protection, *2008 Strategic Plan and Report to the CARB on Meeting AB32 Forestry Sector Targets* (October, 2008), at p. 2.)

Human activities, such as motor vehicle use, energy production and land development, also result in both direct and indirect emissions that contribute to highly elevated concentrations of GHGs in the atmosphere. (California Energy Commission, *Inventory of California Emissions and Sinks: 1990 to 2004* (2006).)[1] Transportation

[1] Multiple statewide emission inventories covering the same period of time may vary. This is largely due to inventories characterizing an emission source by sectors (e.g. agriculture, cement, transportation, etc.) which may not be treated the same depending on the methodology used and access to information. Thus,

alone is estimated to account for nearly 40 percent of California's GHG emissions. (California Air Resources Board, *Climate Change Proposed Scoping Plan* (2008), at p. 11 ("Scoping Plan"); California Energy Commission 2007, *2007 Integrated Energy Policy Report*, CEC-100-2007-008-CMF ("2007 IEPR") at p. 18, Figure 1-2.) Emissions attributable to transportation result largely from development that increases, rather than decreases, vehicle miles traveled: low density, unbalanced land uses separating jobs and housing, and a focus on single-occupancy vehicle travel. (California Energy Commission, The Role of Land Use In Meeting California's Energy and Climate Change Goals. (2007) at p. 9.) In approaching regulation of GHG emissions in California, for example, the California Air Resources Board ("ARB") proposes to regulate various economic sectors that are known to emit GHGs, including electric power, transportation, industrial sources, landfills, commercial and residential sectors, agriculture and forestry. (Scoping Plan, Appendix F.) With a growing population and economy, California's total GHG emissions continue to increase. As explained below, this rapid rate of increase in GHG emissions is causing a change in the composition of atmospheric gases that may cause life threatening adverse environmental consequences.

What Effects May Result from Increased Greenhouse Gas Emissions?

Several measurable effects, including, among others, an increase in global average temperatures have been attributed to increases in GHG emissions resulting from human activity. (Intergovernmental Panel on Climate Change, *Working Group 1 Report: The Physical Science Basis* (2001), at p. 101.) Evidence further indicates that a warmer planet may in turn lead to changes in rainfall patterns, a retreat of polar icecaps, a rise in sea level, and changes in ecosystems supporting human, animal and plant life. (U.S. Environmental Protection Agency, *Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act,* April 17, 2009 ("Technical Support Document"), at pp. ES-1 to ES-3.) Climate change is not the only effect of increased GHG emissions. Impacts to human health and ocean acidification are also attributed to increasing concentrations of GHGs in the Earth's atmosphere. (*Id*. at p. 57.)

Globally elevated concentrations of GHGs have been observed to induce a range of associated effects. For example, the effects of atmospheric warming include, but are not limited to, increased likelihood of more frequent and intense natural disasters, increased drought, and harm to agriculture, wildlife, and ecological systems. (Technical Support Document at pp. ES-1, ES-6.) According to a report prepared for the California Climate Change Center:

> Climate change is likely to affect the abundance, production, distribution, and quality of ecosystem services throughout the State of California

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two statewide emissions inventories may be different depending on the agency that created them or its intended application. The CARB is in the process of updating its statewide data and methodologies to be consistent with international and national guidelines. The typical emissions inventory covers 1990 to 2004.

> including the delivery of abundant and clean water supplies to support human consumption and wildlife, climate stabilization through carbon sequestration, the supply of fish for commercial and recreational sport fishing. For example, as described in this report, areas of the state suitable for forage production to support cattle grazing in natural areas could shift as some parts of the state become too dry to support forage and others become wetter. The ability of the State's forests to sequester carbon and support climate stabilization could be hindered as productivity decreases and fires increase. And increased water temperatures in streams due to a decrease in provision of fresh water could seriously reduce salmon reproduction and subsequently reduce the number of salmon available for commercial and recreational harvest. Also, areas of the state suitable for forage production to support cattle grazing in natural areas could shift as some parts of the state become too dry to support forage and others become wetter. All of these ecosystem services have economic value and that value and its distribution is likely to changes under a changing climate.

(Rebecca Shaw, et al., for the California Climate Change Center, *The Impact of Climate Change on California's Ecosystem Services*, March 2009, CEC-500-2009-025-D, at p. 1.)

The effects of increased GHG concentrations are already being felt in California. For example, global atmospheric changes are causing sea levels to rise. An increase of approximately 8 inches has been recorded at the Golden Gate Bridge over the past 100 years. Such sea level rise threatens low coastal areas with inundation and increased erosion. (Scoping Plan, at p. 10.)

While sea levels continue to rise, the Sierra snowpack has been shrinking. Average annual runoff from spring snowmelt has decreased 10% in the last 100 years. Because snow in the Sierra acts as a reservoir, holding winter water for use later in the year, reduced snowpack creates greater potential for summer droughts and reduced hydroelectricity generation. (Office of Environmental Health and Hazard Assessment, April, 2009, Indicators of Climate Change in California, at p. 76.) Climate change is also thought to account for changes in the timing of California's major precipitation events. As explained in a report prepared for the California Climate Change Center:

> reservoirs were designed to store only a fraction of the state's entire yearly precipitation, under the assumption that the annual mountain snowpack would melt at roughly the same time every year. During anomalously high rain or snowmelt events, reservoirs must not only store water, but also discharge excess water to avoid flooding. Water must sometimes be discharged in anticipation of large events to reduce flood risk. The dual functions of storage and flood management require reservoir managers to carefully balance factors such as precipitation, snowmelt timing, reservoir storage capacity, and demand. Even if future precipitation remains

unchanged, shifts in snowmelt timing can affect California's water supply during the warm season due to reservoir storage capacity constraints.

(Sarah Kapnick and Alex Hall, for the California Climate Change Center, *Observed Changes in the Sierra Nevada Snowpack: Potential Causes and Concerns*, March 2009, CEC-500-2009-016-D, at p. 1.)

Climate change is also expected to increase the number and intensity of forest fires. (Technical Support Document, at p. 91; *see also* Indicators of Climate Change (2009) at p. 131.) A generally warmer climate is associated with a longer summer season, which in turn dries vegetation and fuels making ignition easier and hastens wildfire spread. (*Ibid*; see also A. L. Westerling, for the California Climate Change Center*, Climate Change, Growth and California Wildfire*, March 2009, CEC-500-2009-046-D, at pp. 1-2.) Not only do wildfires release additional carbon and increase air pollutants, but they also cause indirect effects. For example, wildfires reduce vegetative cover leading to increased water runoff, which has affected watersheds and dampens the effectiveness of California's water works infrastructure. This will degrade California's water quality and challenge water treatment operations to provide safe drinking water. Adverse health impacts from heat-related illnesses are expected with hotter temperatures, and, due to poorer air quality, lung disease, asthma, and other respiratory and circulatory problems will be exacerbated. (California Climate Action Team, Executive Summary Report to Governor Schwarzenegger and the California Legislature (2006) at pp. xii to xiii, 27.); see also Technical Support Document, at pp. ES-4, 69-71.)

Why is California Involved in Greenhouse Gas Regulation?

California is vulnerable to the effects of global warming, and, despite its global nature, action to curb GHG emissions is needed on a statewide level. The legislative findings in Assembly Bill 32 (Chapter 448, Statutes 2006) ("AB32"), for example, state:

> … Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California. The potential adverse impacts of global warming include the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other human health-related problems.
>
> … Global warming will have detrimental effects on some of California's largest industries, including agriculture, wine, tourism, skiing, recreational and commercial fishing, and forestry. It will also increase the strain on electricity supplies necessary to meet the demand for summer air-conditioning in the hottest parts of the state.

(Health & Safety Code, § 38501(a), (b).) The Legislature further declared: “action taken by California to reduce emissions of greenhouse gases will have far-reaching effects by encouraging other states, the federal government, and other countries to act.” (*Id*. at subd. (d).) As the world’s fifteenth largest emitter of GHGs from human activity and natural sources, California is uniquely positioned to act to reduce GHGs. (Scoping Plan, at pp. 11.)

Reducing greenhouse gas emissions is a necessary response to the threats posed by climate change. Efforts to reduce emissions may result in other significant benefits as well. Governor Schwarzenegger laid out the case for action to reduce greenhouse gas emissions in Executive Order S-3-05:

> … California-based companies and companies with significant activities in California have taken leadership roles by reducing greenhouse gas (GHG) emissions, including carbon dioxide, methane, nitrous oxide and hydrofluorocarbons, related to their operations and developing products that will reduce GHG emissions; …
>
> … [C]ompanies that have reduced GHG emissions by 25 percent to 70 percent have lowered operating costs and increased profits by billions of dollars; …
>
> … [T]echnologies that reduce greenhouse gas emissions are increasingly in demand in the worldwide marketplace, and California companies investing in these technologies are well-positioned to profit from this demand, thereby boosting California's economy, creating more jobs and providing increased tax revenue; …
>
> … [M]any of the technologies that reduce greenhouse gas emissions also generate operating cost savings to consumers who spend a portion of the savings across a variety of sectors of the economy; this increased spending creates jobs and an overall benefit to the statewide economy.

Thus, the Governor, Legislature and private sector have concluded that action to reduce greenhouse gas emissions is necessary and beneficial for the State.

<u>What is California Doing to Reduce its Greenhouse Gas Emissions?</u>

Action to curb greenhouse gas emissions is taking place on many fronts. As described above, the private sector has already taken important steps to increase efficiency and lower costs associated with such emissions. Many local governments have also adopted, or are currently developing, various plans and programs designed to reduce community-wide GHG emissions. (Office of Planning and Research, *The California Planner’s Book of Lists* (January 2009) (“Book of Lists”), at pp. 92-100; see also Scoping Plan, at p. 26.) Due to its potential vulnerability to the effects of GHG emissions, and the wide variety of GHG emissions sources within its borders, California has enacted several laws and programs designed to reduce the State's GHG emissions. Several major legislative initiatives are described below.

AB32 – The Global Warming Solutions Act

Assembly Bill 32 (Chapter 448, Statutes 2006) is a key piece of California's effort to reduce its GHG emissions. AB32 requires the California Air Resources Board ("ARB") to establish regulations designed to reduce California's GHG emissions to 1990 levels by 2020. (Health & Safety Code, § 38550.) On December 11, 2008, ARB adopted its Scoping Plan, setting forth a framework for future regulatory action on how California will achieve that goal through sector-by-sector regulation. (ARB, Resolution No. 08-47; see also Health & Safety Code, § 38561.) ARB must adopt, no later than January 1, 2012, rules and regulations to implement the GHG emissions reductions envisioned in the Scoping Plan. (Health & Safety Code, § 38562.)

The AB32 Scoping Plan outlines a set of actions designed to reduce overall GHG emissions in California to 1990 levels by 2020. The Scoping Plan presents GHG emission reduction strategies that combine regulatory approaches, voluntary measures, fees, policies, and programs. Reduction strategies are expected to evolve as technologies develop and progress toward the State's goal is monitored. Thus, the Scoping Plan sets forth the outline of California's strategy to reduce GHG emissions on a statewide basis.

SB375

As noted above, nearly 40 percent of California's GHG emissions come from the State's transportation sector. (Chapter 728, Statutes 2007, § 1(a).) Technology innovation and lower-carbon fuels alone will not reduce transportation-related emissions sufficiently for California to reach the reduction goals set out in AB32. (*Id*. at § 1(c).) Therefore, in SB375, California enacted several measures to reduce vehicular emissions through land-use planning.

Specifically, SB375 requires ARB to develop "greenhouse gas emission reduction targets for the automobile and light truck sector" for each metropolitan planning organization (MPO). (Gov. Code, § 65080(b)(2)(A).) Once that target is set, each MPO must develop a sustainable communities strategy (SCS), as part of its regional transportation plan, that will set forth a development pattern that will achieve the reduction target approved by the ARB. (*Id*. at subd. (b)(2)(B).) The MPO's transportation planning activities must be consistent with the adopted SCS. (*Id*. at subd. (b).) While an SCS does not supersede a local government's land use authority, SB375 created an exemption from CEQA for local transit-oriented residential projects that are consistent with the applicable SCS as an incentive. (*Id*. at subd. (b)(2)(J); Pub. Resources Code, § 21155.1.)

CEQA and SB97

While AB32 and SB375 target specific types of emissions from specific sectors, the California Environmental Quality Act ("CEQA") regulates nearly all governmental activities and approvals. CEQA generally requires that a lead agency analyze the potential adverse environmental impacts of their decisions, and, if those impacts are determined to be significant, to avoid those impacts through mitigation or project alternatives. As awareness of the causes and effects of GHG emissions has increased, those effects began to be addressed in environmental analyses on a project-level basis. Federal courts, moreover, have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Uncertainty developed, however, among public agencies regarding how GHG emissions should be analyzed in environmental documents prepared pursuant to CEQA.

To provide greater certainty to lead agencies, Governor Schwarzenegger signed Senate Bill 97 (Chapter 148, Statutes 2007). (Governor Schwarzenegger's Signing Message, SB 97.) That statute, among other things, constitutes the Legislature's recognition that GHG emissions and the effects of GHG emissions are appropriate subjects for CEQA analysis. Pursuant to SB97, OPR developed, and the Resources Agency will adopt, amendments to the State CEQA Guidelines to address analysis and mitigation of the potential effects of GHG emissions in CEQA documents and processes. As new information or criteria established by ARB in the AB 32 process becomes available, OPR and the Resources Agency will periodically update the CEQA Guidelines to account for that new information. This rulemaking package responds to the Legislature's directive in SB97.

Questions concerning the relationship between AB32, SB375 and CEQA were raised in public comments on the Proposed Amendments. The Resources Agency developed responses to those questions in the Responses to Comments, which are appended to this Final Statement of Reasons. Further discussion of the relationship between AB32, SB375 and CEQA is provided in the Thematic Responses at the end of this Final Statement of Reasons.

BACKGROUND ON THE DEVELOPMENT OF THE PROPOSED AMENDMENTS

OPR developed the Proposed Amendments pursuant to Public Resources Code section 21083.05, which states in part:

> On or before July 1, 2009, the Office of Planning and Research shall prepare, develop, and transmit to the Resources Agency guidelines for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions as required by this division, including, but not limited to, effects associated with transportation or energy consumption.

In developing the Proposed Amendments, OPR actively sought the input, advice, and assistance of numerous interested parties and stakeholder groups. (Letter from OPR Director, Cynthia Bryant, to Secretary for the Natural Resources Agency, Mike Chrisman, April 13, 2009.) Specifically, OPR met with representatives of numerous agencies and organizations to discuss the perspectives of the business community, the environmental community, local governments, non-governmental organizations, state agencies, public health officials, CEQA practitioners and legal experts. In addition, OPR took advantage of numerous regional and statewide conferences to raise awareness about CEQA and GHG emissions among diverse audiences and to seek their input. These activities satisfy the provisions of Government Code section 11346.45 which require early public involvement in complex proposals.

After publishing a preliminary draft, on January 8, 2009, OPR continued to conduct extensive public outreach, including two public workshops, to receive input on the Preliminary Amendments. Both public workshops were well attended, drawing over two hundred participants representing various California business interests, environmental organizations, local governments, attorneys and consultants. In addition to oral comments at its workshops, OPR received over eighty written comment letters.

Some comments suggested additional amendments to the CEQA Guidelines. Other comments sought clarification of the language in the preliminary amendments. OPR incorporated those suggestions and clarifications to the extent possible and appropriate into its April 13, 2009, submittal to the Resources Agency. Some suggestions were not appropriate for inclusion, however, due to conflict with existing statutory authority and/or case law. For example, some comments submitted to OPR during its public workshops indicated that the Guidelines should be addressed to "Climate Change" rather than just the effects of GHG emissions. The focus in the Guidelines on GHG emissions is appropriate for at least three reasons.

First, the Legislative authorization for the Proposed Amendments refers specifically to guidelines on the "mitigation of greenhouse gas emissions and the effects of greenhouse gas emissions." (Pub. Resources Code, § 21083.05.) Had the Legislature intended the Guidelines to address climate change or global warming specifically, it presumably would have so indicated. Second, the precise "effect" of GHG emissions from a project is a factual matter for the lead agency to determine. Such effects may include "climate change," "global warming" and other changes in the physical environment (increased ocean acidity or sea-level rise, for example). (EPA, Draft Endangerment Finding, 74 Fed. Reg. 18886 (April 24, 2009), Technical Support Document, at pp. ES-2 to ES-3; see further discussion at pages 4-5, above.) Thus, rather than limit analysis to a particular effect, the proposed Guidelines on GHG emissions are consistent with the treatment of air pollutants in the existing Appendix G, which focus largely on the concentration of pollutants. (See, e.g., existing State CEQA Guidelines, Appendix G, III.d.) Third, the focus in a cumulative impacts analysis is "whether any additional effect caused by the proposed project should be considered significant given the existing cumulative effect." (*CBE*, *supra*, 103 Cal. App. 4th at 118.)

Thus, the Proposed Amendments appropriately focus on a project's potential incremental contribution of GHGs rather than on the potential effect itself (i.e., climate change). Notably, however, the Proposed Amendments expressly incorporate the fair argument standard. (See, e.g., proposed Section 15064.4(b)(3).) Thus, if there is any substantial evidence supporting a fair argument that a project's GHG emissions may result in any adverse impacts, including climate change, the lead agency must resolve that concern in an EIR.

THE NATURAL RESOURCES AGENCY'S RULEMAKING PROCESS

The Natural Resources Agency commenced the rulemaking process on the Amendments on July 3, 2009, by publishing its Notice of Proposed Action in the California Regulatory Notice Register. (2009 No. 27-Z.) In addition, the Notice of Proposed Action was mailed to over 640 interested parties, and notices were e-mailed to those parties that requested electronic notification. The Natural Resources Agency also posted the Notice, Proposed Text and Initial Statement of Reasons on its website, and invited public comments on the proposed amendments between July 3, 2009, and August 20, 2009. Public hearings were held on August 18, 2009, and August 20, 2009, in Los Angeles and Sacramento, respectively, at which verbal and written comments and presentations were accepted. To ensure that all interested parties were able to provide written comments if they so chose, the Natural Resources Agency extended the public comment period to August 27, 2009. The Natural Resources Agency received over 80 comment letters on the proposed amendments.

Following review of all public comments received during the public review period and at the public hearings, the Natural Resources Agency determined that further revisions to the proposed text were appropriate. It, therefore, mailed a Notice of Proposed Changes to all hearing attendees and all persons that requested notice. Electronic notices were e-mailed to those requesting such notification. The Notice of Proposed Changes, Revised Text of the proposed amendments, comment letters, and all prior rulemaking documents were posted on the Natural Resources Agency's website. Since all revisions to the proposed amendments were sufficiently related to the originally noticed text, public comment was invited between October 23, 2009, and November 10, 2009. The Natural Resources Agency received over 20 comment letters on the revisions to the proposed amendments.

Following the close of the second public comment period, the Natural Resources Agency reviewed and considered all written comments. The Secretary for Natural Resources determined that, other than two non-substantive, clarifying changes in sections 15126.2(a) and 15126.4(c), described below, no further revisions to the proposed amendments was necessary. Secretary Mike Chrisman adopted the amendments described in this Final Statement of Reasons in December 2009.

Throughout the rulemaking process, staff of the Natural Resources Agency met with all interested parties requesting in person meetings. It also attended and presented at various conferences hosted by, among others, the California Chapter of the American Planning Association, the California State Bar's Environmental Law Conference, County Counsels Association of California, several county bar association meetings and local government forums to provide updates on the proposed amendments and to ensure widespread participation in the Natural Resources Agency's rulemaking process.

Copies of all relevant rulemaking documents, including hearing transcripts, notices, and agendas, are included in the record of proceedings.

ADOPTED AMENDMENTS

Analysis of GHG emissions in a CEQA document presents unique challenges to lead agencies. Such analysis must be consistent with existing CEQA principles, however. Therefore, the Amendments comprise relatively modest changes to various portions of the existing CEQA Guidelines. Modifications address those issues where analysis of GHG emissions may differ in some respects from more traditional CEQA analysis. Other modifications clarify existing law that may apply both to analysis of GHG emissions as well as more traditional CEQA analyses. The incremental approach in the Amendments is consistent with Public Resources Code section 21083(f), which directs OPR and the Resources Agency to regularly review the Guidelines and propose amendments as necessary.

The Legislature expressly left development of the Guidelines to the discretion of OPR and the Resources Agency. That discretion is governed by the Government Code, which requires that any administrative regulations be consistent, and not conflict, with existing statutory authority. (Gov. Code, § 11342.2.) Thus, the Resources Agency intends, as did OPR, the Amendments to incorporate existing law, and where necessary "to implement, interpret, make specific or otherwise carry out the provisions of the statute." (*Ibid*.) In addition, the Guidelines must be "reasonably necessary" to carry out a legislative directive. (*Ibid*.) Because the determination of "reasonable necessity" implicates an agency's expertise, courts will defer to an agency's findings of necessity unless the action is arbitrary, capricious or without reasonable basis. (*Communities for a Better Environment v. California Resources Agency* (2002) 103 Cal.App.4th 98, 109 ("*CBE*").)

The Amendments include changes to or additions of fourteen sections of the existing Guidelines, as well as changes to Appendices F (Energy Conservation) and G (Environmental Checklist Form). The Amendments are discussed below.

SECTION 15064. DETERMINING THE SIGNIFICANCE OF THE ENVIRONMENTAL EFFECTS CAUSED BY A PROJECT.

Specific Purposes of the Amendment

Amendments are proposed to two subdivisions of the existing section 15064. The first, to subdivision (f)(5), is a grammatical correction that qualifies as a "change without regulatory effect" pursuant to section 100(a)(4) of the Office of Administrative Law's regulations governing the rulemaking process. (Cal. Code Regs., tit. 1, § 100(a)(4).) The second set of amendments is to subdivision (h)(3). The latter amendments are described in detail below.

<u>Cumulative Impacts</u>

Existing subdivision (h)(3) allows an agency to find that a project's potential cumulative impacts are less than significant due to compliance with requirements in a plan or mitigation program. (*CBE, supra,* 103 Cal.App.4th at 111 ("a lead agency's use of existing environmental standards in determining the significance of a project's environmental impacts is an effective means of promoting consistency in significance determinations and integrating CEQA environmental review activities with other environmental program planning and regulation").) In effect, that section creates a rebuttable presumption that compliance with certain plans and regulations reduces a project's potential incremental contribution to a cumulative effect to a level that is not cumulatively considerable.

The existing Guidelines text includes several criteria that define which plans or programs may create such a presumption. To satisfy those criteria, a plan or program must: (1) have been previously approved, (2) contain specific requirements that avoid or substantially lessen the cumulative problem within a defined geographic area, and (3) be either specified in law or approved by a public agency with jurisdiction over affected resources. These criteria ensure that the presumption applies only where plans or programs have undergone public scrutiny and include binding requirements to address a cumulative problem. The existing text lists three types of plans as examples that may be relied upon for a cumulative analysis. The word "e.g." in the existing text indicates, however, that the list is not exclusive. The Third District Court of Appeal upheld what is now section 15064(h)(3) in the *CBE* decision. (*CBE*, *supra*, 103 Cal.App.4th at 115-116.)

<u>Use of Plans and Regulations in a Cumulative Impacts Analysis</u>

The Proposed Amendments include two changes to subdivision (h)(3). First, the Amendments would add several plans and regulations to the list of examples. The Proposed Amendments would add "habitat conservation plan, natural community conservation plan, [and] plans or regulations for the reduction of greenhouse gas emissions" to the list of plans and programs that may be considered in a cumulative impacts analysis. As explained below, the Resources Agency finds that the added plans and regulations satisfy the criteria in the existing text.

"Habitat conservation plans" are defined in the federal Endangered Species Act, and typically include specific requirements to protect listed species within a defined geographic area. (16 U.S.C. § 1539.) Though a habitat conservation plan ("HCP") may be prepared to address the impacts of one particular project, HCPs may also be, and often have been, prepared to address the impacts of cumulative development within a defined area. (Fish and Wildlife Service and National Marine Fisheries Service, Habitat Conservation Planning and Incidental Take Permit Processing Handbook (November 4, 1996), at pp. 1-6 to 1-7, 1-14 to 1-15.) Most HCPs, other than "low effect HCPs," will also likely need to undergo environmental review under the National Environmental Policy Act. (*Id*. at Ch. 5.) In such cases, an applicable HCP may appropriately be used in a cumulative impacts analysis as described in subdivision (h)(3).

"Natural community conservation plans" ("NCCPs") are defined in the California Natural Community Conservation Planning Act. (Fish & G. Code, §§ 2800 et seq.) The purpose of an NCCP is to conserve natural communities at the ecosystem scale while accommodating compatible land uses. An NCCP includes, among others, measures to avoid or minimize impacts to natural communities, conservation obligations, and compliance monitoring. An NCCP is adopted by the Department of Fish and Game as well as local agencies with land use authority in a defined area. As discretionary acts of public agencies, NCCPs must undergo environmental review pursuant to CEQA. Thus, NCCPs satisfy the criteria in existing subdivision (h)(3).

The Legislature recognized local GHG planning efforts in Health & Safety Code section 38561(c) by directing the California Air Resources Board (ARB) to consider such programs in developing its Scoping Plan. Greenhouse gas emission reduction plans are not currently specified in law. However, the ARB's Climate Change Scoping Plan includes a recommended reduction target for local governments and community-level emissions of 15 percent by 2020. (California Air Resources Board, *Climate Change Proposed Scoping Plan* (2008), at p. 27 ("Scoping Plan").) The Scoping Plan also recognized the important role local greenhouse gas reduction plans would play in achieving statewide reductions. The Scoping Plan itself suggests elements that such plans should include. (Scoping Plan, Appendix C, at p. C-49.)

Independent of the Scoping Plan, many local governments have adopted, or are currently developing, various plans and programs designed to curb GHG emissions. (Office of Planning and Research, *The California Planner's Book of Lists* (January 2009) ("Book of Lists"), at pp. 92-100; see also Scoping Plan, at p. 26.) Other public agencies, such as school districts and public universities, may also adopt greenhouse gas reduction plans to govern their own activities. Provided that such plans contain specific requirements with respect to resources that are within the agency's jurisdiction to avoid or substantially lessen the agency's contributions to GHG emissions, both from its own projects and from private projects it has approved or will approve, such plans may be appropriately relied on in a cumulative impacts analysis. Additional guidance regarding the characteristics of greenhouse gas reduction plans that may be used in this context is provided in the proposed Section 15183.5, and is explained in greater detail below. Thus, greenhouse gas reduction plans satisfying such criteria would satisfy the criteria in existing subdivision (h)(3).

Finally, requirements addressing a cumulative problem may also take the form of regulations. AB 32, for example, requires ARB to adopt regulations that achieve the maximum technologically feasible and cost effective GHG reductions to reach the adopted state-wide emissions limit. (Health & Safety Code, § 38560.) Pursuant to Health and Safety Code section 38560(b), ARB will adopt a first set of regulations by January 1, 2010. Thus, a lead agency may consider whether ARB's GHG reduction regulations satisfy the criteria in existing subdivision (h)(3).

While section 15064(h)(3) creates a presumption that, where a plan, program or regulation governs a project's GHG emissions, and the project complies with those requirements, those emissions are not cumulatively considerable. That presumption is rebuttable, however. The Proposed Amendments do not alter the standard, reflected in the existing Guidelines, that if substantial evidence supports a fair argument that, despite compliance with the requirements in a plan or program, a project may have a significant effect on the environment, then an EIR must be prepared.

Demonstrating How the Plan, Program or Regulation Addresses Cumulative Impacts

In addition to augmenting the list of plans, programs and regulations that give rise to the presumption that a project's contribution is not cumulatively considerable, the Amendments also contain explanatory language designed to ensure that the plan or regulation relied on in a cumulative impacts analysis actually addresses the cumulative effect of concern for the particular project under consideration. This language is necessary to avoid misapplication of subdivision (h)(3). For example, shortly after ARB identified early action items, some lead agencies determined that a project's contribution of GHG emissions was not cumulatively considerable because the project was not inconsistent with the early action items. (See, e.g., Tentative Ruling, San Bernardino County Superior Court Case Nos. 810232, 800607 (ruling that consistency with CAT Strategies alone does not provide sufficient information about the potential impacts of a project); see also California Environmental Protection Agency, *Climate Action Team Report to Governor Schwarzenegger and the Legislature*, March 2006, at pp. 39-63.) Such an analysis, however, would fail to account for emissions that are not addressed by the early action items. Because those early action items largely addressed industrial-type emissions, consistency with the early action items would have little relevance for a residential subdivision project. Likewise, consistency with plans that are purely aspirational (i.e., those that include only unenforceable goals without mandatory reduction measures), and provide no assurance that emissions within the area governed by the plan will actually address the cumulative problem, may not achieve the level of protection necessary to give rise to this subdivision's presumption. Thus, by requiring that lead agencies draw a link between the project and the specific provisions of a binding plan or regulation, section 15064(h)(3) would ensure that cumulative effects of the project are actually addressed by the plan or regulation in question.

Demonstrating that compliance with a plan addresses a cumulative problem is already impliedly required by CEQA. For example, an initial study must include sufficient information to support its conclusions. (State CEQA Guidelines, § 15063(d)(3).) Similarly, section 15128 requires a lead agency to explain briefly the reasons that an impact is determined to be less than significant and therefore was not analyzed in an EIR. The added sentence, therefore, reflects existing law and is necessary to ensure that plans are not misapplied in a CEQA analysis.

<u>Policy Goals</u>

Inclusion of additional plans and programs to the list of examples supports two policy goals. First, an expanded list promotes integration of various regulatory mechanisms to reduce duplication. (See, e.g., Pub. Resources Code, § 21003(a) (state policy is that "[l]ocal agencies integrate the requirements of [CEQA] with planning and environmental review procedures otherwise required by law or by local practice …"), (f) ("[a]ll persons and public agencies involved in the environmental review process be responsible for carrying out the process in the most efficient, expeditious manner in order to conserve the available financial, governmental, physical, and social resources with the objective that those resources may be better applied toward the mitigation of actual significant effects on the environment").) Second, the addition of GHG emissions reduction plans and regulations for the reduction of GHG emissions reflects the view of both the OPR and the Resources Agency that the effects of GHG emissions resulting from individual projects are best addressed and mitigated at a programmatic level.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) The Guidelines must address the determination of whether the "possible effects of a project are individually limited but cumulatively considerable." (*Id*. at § 21083(b)(2).) Due to the global nature of GHG emissions and their potential effects, GHG emissions will typically be addressed in a cumulative impacts analysis. (See, e.g., EPA, Draft Endangerment Finding, 74 Fed. Reg. 18886, 18904 (April 24, 2009) ("cumulative emissions are responsible for the cumulative change in the stock of concentrations in the atmosphere"); California Air Pollution Control Officers Association, *CEQA and Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act* (January 2008) ("CAPCOA White Paper"), at p. 35 ("GHG impacts are exclusively cumulative impacts; there are no non-cumulative GHG emission impacts from a climate change perspective").) Existing section 15064(h) governs the analysis of cumulative effects in an initial study. The proposed amendments to section 15064(h)(3), on determining the significance of cumulative impacts in an initial study, are therefore necessary to carry out this legislative directive.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and that the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and case law interpreting CEQA for determining the significance of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).)[2] Thus, the Amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

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[2] Federal court decisions interpreting NEPA is persuasive authority in CEQA cases. (*Western Placer Citizens for an Ag. & Rur. Env. v. County of Placer* (2006) 144 Cal.App. 4th 890, 902.)

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the amendments to this section are intended to reduce the costs of environmental review on lead agencies and project applicants by encouraging the use of existing environmental analysis where available. (Pub. Resources Code, § 21003(d) (use information in existing EIRs in order to reduce duplication), (f) (environmental review should proceed in the most efficient manner possible).)

SECTION 15064.4. DETERMINING THE SIGNIFICANCE OF IMPACTS FROM GREENHOUSE GAS EMISSIONS

Specific Purposes of the Amendment

A key component of environmental analysis under CEQA is the determination of significance. (Pub. Resources Code § 21002; *Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1106-07.) Guidelines on the analysis of GHG emissions must, therefore, include provisions on the determination of significance of those emissions.

New section 15064.4, on the determination of significance of GHG emissions, reflects the existing CEQA principle that there is no iron-clad definition of "significance." (State CEQA Guidelines, § 15064(b); *Berkeley Keep Jets Over the Bay Com. v. Board of Port Comm*. (2001) 91 Cal.App.4th 1344, 1380-81 ("*Berkeley Jets*").) Accordingly, lead agencies must use their best efforts to investigate and disclose all that they reasonably can regarding a project's potential adverse impacts. (*Ibid*; *see also* State CEQA Guidelines, § 15144.) Section 15064.4 is designed to assist lead agencies in performing that required investigation. In particular, it provides that lead agencies should quantify GHG emissions where quantification is possible and will assist in the determination of significance, or perform a qualitative analysis, or both as appropriate in the context of the particular project, in order to determine the amount, types and sources of GHG emissions resulting from the project. Regardless of the type of analysis performed, the analysis must be based "to the extent possible on scientific and factual data." In addition, lead agencies should also consider several factors. The specific provisions of section 15064.4 are discussed below.

<u>Quantitative Analysis</u>

Subdivision (a) of section 15064.4 states that lead agencies should calculate or estimate the GHG emissions resulting from the proposed project. This directive reflects the holding in the *Berkeley Jets* case, which required a Port Commission to quantify emissions of toxic air contaminants even in the absence of a universally accepted methodology for doing so. (*Berkeley Jets*, *supra*, 91 Cal.App.4th at p. 1370 ("The fact that a single methodology does not currently exist that would provide the Port with a precise, or 'universally accepted,' quantification of the human health risk from TAC exposure does not excuse the preparation of any health risk assessment--it requires the Port to do the necessary work to educate itself about the different methodologies that <u>are</u> available") (emphasis in original).) That case also required quantitative analysis of single-event noise, even though the applicable thresholds were expressed as cumulative noise levels. (*Id*. at 1382.) Quantification was required in that context in order to identify existing noise levels, the number of additional flights, the frequency of those flights, the degree to which the increased flights would cause increased noise levels at a given location, and ultimately, the community's reaction to that noise. (*Ibid*.) In other words, quantification would assist the lead agency in determining whether the increased noise would be potentially significant. (*Ibid*. ("CEQA requires that the Port and the inquiring public obtain the technical information needed to assess whether the ADP will merely inconvenience the Airport's nearby residents or damn them to a somnambulate-like existence"); see also *Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1109 ("in preparing an EIR, the agency must consider and resolve every fair argument that can be made about the possible significant environmental effects of a project, irrespective of whether an established threshold of significance has been met with respect to any given effect").)

With the foregoing principles in mind, the quantification called for in proposed section 15064.4(a)(1) is reasonably necessary to ensure an adequate analysis of GHG emissions using available data and tools, in accordance with Public Resources Code Section 21083.05. Even where a lead agency finds that no numeric threshold of significance applies to a proposed project, the holdings in the *Berkeley Jets* and *Protect the Historic Amador Waterways* cases, described above, require quantification of emissions if such quantification will assist in determining the significance of those emissions. OPR and the Resources Agency find that quantification will, in many cases, assist in the determination of significance, as explained below. (State CEQA Guidelines, § 15142 ("An EIR shall be prepared using an interdisciplinary approach which will ensure the integrated use of the natural and social sciences and the consideration of qualitative as well as quantitative factors").)

First, quantification of GHG emissions is possible for a wide range of projects using currently available tools. Modeling capabilities have improved to allow quantification of emissions from various sources and at various geographic scales. (Office of Planning and Research, *CEQA and Climate Change: Addressing Climate Change Through the California Environmental Quality Act Review*, Attachment 2: Technical Resources/Modeling Tools to Estimate GHG Emissions (June 2008); CAPCOA White Paper, at pp. 59-78.) Moreover, one of the models that can be used in a GHG analysis, URBEMIS, is already widely used in CEQA air quality analyses. (CAPCOA White Paper, at p. 59.) Second, quantification informs the qualitative factors listed in proposed section 15064.4(b). Third, quantification indicates to the lead agency, and the public, whether emissions reductions are possible, and if so, from which sources. Thus, if quantification reveals that a substantial portion of a project's emissions result from energy use, a lead agency may consider whether design changes could reduce the project's energy demand.

Proposed section 15064.4(a)(1) also reflects existing case law that reserves for lead agencies the precise methodology to be used in a CEQA analysis. (*See*, *e.g.*, *Eureka Citizens for Responsible Gov't v. City of Eureka* (2007) 147 Cal.App.4th 357, 371-373.) As indicated above, a wide variety of models exist that could be used in a GHG analysis. (CAPCOA White Paper, at pp. 59-78.) Further, not every model will be appropriate for every project. For example, URBEMIS may be an appropriate tool to analyze a typical residential subdivision or commercial use project, but some public utilities projects, such as waste-water treatment plants, may require more specialized models to accurately estimate emissions. (*Id*. at pp. 60-65.) The requirement to disclose any limitations in the model or methodology chosen also reflects the standard for adequacy of EIRs in existing State CEQA Guidelines section 15151.

Qualitative and Performance Standard Based Analysis

As explained in greater detail below in the Thematic Responses, CEQA does not require quantification of emissions in every instance. If the lead agency determines that quantification is not possible, would not yield information that would assist in analyzing the project's impacts and determining the significance of the GHG emissions, or is not appropriate in the context of the particular project, section 15064.4(a) would allow the lead agency to consider qualitative factors or performance standards. Consideration of qualitative factors is appropriate for several reasons. First, CEQA directs lead agencies to consider qualitative factors. (Pub. Resources Code, § 21001(g) (CEQA's purpose includes to: "require governmental agencies at all levels to consider qualitative factors as well as economic and technical factors and long-term benefits and costs, in addition to short-term benefits and costs and to consider alternatives to proposed actions affecting the environment").) Second, existing section 15064.7 of the State CEQA Guidelines indicate that thresholds of significance may be qualitative, which implies that a determination of significance without a threshold could also evaluate qualitative factors. Third, the existing CEQA Guidelines state that the determination of significance requires a lead agency to use its judgment based on *all* relevant information. (State CEQA Guidelines, § 15064(b); see also *id*. at §§ 15064.7 (thresholds may be qualitative), 15142 (analysis should be interdisciplinary and both qualitative and quantitative).)

Subdivision (a) would also allow a lead agency to rely on performance-based standards to assist in the determination of significance. Just as with quantification, the purpose of engaging in a qualitative or performance standard based analysis is to develop information relevant to a significance determination. Several examples exist of the types of performance standards that might appropriately be used in determining the significance of greenhouse gas emissions. Proposed section 15183.5(b)(1)(D), for example, contemplates that a plan for the reduction of greenhouse gas emissions may contain performance based standards. Where such standards are developed as part of such a plan, a lead agency would have evidence indicating that compliance with such standards would indicate that the impact of greenhouse gas emissions would be less than significant. Further, in adopting SB375, the Legislature acknowledged that regional transportation plans, and the environmental impact reports prepared to analyze those plans, may contain performance standards that would apply to transit priority projects. (See, e.g., Public Resources Code, § 21155.2.) Other potential examples include the Bay Area Air Quality Management District's proposed Best Management Practices for Construction Greenhouse Gas Emissions (calling for use of alternative fuels, local building materials and recycling), and the California Public Utilities Commission's Performance Standard for Power Plans (requiring emissions no greater than a combined cycle gas turbine plant). Compliance with such standards may be relevant to the significance determination, when considered in conjunction with the project's total projected emissions. Section 15064.4(a) was revised in response to comments to clarify that lead agencies may rely on quantitative or qualitative analyses, or both, in part to emphasize that qualitative analyses and performance standards may be useful supplements to a quantitative analysis.

Similar to use of a significance threshold, a lead agency must exercise care to ensure that performance standards do not replace a full analysis of all potential emissions. (*Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1109 ("in preparing an EIR, the agency must consider and resolve every fair argument that can be made about the possible significant environmental effects of a project, irrespective of whether an established threshold of significance has been met with respect to any given effect").) For example, while a Platinum LEED® rating could assist a lead agency in determining whether emissions related to a building's energy use may be significant, that performance standard may not reveal sufficient information to evaluate transportation-related emissions associated with that proposed project.

As indicated above, even a qualitative analysis must be based to the extent possible on scientific and factual data. Further, the type of analysis that is required will depend on the context of a particular project. Given the multitude of different project types and sizes, and different agencies subject to CEQA, the CEQA Guidelines, which are general by necessity, cannot specify precisely when a quantitative analysis may be required or a qualitative analysis may be appropriate. The following hypothetical examples may illustrate, however, how section 15064.4(a) could operate:

> **Project 1**: a small habitat restoration project is proposed in a remote part of California. Workers would drive to the site where they would camp for the duration of the project. Some gas-powered tools and machinery may be required. Cleared brush would either be burned or would decay naturally.
>
> **Project 2**: a large commercial development is proposed in an suburban context. Heavy-duty machinery would be required in various construction phases spanning many months. Following construction, the development would rely on electricity, water and wastewater services from the local utilities. Natural gas burners would be used on site. The development would employ several hundred workers and attract thousands of customers daily. A traffic study has been prepared for the project. The local air quality management district's guidance document recommends that projects of similar size and character should use of URBEMIS, or another similar model, to estimate the air quality impacts of the development.

In the context of Project 2 a quantitative analysis would likely be appropriate. The URBEMIS model, which would likely be used to analyze other emissions, could also be used to estimate emissions from both project-related transportation and on-site indirect emissions (landscaping, hot-water heaters, etc.) Modeling is typically done for projects of like size and character. Other models are readily available to estimate emissions associated with utility use. In the context of Project 2, a lead agency may find it difficult to demonstrate a good faith effort through a purely qualitative analysis. (See, e.g., *Berkeley Keep Jets Over the Bay Com. v. Board of Port Comm*. (2001) 91 Cal.App.4th 1344, 1370.)

In the context of Project 1, however, a qualitative analysis would likely be appropriate. Project 1's emissions are not easily modeled, and the Project is small in scale. While it may be technically possible, quantification of the emissions may not reveal any additional information that indicates the significance of those emissions or how they may be reduced that could not be provided in a qualitative assessment of emissions sources. (See, e.g., Public Resources Code, § 21003(f) ("public agencies involved in the environmental review process be responsible for carrying out the process in the most efficient, expeditious manner in order to conserve the available financial, governmental, physical, and social resources with the objective that those resources may be better applied toward the mitigation of actual significant effects on the environment").)

<u>Factors Potentially Indicating Significance</u>

The qualitative factors listed in the proposed section 15064.4(b) are intended to assist lead agencies in collecting and considering information relevant to a project's incremental contribution of GHG emissions and the overall context of such emissions. Notably, while subdivision (b) provides a list of factors that should be considered by public agencies in determining the significance of a project's GHG emissions, other factors can and should be considered as appropriate.

<u>Determine Whether Emissions Will Increase or Decrease</u>

The first factor in subdivision (b), for example, asks lead agencies to consider whether the project will result in an increase or decrease in different types of GHG emissions relative to the existing environmental setting. All project components, including construction and operation, equipment and energy use, and development phases must be considered in this analysis. (State CEQA Guidelines, § 15378 (project includes "the whole of the action").) For example, a mass transit project may involve GHG emissions during its construction phase, but substantial evidence may also indicate that it will cause existing commuters to switch from single-occupant vehicles to mass transit use. Operation of such a project may ultimately result in a decrease in GHG emissions. Such analysis, provided that it is supported with substantial evidence and fully accounts for all project emissions, may support a lead agency's determination that GHG emissions associated with a project are not cumulatively considerable.

This section's reference to the "existing environmental setting" reflects existing law requiring that impacts be compared to the environment as it currently exists. (State CEQA Guidelines, § 15125.) This clarification is necessary to avoid a comparison of the project against a "business as usual" scenario as defined by ARB in the Scoping Plan. Such an approach would confuse "business as usual" projections used in ARB's Scoping Plan with CEQA's separate requirement of analyzing project effects in comparison to the environmental baseline. (*Compare* Scoping Plan, at p. 9 ("The foundation of the Proposed Scoping Plan's strategy is a set of measures that will cut greenhouse gas emissions by nearly 30 percent by the year 2020 as compared to business as usual") *with Fat v. County of Sacramento* (2002) 97 Cal.App.4th 1270, 1278 (existing environmental conditions normally constitute the baseline for environmental analysis); see also *Center for Bio. Diversity v. City of Desert Hot Springs*, Riverside Sup. Ct. Case No. RIC464585 (August 6, 2008) (rejecting argument that a large subdivision project would have a "beneficial impact on CO2 emissions" because the homes would be more energy efficient and located near relatively uncongested freeways).) Business as usual may be relevant, however, in the discussion of the "no project alternative" in an EIR. (State CEQA Guidelines, § 15126.6(e)(2) (no project alternative should describe what would reasonably be expected to occur in the future in the absence of the project).)

Notably, section 15064.4(b)(1) is not intended to imply a zero net emissions threshold of significance. As case law makes clear, there is no "one molecule rule" in CEQA. (CBE, *supra*, 103 Cal.App.4th at 120.)

<u>Thresholds of Significance</u>

The second factor in subdivision (b) asks whether a project exceeds a threshold of significance for GHG emissions. Section 21000(d) of the Public Resources Code expressly directs public agencies to identify whether there are any critical thresholds for health and safety to identify those areas where the capacity of the environment is limited. A threshold is an "identifiable quantitative, qualitative or performance level" at which impacts are normally less than significant. (State CEQA Guidelines, § 15064.7(a); *see also Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1107.) Lead agencies may rely on thresholds developed by other agencies that have particular expertise in the subject matter under consideration. (*See*, *e.g.*, State CEQA Guidelines, Appendix G, Sample Question III ("[w]here available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make" a significance determination).) For example, a lead agency may look to standards included in a Basin Plan to assist in the determination of whether water quality impacts are significant. (*Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1107 ("[s]uch thresholds can be drawn from existing environmental standards, such as other statutes or regulations").)

Several agencies have developed, or are in the process of developing, thresholds of significance for GHG emissions.[3] For example, thresholds are currently being developed, or have already been adopted by the Bay Area Air Quality Management District for operations and construction,[4] the City of Davis for residential

[3] Reference to these thresholds and proposed thresholds does not reflect an endorsement of those thresholds; rather, they are cited solely for the purpose of demonstrating that agencies are developing such thresholds.
[4] BAAQMD CEQA Guidelines Update: work in progress - http://www.baaqmd.gov/pln/ ceqa/index.htm.

developments,[5] and the South Coast Air Quality Management District for industrial projects.[6] Regardless of the threshold chosen, however, this section does not alter the pre-existing rule under CEQA that if substantial evidence supports a fair argument that a project may result in significant impacts, despite compliance with a threshold, an EIR must be prepared. (*Mejia v. City of Los Angeles* (2005) 130 Cal.App.4th 322, 342.) Further, "in preparing an EIR, the agency must consider and resolve every fair argument that can be made about the possible significant environmental effects of a project, irrespective of whether an established threshold of significance has been met with respect to any given effect." (*Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1109.)

Consistent with the above, if relying on a threshold developed by another agency, lead agencies must exercise caution in selecting a threshold to ensure that the threshold is appropriately applied. For CEQA purposes, a threshold identifies a level below which an environmental impact will normally be less than significant. (State CEQA Guidelines, § 15064.7(a).) Some agencies have adopted "thresholds" pursuant to other laws that may not be applicable in the CEQA context. ARB has adopted several thresholds pursuant to AB32, for example, to address specific purposes that are unrelated to CEQA. For example, the *de minimis* threshold governs the level at which emissions will be regulated by ARB's AB32 regulations. (Health & Safety Code, § 38561(e); Scoping Plan, at pp. 96-97.) CEQA does not permit use of a *de minimis* threshold, however. (*CBE*, *supra*, 103 Cal.App.4th at p. 121.) Additionally, the Reporting Threshold is the level at which emissions from large industrial sources are required to be reported. (Scoping Plan, at pp. 108-109; *see also* CARB Board Resolution 07-54 (2007).) Again, this reporting threshold reflects a policy decision regarding regulation by the ARB, but does not address the level at which environmental harm may occur, and does not satisfy a lead agency's duties under CEQA related to review of projects which may result in significant adverse environmental impacts.

Consistency with a Plan or Regulation

Finally, the third factor in subdivision (b) directs consideration of the extent to which a project complies with a plan or regulation to reduce GHG emissions. That section further states, however, that to be used for the purpose of determining significance, a plan must contain specific requirements that result in reductions of GHG emissions to a less than significant level. This clarification is necessary because of the wide variety of climate action plans and GHG reduction plans that are currently being adopted by public agencies. ARB, for example, recently adopted its statewide Scoping Plan. That plan may not be appropriate for use in determining the significance of individual projects, however, because it is conceptual at this stage and relies on the future development of regulations to implement the strategies identified in the Scoping

[5] City of Davis (2009) Greenhouse Gas Emission Threshold and Standards for New Residential Development; Accessed 5/27/09, http://cityofdavis.org/pgs/sustainability/pdfs/15_4.21.09_GHG%20Standards.pdf
[6] SCAQMD (2008) Interim CEQA GHG Significance Threshold for Stationary Sources, Rules and Plans, Accessed 5/27/09 http://www.aqmd.gov/hb/2008/December/081231a.htm.

Plan. (Scoping Plan, at p. 9.) Regulations that will require actual reductions of GHG emissions may not be adopted until 2012. (*Ibid*.) Once those regulations are adopted and being implemented, they may, if appropriate, be used to assist in the determination of significance, similar to the current use of air quality, water quality and other similar environmental regulations. (*CBE*, *supra*, 103 Cal. App. 4th at 111 ("a lead agency's use of existing environmental standards in determining the significance of a project's environmental impacts is an effective means of promoting consistency in significance determinations and integrating CEQA environmental review activities with other environmental program planning and regulation").)

In addition to the regulations that will be developed to implement the Scoping Plan, this factor would also allow lead agencies to consider plans that are developed to reduce GHG emissions on a regional or local level. (Scoping Plan, at p. 26.) The proposed section 15064.4(b)(3) is intended to be read in conjunction with the section 15064(h)(3), as proposed to be amended, and proposed section 15183.5. Those sections each indicate that local and regional plans may be developed to reduce GHG emissions. If such plans reduce community-wide emissions to a level that is less than significant, a later project that complies with the requirements in such a plan may be found to have a less than significant impact.

Notably, CEQA does not provide a specific definition of "comply" in the context of determining a project's consistency with a particular plan. Some guidance may be gleaned, however, from case law interpreting the requirement that a local government's activities be consistent with its General Plan. In that context, a "zoning ordinance [for example] is consistent with the city's general plan where, considering all of its aspects, the ordinance furthers the objectives and policies of the general plan and does not obstruct their attainment." (*City of Irvine v. Irvine Citizens Against Overdevelopment* (1994) 25 Cal. App. 4th 868, 879.) Reading section 15064.4 together with 15064(h)(3), however, to demonstrate consistency with an existing GHG reduction plan, a lead agency would have to show that the plan actually addresses the emissions that would result from the project. Thus, for example, a subdivision project could not demonstrate "consistency" with the ARB's Early Action Measures because those measures do not address emissions resulting from a typical housing subdivision. (ARB, Expanded List of Early Action Measures to Reduce Greenhouse Gas Emissions in California Recommended for Board Consideration, October 2007; see also State CEQA Guidelines, §§ 15063(d)(3) (initial study must be supported with information to support conclusions), 15128 (determination in an EIR that an impact is less than significant must be briefly explained).)

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) A key component of environmental analysis under CEQA is the determination of significance. (*Id*. at § 21002; *Protect the Historic Amador Waterways, supra,* 116 Cal.App.4th at

1106-07.) The new section 15064.4, on determining the significance of impacts of GHG emissions, is therefore necessary to carry out this legislative directive.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the Amendments were proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for determining the significance of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).)[7] Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, by providing greater certainty to lead agencies regarding the determination of significance of GHG emissions, the cost of environmental analysis, and potential litigation, may be reduced.

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[7] Federal court decisions interpreting NEPA is persuasive authority in CEQA cases. (*Western Placer Citizens for an Ag. & Rur. Env. v. County of Placer* (2006) 144 Cal.App. 4th 890, 902.)

SECTION 15064.7. THRESHOLDS OF SIGNIFICANCE

Specific Purposes of the Amendment

Proposed subdivision (c) of section 15064.7 would allow a lead agency to adopt a threshold developed by another agency, or recommended by experts, provided that such threshold is supported with substantial evidence. This proposed regulation is reasonably necessary because many lead agencies perform general governmental functions, and may lack the specific expertise necessary to develop their own thresholds of significance for GHG emissions. Such agencies may rely on thresholds developed by other agencies with specialized expertise (such as an air quality management district) in conducting their CEQA analyses. (OPR, Thresholds of Significance: Criteria for Defining Environmental Significance, September 1994, at p. 7.) In fact, Appendix G of the State CEQA Guidelines expressly encourages lead agencies to rely on thresholds established by local air quality management districts. (State CEQA Guidelines, Appendix G, Question III.)

Several local and regional air districts are in the process of developing thresholds for GHG emissions. As noted above, for example, thresholds are currently being developed, or have already been adopted by the Bay Area Air Quality Management District for operations and construction, the City of Davis for residential developments, and the South Coast Air Quality Management District for industrial projects. Lead agencies within the jurisdiction of an air district, or other agency, that adopts a GHG emissions threshold may adopt such a threshold as its own. In adopting any threshold of significance, including one developed by an expert or agency with specialized expertise, the lead agency must support the threshold with substantial evidence in the administrative record. (State CEQA Guidelines, § 15064.7(b).)

Independent experts may also develop such thresholds for use by public agencies. For example, the California Air Pollution Control Officers Association has published a White Paper on developing thresholds of significance for GHG emissions. (CAPCOA White Paper, at pp. 31-58.) A lead agency could potentially use CAPCOA's suggestions in developing its own thresholds. Because any threshold must be supported with substantial evidence, and must be adopted through a public process, any threshold recommended by an expert that is ultimately adopted will undergo sufficient scrutiny to ensure its legitimacy. (State CEQA Guidelines, § 15064.7(b).)

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) Defining "significance" is a critical step in the lead agency's impact analysis and therefore needs to be addressed as part of the Proposed Action. Section 21000(d) of the Public Resources Code encourages the development of thresholds. These sections together require OPR and the Resources Agency to develop and adopt regulations governing the adoption of thresholds of significance for GHG emissions.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for determining the significance of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, by providing greater certainty to lead agencies regarding the determination of significance of GHG emissions, the cost of environmental analysis, and potential litigation, may be reduced.

SECTION 15065. MANDATORY FINDINGS OF SIGNIFICANCE

Specific Purposes of the Amendment

The amendment to section 15065(b)(1) would change the word “preliminary” to “public.” The purpose of this amendment is to make section 15065 consistent with section 21064.5 of the Public Resources Code. The latter provision defines a mitigated negative declaration to be a negative declaration where mitigation measures are added to a project “before the proposed negative declaration and initial study are released for *public* review[.]” (State CEQA Guidelines, § 15070(b)(1).) In contrast, existing CEQA Guidelines section 15065(b)(1), dealing with mandatory findings of significance, would require a commitment to mitigation prior to “preliminary” review. “Preliminary Review,” as that term is used in section 15060, refers to a period following receipt of an application during which a lead agency determines whether an exemption applies to the project or whether an EIR would clearly be prepared. Read literally, existing section 15065 would require a commitment to mitigation before an initial study is even conducted. Because the statutory definition of mitigated negative declaration contemplates that mitigation measures may be developed during the preparation of the initial study prior to public review, the change in 15065 from “preliminary” to “public” is appropriate.

Necessity

Section 21083 of the Public Resources Code directs OPR to develop, and the Resources Agency to adopt, guidelines on the implementation of CEQA. The Amendment is necessary to ensure that those guidelines are consistent with relevant statutory definitions.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency’s Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency’s determination that the Amendmentswould make the existing Guidelines easier to follow as a result of greater internal consistency. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific existing statutory CEQA provisions and/or case law interpreting CEQA. Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, by providing greater consistency within the Guidelines, the cost of environmental analysis, and potential litigation, may be reduced.

SECTION 15086. CONSULTATION CONCERNING DRAFT EIR

The revision to this section is a non-substantive correction to this section's reference to the California Air Resources Board. This revision, therefore, qualifies as a "change without regulatory effect" pursuant to section 100(a)(4) of the Office of Administrative Law's regulations governing the rulemaking process. (Cal. Code Regs., tit. 1, § 100(a)(4).)

SECTION 15093. STATEMENT OF OVERRIDING CONSIDERATIONS

Specific Purposes of the Amendment

Section 21081(b) of the Public Resources Code provides that a lead agency may approve or carry out a project with significant and unavoidable impacts only after the lead agency makes a finding that "specific overriding economic, legal, social, technical or other benefits of the project outweigh the significant effects on the environment." The State CEQA Guidelines describes the factors that a lead agency must weigh in determining whether to approve a project with adverse environmental effects:

> CEQA recognizes that in determining whether and how a project should be approved, a public agency has an obligation to balance a variety of public objectives, including economic, environmental, and social factors and in particular the goal of providing a decent home and satisfying living environment for every Californian. An agency shall prepare a statement of overriding considerations as described in Section 15093 to reflect the ultimate balancing of competing public objectives when the agency decides to approve a project that will cause one or more significant effects on the environment.

(State CEQA Guidelines, § 15021(d).) The California Supreme Court has further observed that "an agency's decision that the specific benefits a project offers outweigh any environmental effects that cannot feasibly be mitigated … lies at the core of the lead agency's discretionary responsibility under CEQA…." (*City of Marina v. Board of Trustees of Cal. State Univ* (2006) 39 Cal.4th 341, 368.)

In the context of GHG emissions, some projects may cause adverse environmental impacts but still provide an overall benefit of reducing GHG emissions on a statewide or regional level. For example, a city may make a policy choice to allow increased housing density within a jobs-rich region in order to reduce region-wide GHG emissions from vehicles and transportation. (See, e.g., 2007 IEPR, at p. 210.) Though the introduction of new housing within the jurisdiction may result in near-term or local adverse impacts related to GHG emissions, doing so may assist the region as a whole in meeting region-wide reduction targets. Thus, subdivision (a) of section 15093 was revised to expressly allow a lead agency to consider this type of environmental benefit of a project in making a statement of overriding considerations.

The revision to section 15093(a) accomplishes two objectives. First, it reminds lead agencies and the public that even a project that appears environmentally beneficial may itself cause adverse environmental impacts, and such impacts must undergo full CEQA review, and, if applicable, a statement of overriding considerations. Second, it discourages purely local interests from dominating consideration of a project by expressly allowing a lead agency to consider region- and statewide benefits of a project. Further, "economic, legal, social, technical and other benefits" could be interpreted to refer to local benefits. This addition would ensure that lead agencies may consider regional and statewide benefits in considering a project's adverse impacts. Finally, the proposed addition makes clear, consistent with section 15021(d) of the existing State CEQA Guidelines, that the lead agency may consider environmental benefits to balance a project's significant adverse environmental effects that remain even after the adoption of all available feasible mitigation measures.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) If a lead agency determines that a project's GHG emissions will result in significant and unavoidable impacts, a lead agency may only approve the project if it makes specified findings. (*Id*. at § 21081(b).) This amendment is necessary to ensure that a lead agency considers state-wide and regional benefits of a project in addition to purely local benefits. Because consideration of state-wide and region-wide benefits may also apply to impacts unrelated to GHG emissions, the amendment was worded broadly to address any significant environmental impact.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the proposed revisions. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and/or make specific statutory CEQA provisions and case law interpreting CEQA for making statements of overriding considerations. Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California.

SECTION 15125. ENVIRONMENTAL SETTING

Specific Purposes of the Amendment

Section 15125 reflects existing law requiring examination of project impacts in relation to the existing environment. Subsection (d) states that lead agencies should consider whether the proposed project is inconsistent with applicable local and regional plans. That subsection provides a non-exclusive list of plans for potential consideration. The Amendments would add specific plans, regional blueprint plans and greenhouse gas reduction plans to subdivision (d). The added plans are necessary to ensure that GHG emissions analyses in such plans are addressed.

Specific Plans

Specific Plans address a defined geographic area within the area covered by a General Plan. (Gov. Code, § 65450 ("After the legislative body has adopted a general plan, the planning agency may, or if so directed by the legislative body, shall, prepare specific plans for the systematic implementation of the general plan for all or part of the area covered by the general plan").) Specific Plans must contain "[s]tandards and criteria by which development will proceed, and standards for the conservation, development, and utilization of natural resources, where applicable." (*Id*. at § 65451(a)(3).) Thus, given that so many local governments are addressing GHG emissions in their policy documents, and that Specific Plans must contain standards and criteria, it is likely that Specific Plans may address GHG emissions, and consistency with adopted Specific Plans should be considered in EIRs.

Regional Blueprint Plans

Regional Blueprint Plans are being developed in many of California's Metropolitan Planning Organizations through grants provided by the California Department of Transportation. While originally designed to address transportation efficiencies, Regional Blueprint Plans typically involve smart growth planning with an aim to reducing vehicle miles traveled at a regional level. As a result, Regional Blueprint Plans can provide information regarding the region's existing transportation setting and identify methods to reduce region-wide transportation-related impacts. (Scoping Plan, Appendix C, at pp. C-74-C-84.) Land use decisions impact many sectors responsible for GHG emissions, including transportation, electricity, water, waste, and others. However, the primary impact of land use development on GHG emissions relates to vehicle use. (Land Use Subcommittee of the Climate Action Team, *LUSCAT Submission to CARB Scoping Plan on Local Government, Land Use, and Transportation* (2008), at p. 13.) Blueprint Plans highlight this relationship between land use and transportation and how this relationship may impact a local community's and region's GHG emissions. Analysis of GHG reduction is not required by Blueprint grants but it is recommended. Therefore, Blueprint Plans provide an indication of the GHG emissions potentially created or reduced by the plan. (LUSCAT (2009), at p. 30.) Given the large percentage of GHG emissions that result from transportation in

California, a project's consistency with a Regional Blueprint Plan can provide information indicating whether the project could have significant environmental impacts related to GHG emissions. (*Ibid*.) Regional Blueprint Plans may, therefore, provide evidence to assist the lead agency in determining whether a project may tend to increase or decrease GHG emissions relative to the existing baseline. Thus, where such a plan has been developed and adopted by an MPO, lead agencies may find it useful to evaluate the project's consistency with that Blueprint Plan.

Plans for the Reduction of Greenhouse Gas Emissions

The Amendments would add plans for the reduction of greenhouse gas emissions to the list of plans in section 15125(d). Many local and regional plans now include policies relating to, and analyses of, GHG emissions. (OPR, Book of Lists, at pp. 92-100; Scoping Plan, at p. 26.) Many such plans include detailed information on the jurisdiction's inventory of GHG emissions and measures to reduce such emissions. (*Ibid*.) Such plans may also include prescriptions for specific mitigation measures to address GHG emissions. (Scoping Plan, Appendix C, at p. C-49.) Where such a plan has been developed and adopted within the relevant jurisdiction, a project's inconsistency with that plan could be an indication of potential adverse environmental impacts.

Notably, while section 15125(d) requires an EIR to discuss any inconsistencies of a project with the listed plans, it does not mandate a finding of significance resulting from any identified inconsistencies. The plans simply provide information regarding the project's existing setting and inconsistency may be an indication of potentially significant impacts. The determination of significance is to be made by the lead agency.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines addressing the mitigation of GHG emissions and the effects of the GHG emissions. (Pub. Resources Code, § 21083.05.) As indicated above, one potential indicator of a project's potential GHG emissions impacts is whether the project is consistent with applicable plans that have addressed that impact. Thus, the addition of plans that may address GHG emissions to the list of plans in the existing section 15125 is reasonably necessary to ensure that such analysis occurs.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analyzing the effects of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the amendments to this section are intended to reduce the costs of environmental review on lead agencies and project applicants by encouraging the use of existing environmental information where available. (Pub. Resources Code, § 21003(d) (use information in existing EIRs in order to reduce duplication), (f) (environmental review should proceed in the most efficient manner possible).)

SECTION 15126.2. CONSIDERATION AND DISCUSSION OF SIGNIFICANT ENVIRONMENTAL EFFECTS.

Amendments are proposed to two subdivisions of the existing section 15126.2. The first, to subdivision (c), adds a cross-reference to the Public Resources Code and another section of the State CEQA Guidelines. This revision, therefore, qualifies as a "change without regulatory effect" pursuant to section 100(a)(4) of the Office of Administrative Law's regulations governing the rulemaking process. (Cal. Code Regs., tit. 1, § 100(a)(4).) The second change, made in response to public comments, adds a sentence to the end of existing subdivision (a). That change is described in greater detail below.

Specific Purposes of the Amendment

Several comments submitted as part of the Natural Resources Agency's SB97 rulemaking process urged it to develop guidance addressing the analysis of the impacts of climate change on a project. These comments similarly suggested that such guidance was appropriate in light of the release of the draft California Climate Adaptation Strategy (Adaptation Strategy), developed pursuant to Executive Order S-13-2008. In considering such comments, it is important to understand several key differences between the Adaptation Strategy and the California Environmental Quality Act. First, the Adaptation Strategy is a policy statement that contains recommendations; it is not a binding regulatory document. Second, the Adaptation Strategy focuses on how the State can plan for the effects of climate change. CEQA's focus, on the other hand, is the analysis of a particular project's greenhouse gas emissions on the environment, and mitigation of those emissions if impacts from those emissions are significant. Given these differences, CEQA should not be viewed as the tool to implement the Adaptation Strategy; rather, as indicated in the Strategy's key recommendations, advanced programmatic planning is the primary method to implement the Adaptation Strategies.

There is some overlap between CEQA and the Adaptation Strategy, however. As explained in both the Initial Statement of Reasons and in the Adaptation Strategy, section 15126.2 may require the analysis of the effects of a changing climate under certain circumstances. (Initial Statement of Reasons, at pp. 68-69.) In particular, Section 15126.2 already requires an analysis of placing a project in a potentially hazardous location. Further, several questions in the Appendix G checklist already ask about wildfire and flooding risks. Many comments on the proposed amendments asked for additional guidance, however.

Having reviewed all of the comments addressing the effects of climate change, the Natural Resources Agency revised the proposed amendments to include a new sentence in Section 15126.2 clarifying the type of analysis that would be required. Existing section 15126.2(a) provides an example of a potential hazard requiring analysis: placing a subdivision on a fault line. The new sentence adds further examples, as follows:

> Similarly, the EIR should evaluate any potentially significant impacts of locating development in other areas susceptible to hazardous conditions (e.g., floodplains, coastlines, wildfire risk areas) as identified in authoritative hazard maps, risk assessments or in land use plans addressing such hazards areas.

According to the Office of Planning and Research, at least sixty lead agencies already require this type of analysis. (California Governor's Office of Planning and Research, State Clearinghouse, The California Planners' Book of Lists (January, 2009), at p. 109.) This addition is reasonably necessary to guide lead agencies as to the scope of analysis of a changing climate that is appropriate under CEQA.

As revised, section 15126.2 would provide that a lead agency should analyze the effects of bringing development to an area that is susceptible to hazards such as flooding and wildfire, both as such hazards currently exist or may occur in the future. Several limitations apply to the analysis of future hazards, however. For example, such an analysis may not be relevant if the potential hazard would likely occur sometime after the projected life of the project (i.e., if sea-level projections only project changes 50 years in the future, a five-year project may not be affected by such changes). Additionally, the degree of analysis should correspond to the probability of the potential hazard. (State CEQA Guidelines, § 15143 ("significant effects should be discussed with emphasis in proportion to their severity and probability of occurrence").) Thus, for example, where there is a great degree of certainty that sea-levels may rise between 3 and 6 feet at a specific location within 30 years, and the project would involve placing a wastewater treatment plant with a 50 year life at 2 feet above current sea level, the potential effects that may result from inundation of that plant should be addressed. On the other extreme, while there may be consensus that temperatures may rise, but the magnitude of the increase is not known with any degree of certainty, effects associated with temperature rise would not need to be examined. (State CEQA Guidelines, § 15145 ("If, after thorough investigation, a lead agency finds that a particular impact is too speculative for evaluation, the agency should note its conclusion and terminate the discussion of the impact").) Lead agencies are not required to generate their own original research on potential future changes; however, where specific information is currently available, the analysis should address that information. (State CEQA Guidelines, § 15144 (environmental analysis "necessarily involves some degree of forecasting. While seeing the unforeseeable is not possible, an agency must use its best efforts to find out and disclose all that it reasonably can").)

The decision in *Baird v. County of Contra Costa* (1995) 32 Cal.App.4th 1464, does not preclude this analysis. In that case, the First District Court of Appeal held that a county was not required to prepare an EIR due solely to pre-existing soil contamination that the project would not change in any way. (Id. at 1468.) No evidence supported the petitioner's claim that the project would "expose or exacerbate" the pre-existing contamination, which was located several hundred to several thousand feet from the project site. (Id. at n. 1.) Moreover, the project would have no other significant effects on the environment, and other statutes exist to protect residents from contaminated soils. Thus, the question confronting that court was whether pre-existing contamination near the project was, by itself, enough to require preparation of an EIR. It held that, in those circumstances, an EIR was not required. That court also acknowledged, however, that where there is a potential for ultimately changing the environment, an EIR could be required. (Id. at p. 1469.) Thus, unlike the circumstances in the *Baird* case, the analysis required in section 15126.2(a) would occur if an EIR was otherwise required. Similarly, the addition to that section contemplates hazards which the presence of a project could exacerbate (i.e., potential upset of hazardous materials in a flood, increased need for firefighting services, etc.).

This revision was described in the Natural Resources Agency's Notice of Proposed Changes and the public was invited to present comments on that change. The Natural Resources Agency determined that the change was sufficiently related to the original proposal described in the Notice of Proposed Action, so a fifteen day comment period was appropriate. It is sufficiently related because the Notice of Proposed Action explained that the rulemaking activity was intended to address the directive in SB97 to provide guidelines on the analysis of the "effects of greenhouse gas emissions." As explained in the Initial Statement of Reasons, the Natural Resources Agency initially chose not to provide specific guidance on the analysis of the effects of placing development in an area subject to the effects of climate change because the Agency interpreted existing section 15126.2(a) to already require that analysis under certain circumstances. As indicated above, however, many comments on the proposed amendments suggested revisions to section 15126.2(a) to provide additional guidance. The areas susceptible to hazards include those that may result from a changing climate. Thus, the change is sufficiently related that a reasonable person would be put on notice that such a change could occur as a result of the rulemaking activity described in the Notice of Proposed Action.

Finally, following review of comments on this revision, the Natural Resources Agency clarified that this analysis applies only to "potentially significant" effects of locating developing in areas susceptible to hazards. Because this revision clarifies the last sentence in section 15126.2(a), consistent with the Public Resources Code, and does not alter the requirements, rights, responsibilities, conditions, or prescriptions contained in the originally proposed text, this revision is nonsubstantial and need not be circulated for additional public review. (Government Code, § 11346.8(c); Cal. Code Regs., tit. 1, § 40.)

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines addressing the analysis of the effects of GHG emissions. (Pub. Resources Code, § 21083.05.) As explained above, the effects of GHG emissions include flooding, sea-level rise and wildfires. Thus, the addition of a clarifying sentence to existing section 15126.2(a), requiring analysis of the effects of placing developing in hazardous locations, is reasonably necessary to ensure that such analysis occurs with respect to areas subject to potential hazards resulting from climate change.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analyzing the effects of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, by providing greater certainty to lead agencies regarding the analysis that may be required of the potential effects of climate change on a project, the cost of environmental analysis, and potential litigation, may be reduced.

SECTION 15126.4. CONSIDERATION AND DISCUSSION OF MITIGATION MEASURES PROPOSED TO MINIMIZE SIGNIFICANT EFFECTS.

Specific Purposes of the Amendment

Section 21083.05 of the Public Resources Code expressly requires OPR and the Resources Agency to develop regulations on the "mitigation of greenhouse gas emissions." The goals of this legislative mandate are to (1) reduce GHG emissions and (2) to provide consistency in the development of GHG emissions reduction measures. There is no indication, however, that the Legislature intended to alter any existing laws governing mitigation under CEQA. The Amendments, therefore, interpret and make specific existing CEQA law and regulations for mitigation of significant impacts resulting from GHG emissions.

Existing section 15126.4 provides guidance on CEQA's general mitigation requirements. To emphasize that mitigation of GHG emissions is subject to those existing CEQA requirements, OPR and the Natural Resources Agency added a new subdivision (c) to the existing section 15126.4. The Amendments identify five general methods of mitigation that may be tailored to the specific circumstances surrounding a specific project. In response to public comments, the Natural Resources Agency provided additional guidance, described below, in the lead-in sentences introducing those five broad categories of mitigation.

<u>Mitigation of Greenhouse Gas Emissions</u>

Comments submitted on the Amendments indicated general concerns that mitigation for GHG emissions may not be effective or reliable. To further clarify the existing mitigation requirements that would apply to measures to reduce greenhouse gas emissions, the Natural Resources Agency revised the lead-in sentences in subdivision (c). Specifically, the Natural Resources Agency added that all mitigation must be supported with substantial evidence and be capable of monitoring or reporting. This addition reflects the requirement in Public Resources Code that a lead agency's findings on mitigation be supported with substantial evidence and that it must adopt a mitigation monitoring and reporting program along with the project if mitigation measures are required. (Public Resources Code, §§ 21081(a)(1), 21081.6.)

In response to comments, the Natural Resources Agency had originally also proposed to add a sentence indicating that only emissions reductions that were not required by some other law or contract could qualify as mitigation. In response to comments on that proposed revision, that sentence is no longer proposed to be added to the lead-in section; rather, subdivision (c)(3) will be clarified, as described below.

<u>Mitigation Identified in an Existing Plan</u>

The first type of mitigation of GHG emissions that may be considered includes measures identified in an existing plan. As indicated above, many agencies are beginning to address GHG emissions at a planning level. (OPR, Book of Lists, at pp. 92-100.) Some of those GHG reduction plans include specific measures that may be applied on a project-by-project basis. (*Ibid*; *see also* Scoping Plan, Appendix C, at p. C-49.) Proposed subdivision (c)(1), therefore, would encourage lead agencies to look to adopted plans for sources of mitigation measures that could be applied to specific projects.

Project Design Features

The second type of measure that a lead agency should consider is project design features that will reduce project emissions. Various project design features could be used to reduce GHG emissions from a wide variety of projects. The CAPCOA White Paper provides examples of various project design features that may reduce emissions from commercial and residential buildings. (CAPCOA White Paper, at pp. B-13 to B-18.) For example, according to the California Energy Commission, "[r]esearch shows that increasing a community's density and its accessibility to jobs centers are the two most significant factors for reducing vehicle miles traveled," which is an important component of reducing statewide emissions. (California Energy Commission 2007, *2007 Integrated Energy Policy Report*, CEC-100-2007-008-CMF ("2007 IEPR"), at p. 12; see also CEC, *The Role of Land Use in Meeting California's Energy and Climate Goals* (2007) at p. 20.) This subdivision also refers specifically to measures identified in Appendix F, which include a variety of measures designed to reduce energy use. By encouraging lead agencies to consider changes to the project itself, this subdivision further encourages the realization of co-benefits such as reduced energy costs for project occupants, increased amenities for non-vehicular transportation, and others. Thus, project design can reduce GHG emissions directly through efficiency and indirectly through resource conservation and recycling. (Green Building Sector Subgroup of the Climate Action Team, Scoping Plan Measure Development and Cost Analysis (2008) at p. 6 to 9.)

Off-Site Measures

The third type of measures addressing GHG emissions is off-site measures including offsets. Proposed subdivision (c)(3) recognizes the availability of various off-site mitigation measures. Such measures could include, among others, the purchase of carbon offsets, community energy conservation projects, and off-site forestry projects. (*See*, *e.g*., South Coast Air Quality Management District, SoCal Climate Solutions Exchange (June 2008), at pp.1; Rodeo Refinery Settlement Agreement, BAAQMD Carbon Offset Fund; Recommendations of the ETAAC, Final Report (February 2008) at pp. 9-5; ARB, Staff Report: Proposed Adoption of California Climate Action Registry Forestry Greenhouse Gas Protocols for Voluntary Purposes (October 17, 2007), at p. 15 ("[t]he three protocols together – the sector, project, and certification protocols – are a cohesive and comprehensive set of methodologies for forest carbon accounting, and furthermore contain all the elements necessary to generate high quality carbon credits"); see also Scoping Plan, Appendix C, at pp. C-21 to C-23.) Off-site mitigation may be appropriate under various circumstances. For example, such mitigation may be appropriate where a project is incapable of design modifications that would sufficiently reduce GHG emissions within the project boundaries. In that case, a lead agency could consider whether emissions reductions may be achieved through such measures as energy-efficiency upgrades within the community or reforestation programs.

The reference to “offsets” in subdivision(c)(3) generated several comments during the public review period. The offsets concept is familiar in other aspects of air quality regulation. The Federal Clean Air Act, for example, provides that increases in emissions from new or modified sources in a nonattainment area must be offset by reductions in existing emissions within the nonattainment area. (See, e.g., 42 U.S.C. § 7503(a)(1)(A).) California laws also apply to offsets and emissions credits. (See, e.g., Health & Saf. Code, § 39607.5.) Those other laws generally require that emissions offsets must be “surplus” or “additional”. Comments on the proposed amendments suggested that to be used for CEQA mitigation purposes, offsets should also be “additional.” Thus, the Natural Resources Agency further refined the revisions it publicized on October 23, 2009, by deleting the lead-in sentence stating that “Reductions in emissions that are not otherwise required may constitute mitigation pursuant to this subdivision,” and amending subdivision (c)(3) to state that mitigation may include “Off-site measures, including offsets <u>that are not otherwise required</u>, to mitigate a project’s emissions[.]”

Moving this concept from the general provisions on mitigation of greenhouse gas emissions to the provision on offsets does not materially alter the rights or conditions in the originally proposed text because the “not otherwise required” concept would only make sense in the context of offsets. Because this revision clarifies section 15126.4(c)(3), consistent with the Public Resources Code and cases interpreting it, and does not alter the requirements, rights, responsibilities, conditions, or prescriptions contained in the originally proposed text, this revision is nonsubstantial and need not be circulated for additional public review. (Government Code, § 11346.8(c); Cal. Code Regs., tit. 1, § 40.)

<u>Sequestration</u>

The fourth type of GHG emissions mitigation measure is sequestration. Indeed, one way to reduce a project’s GHG emissions is to sequester project-related GHG emissions and thereby prevent them from being released into the atmosphere. At present, the most readily available, and accountable, way to sequester GHGs is forest management. California forests have a “unique capacity to remove [carbon dioxide, a GHG,] from the air and store it long-term as carbon.” (Scoping Plan, Appendix C, at p. C-165.) Forest sequestration functions are, therefore, a key part of the ARB’s Scoping Plan and reduction effort. (Scoping Plan, at pp. 64-65.)

The California Climate Action Team has also identified several forest-related sequestration strategies, including, reforestation, conservation forest management, conservation (i.e., avoided development), urban forestry, and fuels management and biomass. (ARB, Staff Report: Proposed Adoption of California Climate Action Registry

Forestry Greenhouse Gas Protocols for Voluntary Purposes (October 17, 2007), at pp. 6-7.) ARB has adopted Forest Protocols for large forestry projects. (ARB, Resolution 07-44 (adopting California Climate Action Registry Forestry Sector Protocol (September 2007), Forest Project Protocol (September 2007) and Forest Verification Protocol (May 2007).) ARB has also adopted Urban Forest Protocols for urban forestry projects. (California Climate Action Registry, Urban Forest Project Reporting Protocol and Verification Protocol (August 2008) (ARB adopted on September 25, 2008).) Such projects could be located on the project site or off-site. (Urban Forest Project Reporting Protocol, at pp. 4-5.) The protocols include methods of measuring the ability of various forestry projects to store capture and store carbon.

Consistent with section 15126.4(a), a lead agency must support its choice of, and its determination of the effectiveness of, any reduction measures with substantial evidence. Substantial evidence in the record must demonstrate that any mitigation program or measure is will result in actual emissions reductions. As a practical matter, where a mitigation program or measure is consistent with protocols adopted or approved by an agency with regulatory authority to develop such a program, a lead agency will more easily be able to demonstrate that off-site mitigation will actually result in emissions reductions. Examples of such protocols include the forestry protocols described above. Where a mitigation proposal cannot be verified with an existing protocol, a greater evidentiary showing may be required.

Measures to be Implemented on a Project-by-Project Basis

Finally, the fifth type of measure that could reduce GHG emissions at a planning level is the development of binding measures to be implemented on a project-specific basis. As explained in greater detail in the discussion of proposed section 15183.5, below, ARB's Scoping Plan strongly encourages local agencies to develop plans to reduce GHG emissions throughout the community. In addition, the CEC's Power Plant Siting Committee is assessing the impacts of GHG emission from proposed new power plants and how they can be mitigated. Comments received during the CEC's informational proceedings warranted a lengthy discussion on the practical application of a programmatic approach to mitigating GHG emissions from new power plants. (CEC, *Committee Guidance on Fulfilling California Environmental Quality Act Responsibilities for Greenhouse Gas Impacts in Power Plant Siting Applications* (2009) at p. 26 to 28.) Existing State CEQA Guidelines sections 15168(b)(4) and 15168(c)(3) recognize that programmatic documents provide an opportunity to develop mitigation plans that will apply on a project-specific basis. Proposed subdivision (c)(5) recognizes that, for a planning level decision, appropriate mitigation of GHG emissions may include the development of a program to be implemented on a project-by-project basis. (State CEQA Guidelines, § 15126.4(a)(2) ("[i]n the case of the adoption of a plan, policy, regulation, or other public project, mitigation measures can be incorporated into the plan, policy, regulation or project design").)

This type of mitigation is subject to the limits of existing law, however. Thus, proposed subdivision (c)(5) should not be interpreted to allow deferral of mitigation.

Rather, it is subject to the rule in existing section 15126.4(a)(1)(B) that such measures "may specify performance standards which would mitigate the significant effect of the project and which may be accomplished in more than one specified way." (*See also San Joaquin Raptor Rescue Center v. County of Merced* (2007) 149 Cal. App. 4th 645, 670-71.)

Suggestions Rejected

During its public involvement process, OPR received comments on its preliminary draft of the proposed amendments related to mitigation. Some comments suggested provisions that were not included in these Proposed Amendments. Several comments, for example, suggested that the Guidelines provide a specific "hierarchy" of mitigation requiring lead agencies to mitigate GHG emissions on-site where possible, and to allow consideration and use of off-site mitigation only if on-site mitigation is impossible or insufficient. OPR and the Resources Agency recognize that there may be circumstances in which requiring on-site mitigation may result in various co-benefits for the project and local community, and that monitoring the implementation of such measures may be easier. However, CEQA leaves the determination of the precise method of mitigation to the discretion of lead agencies. (State CEQA Guidelines, § 15126.4(a)(1)(B); *see also San Franciscans Upholding the Downtown Plan v. City & Co. of San Francisco* (2002) 102 Cal. App. 4th 656, 697.)

Several comments also suggested that mitigation for GHG emissions must be "real, permanent, quantifiable, verifiable, and enforceable." The Proposed Amendments do not include such standards, however, for several reasons. The proposed standard appears to have been derived from section 38562(d) of the Health and Safety Code, which prescribes requirements for regulations to be promulgated to implement AB32. AB32 is a separate statutory scheme, and, as noted above, there is no indication that the legislature intended to alter standards for mitigation under CEQA. Similarly, standards for mitigation under CEQA already exist and are set out in section 15126.4(a). Specifically, mitigation must be fully enforceable, which implies that the measure is also real and verifiable. Additionally, substantial evidence in the record must support an agency's conclusion that mitigation will be effective, and in the context of an EIR, courts will defer to an agency's determination of a measure's effectiveness. (*Environmental Council of Sacramento v. City of Sacramento* (2006) 147 Cal.App.4th 1018, 1041 (mitigation ratio is supportable even at less than 1:1 given the project's circumstances); *Ass'n of Irritated Residents v. County of Madera* (2003) 107 Cal.App.4th 1383, 1398 (lead agency has discretion to resolve dispute regarding the effectiveness of an EIR's mitigation measures).) No existing law requires CEQA mitigation to be quantifiable. Rather, mitigation need only be "roughly proportional" to the impact being mitigated. (State CEQA Guidelines, § 15126.4(a)(4)(B); see also id. at § 15142.)

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the mitigation of GHG emissions. (Pub. Resources Code, § 21083.05.) The proposed subdivision (c) sets out types of mitigation of GHG emissions that a lead agency may consider. Thus, that subdivision is reasonably necessary to implement the Legislature's directive.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the proposed action and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the proposed action. This conclusion is based on the Resources Agency's determination that the proposed action is necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the proposed action adds no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the proposed revisions. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The proposed action interprets and makes specific statutory CEQA provisions and/or case law interpreting CEQA for mitigating the impacts of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th

Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the proposed action does not add any substantive requirements, it will not result in an adverse impact on businesses in California. On the contrary, by providing greater certainty to lead agencies regarding the determination of significance of GHG emissions, the cost of environmental analysis, and potential litigation, may be reduced.

SECTION 15130. DISCUSSION OF CUMULATIVE IMPACTS

Specific Purposes of the Amendment

The Proposed Amendments include two revisions to the existing section 15130 of the State CEQA Guidelines. The two proposed amendments are described below.

Section 15130(b)(1)(B)

Section 21083(b) of the Public Resources Code requires that an EIR be prepared if the "possible effects of a project are individually limited but cumulatively considerable." That section further defines "cumulatively considerable" to mean that "the incremental effects of an individual project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects."

In determining whether a project may have significant cumulative impacts, a lead agency must engage in a two-step process. First, it must determine the extent of the cumulative problem. To do so, a lead agency must examine the "effects of past projects, the effects of other current projects, and the effects of probable future projects." Once it does so, the lead agency then determines whether the project's incremental contribution to that problem is cumulatively considerable. Section 21100(e) further provides that "[p]reviously approved land use documents, including but not limited to, general plans, specific plans, and local coastal plans, may be used in a cumulative impact analysis."

The existing Guideline section 15130(b) addresses the first step of the process. It offers two options for estimating the effects resulting from past, present and reasonably foreseeable projects. A lead agency may either rely on a list of such projects, or a summary of projections to estimate cumulative impacts. Existing section 15130(b)(1)(B) allows a lead agency to rely on projections in a land use document or certified environmental document that addresses the cumulative impact under consideration.

The proposed amendments would clarify that plans providing such projections need not be limited to land use plans, so long as the plan evaluates the relevant cumulative effect. The proposed amendments would also allow a lead agency to rely on information provided in regional modeling programs. The best projections of the cumulative effect of GHG emissions may be available in up-to-date models such as the International Council for Local Environmental Initiative's Local Government GHG Protocol[8] and the California Climate Action Reserve's Registry general,[9] industry[10] and

[8] ICLEI (2008) Local Government Operations Protocol; Accessed 6/08/09, http://www.icleiusa.org/action-center/tools/lgo-protocol-1
[9] California Climate Action Registry (2009) General Reporting Protocol: Accessed 6/08/09, http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

project type protocols.[11] Such projections may also be supplied in plans that are not strictly "land use" plans. For example, regional transportation plans in certain areas will ultimately include sustainable community strategies which will include projections a region's GHG emissions and related cumulative effects. (Gov Code, § 65080(b)(2).) Finally, some agencies are beginning to develop GHG reduction plans or climate action plans that may also include such projections. (ARB, Scoping Plan, Appendix C, at p. C-49; OPR, Book of Lists, at pp. 92-100.)

The proposed amendments are consistent with section 21083 of the Public Resources Code and CEQA case law. Section 21083 requires consideration of "the effects of past projects, the effects of other current projects, and the effects of probable future projects." Projections in the listed types of plans and models may include inventories of existing emissions and projected future emissions. Section 21100 of the Public Resources Code provides that land use plans "may" be used in a cumulative impacts analysis, but that section does not purport to limit the types of plans that can be used in a cumulative impacts analysis to land use plans. Finally, case law has supported reliance on projections provided by industry, for example, to satisfy the requirement for a discussion of impacts caused by closely related projects. (*Ass'n of Irritated Residents*, *supra*, 107 Cal. App. 4th at 1404.)

While models may provide the most up to date information, lead agencies should still look first to information provided in adopted or certified environmental documents. First, such information has already gone through a public and agency review process. Second, to the extent the model provides information that is not provided in the prior environmental document, the relationship of the model and applicable plans must be explained, along with any changes in circumstances.

Section 15130(d)

The Office of Planning and Research had originally proposed the addition of certain plans to section 15130(d). That section states that previously approved land use plans may be used in a cumulative impacts analysis. Those additions were inadvertently excluded from the proposed amendments that were made available for public review on July 3, 2009. Therefore, the revisions were added to revisions that were made publicly available on October 23, 2009.

The added plans include regional transportation plans and plans for the reduction of greenhouse gas emissions. This change is sufficiently related to the proposal that was originally published. Those plans were proposed for addition to other sections of the proposed amendments, for example, and comments were submitted regarding the use of such plans in cumulative impacts analysis. Plans for the reduction of greenhouse gas emissions were described under section 15064(h)(3), above. Regional

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[10] California Climate Action Registry (2005) Industry Specific Protocols: Accessed 06/08/09, http://www.climateregistry.org/tools/protocols/industry-specific-protocols.html
[11] California Climate Action Registry (2007) Project Protocols: Accessed 06/08/09, http://www.climateregistry.org/tools/protocols/project-protocols.html

transportation plans may contain information regarding transportation-related greenhouse gas emissions that may be useful in a cumulative impacts analysis. As explained above, regional transportation plans in certain areas will ultimately include sustainable community strategies which will include projections a region's GHG emissions and related cumulative effects. (Gov Code, § 65080(b)(2).) Thus, these additions are reasonably necessary to ensure that public agencies perform a cumulative impacts analysis of greenhouse gas emissions as required by Public Resources Code section 21083.05. The additions are also consistent with Public Resources Code section 21100(e) which provides that previously adopted land use plans may be used in a cumulative impacts analysis.

Section 15130(f)

The Natural Resources Agency originally proposed to add subdivision (f) to section 15130 to clarify that sections 21083 and 21083.05 of the Public Resources Code do not require a detailed analysis of GHG emissions solely due to the emissions of other projects. (State CEQA Guidelines, § 15130(a)(1); *Santa Monica Chamber of Commerce v. City of Santa Monica* (2002) 101 Cal.App.4th 786, 799.) Rather, proposed subdivision (f) would have provided that a detailed analysis is required when evidence shows that the incremental contribution of the project's GHG emissions is cumulatively considerable when added to other cumulative projects. (*CBE*, *supra*, 103 Cal.App.4th at 119-120.) In essence, the proposed addition would be a restatement of law as applied to GHG emissions. Analysis of GHG emissions as a cumulative impact is consistent with case law arising under the National Environmental Policy Act. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Other portions of these proposed Guidelines address how lead agencies may determine whether a project's emissions are cumulatively considerable. (See, e.g., Proposed Sections 1506(h)(3) and 15064.4.)

Public comments noted, however, that the new subdivision merely restated the law, and was capable of misinterpretation. The Natural Resources Agency, therefore, determined that because other provisions of the Amendments address the analysis of greenhouse gas emissions as a cumulative impact, and because the reasoning of those is fully explained in the Initial Statement of Reasons, subdivision (f) should not be added to the CEQA Guidelines. The deletion was reflected in the revisions that were made available for further public review and comment on October 23, 2009.

Necessity

Sections 21083 and 21083.05 of the Public Resources Code respectively require that an EIR analyze cumulative impacts and that the effects of GHG emissions be analyzed in CEQA documents. The Amendments include guidance to assist lead agencies to evaluate the cumulative impacts of GHG emissions where an EIR is required. Thus, the Amendments are reasonably necessary to implement the Legislature's directive.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analysis and mitigation of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the

amendments to this section are intended to reduce the costs of environmental review on lead agencies and project applicants by encouraging the use of existing environmental analysis where available. (Pub. Resources Code, § 21003(d) (use information in existing EIRs in order to reduce duplication), (f) (environmental review should proceed in the most efficient manner possible).)

SECTION 15150. INCORPORATION BY REFERENCE

Specific Purposes of the Amendment

The existing CEQA Guidelines allow lead agencies to incorporate information from other documents by reference. (State CEQA Guidelines, § 15150.) Doing so permits a lead agency to avoid repetitious analysis of general matters and to reduce paperwork. (Pub. Resources Code § 21003 (it is state policy that "persons and public agencies involved in the environmental review process be responsible for carrying out the process in the most efficient, expeditious manner in order to conserve the available financial, governmental, physical, and social resources with the objective that those resources may be better applied toward the mitigation of actual significant effects on the environment").) Existing Guidelines section 15150(f) provides that "[i]ncorporation by reference is most appropriate for including long, descriptive, or technical materials that provide general background but do not contribute directly to the analysis of the problem at hand."

The key requirements for documents that may be incorporation by reference are set forth in the statutory definition of "EIR." (Pub. Resources Code, § 21061.) Those requirements include:

- The incorporated information is a matter of public record or is generally available to the public; and
- The incorporated information is reasonably available for inspection at a public place or public building.

Descriptions of global, statewide and regional GHG emissions are particularly well-suited to incorporation by reference. Such descriptions can be technical and lengthy. (Public Policy Institute of California, Climate Policy at the Local Level: A Survey of California's Cities and Counties (November 2008), at pp. 24-32 (describing barriers and constraints to adoption of climate action plans and policies).) General descriptions may also remain current enough to be used in several successive environmental documents. In fact, OPR has found that many agencies are addressing GHG emissions in programmatic documents that could be incorporated by reference into later documents. (OPR, Book of Lists, at pp. 92-100.) Thus, the Resources Agency and OPR find that addition of subdivision (e)(4) is reasonably necessary to effectuate the legislative directive that public agencies conduct environmental review in the most efficient manner possible.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) The Legislature has further directed that resources be conserved wherever possible in the analysis of environment impacts. (*Id*. at § 21003.) Thus, the amendment to add GHG analyses to the list of documents that may be incorporated by reference is reasonably necessary to implement the Legislature's directive.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the proposed action adds no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the proposed revisions. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analysis and mitigation of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the amendments to this section are intended to reduce the costs of environmental review on lead agencies and project applicants by encouraging the use of existing environmental analysis where available. (Pub. Resources Code, § 21003(d) (use information in existing EIRs in order to reduce duplication), (f) (environmental review should proceed in the most efficient manner possible).)

SECTION 15183. PROJECTS CONSISTENT WITH A COMMUNITY PLAN OR ZONING

Specific Purposes of the Amendment

Section 21083.3 of the Public Resources Code provides that projects that are consistent with a General Plan, Community Plan or Zoning may not need to analyze cumulative effects that have already been analyzed in an EIR on the prior planning or zoning action. The exemption may apply, for example, where "uniformly applied development policies or standards" will substantially mitigate a cumulative effect. (Pub. Resources Code, § 21083.3(d).) The statute does not define what types of development policies or standards may be used in this context. It does provide, however, that such standards or policies must have been adopted by the lead agency with a finding, supported with substantial evidence, that the policy or standard will substantially mitigate the environmental effect under consideration. (*Ibid*.) Existing Guidelines section 15183 provides several non-exclusive examples of policies and standards that might apply in the context of section 21083.3, including grading ordinances and floodplain protection ordinances.

The inclusion of "[r]equirements for reducing greenhouse gas emissions, as set forth in adopted land use plans, policies or regulations" among the list of examples of "uniformly applied development policies or standards" is consistent with the direction in section 21083.3. First, the text provides that such requirements would be "adopted" by the lead agency. Second, they would be "development policies or standards" because the requirements would be contained in an adopted "land use plan, policy or regulation." Finally, such requirements could substantially mitigate the effects of GHG emissions by "reducing greenhouse gas emissions" in the adopting jurisdiction. (Proposed Section 15183.5(b) would provide elements that may be included in a GHG emissions reduction plan that might be used in the context of section 15183.)

One comment submitted during OPR's public involvement process questioned whether such requirements relating to reductions in GHG emissions would be kept current. (See, e.g., Letter from Joyce Dillard to OPR, January 26, 2009.) Section 21083.3 specifically provides, however, that such requirements would not apply in this context if "substantial new information shows that the policies or standards will not substantially mitigate the environmental effect." (Pub. Resources Code, § 21083.3(d).) Therefore, lead agencies have an incentive to ensure that their policies remain current.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) The addition to section 15183 is reasonably necessary to carry out the legislature's intent that projects that are consistent with General Plans, Community Plans and Zoning benefit from streamlined CEQA review. Several jurisdictions are beginning to include requirements for reducing GHG emissions in their general plans. (OPR, Book of Lists, at pp. 92-100; Scoping Plan, Appendix C, at p. C-49.) The addition is also reasonably necessary to effectuate the legislature's intent that OPR and the Resources Agency provide guidance on how to analyze GHG emissions.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the proposed revisions. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analysis and mitigation of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to

SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the amendments to this section are intended to reduce the costs of environmental review on lead agencies and project applicants by encouraging the use of existing environmental analysis where available. (Pub. Resources Code, § 21003(d) (use information in existing EIRs in order to reduce duplication), (f) (environmental review should proceed in the most efficient manner possible).)

SECTION 15183.5. TIERING AND STREAMLINING THE ANALYSIS OF GREENHOUSE GAS EMISSIONS

Specific Purposes of the Amendment

In adopting SB375, the Legislature found that “[n]ew provisions of CEQA should be enacted so that the statute encourages … local governments to make land use decisions that will help the state achieve its climate goals under AB 32[.]” (Statutes 2008, Ch. 728, § 1(f).) ARB’s Scoping Plan similarly recognizes the important role that local governments play in reducing the State’s GHG emissions. (ARB, Scoping Plan, at p. 26.) In particular, local government “[d]ecisions on how land is used will have large impacts on the GHG emissions that will result from the transportation, housing, industry, forestry, water, agriculture, electricity, and natural gas sectors.” (*Ibid*.) Decision-making on urban growth and land use planning begins with local general plans. (Gov. Code, § 65030.1 (“The Legislature … finds that decisions involving the future growth of the state, most of which are made and will continue to be made at the local level, should be guided by an effective planning process, including the local general plan, and should proceed within the framework of officially approved statewide goals and policies directed to land use, population growth and distribution, development, open space, resource preservation and utilization, air and water quality, and other related physical, social and economic development factors”).)

GHG emissions may be best analyzed and mitigated at a programmatic level. “For local government lead agencies, adoption of general plan policies and certification of general plan EIRs that analyze broad jurisdiction-wide impacts of GHG emissions can be part of an effective strategy for addressing cumulative impacts and for streamlining later project-specific CEQA reviews.” (OPR, Technical Advisory: CEQA and Climate Change: Addressing Climate Change Through California Environmental Quality Act (CEQA) Review, June 19, 2008, at p. 8.) Other lead agencies may also address GHG emissions programmatically in long range development plans, facilities master plans, and other long-range planning documents.

This emphasis on long-range planning is consistent with state policy expressed in CEQA. The Legislature has clearly stated its preference that lead agencies tier environmental documents wherever feasible. (Pub. Resources Code, § 21093(b).) Specifically:

> The Legislature finds and declares that tiering of environmental impact reports will promote construction of needed housing and other development projects by (1) streamlining regulatory procedures, (2) avoiding repetitive discussions of the same issues in successive environmental impact reports, and (3) ensuring that environmental impact reports prepared for later projects which are consistent with a previously approved policy, plan, program, or ordinance concentrate upon environmental effects which may be mitigated or avoided in connection with the decision on each later project. The Legislature further finds and

> declares that tiering is appropriate when it helps a public agency to focus upon the issues ripe for decision at each level of environmental review and in order to exclude duplicative analysis of environmental effects examined in previous environmental impact reports.

(Pub. Resources Code, § 21093(a).) The Amendments, therefore, include the addition of a new section 15183.5 to address both tiering and streamlining of GHG analyses, as well as the proper use of GHG reduction plans in CEQA analyses. Explanation of the rationale of each new subdivision is provided below.

<u>Existing Methods of Streamlining and Tiering</u>

Because GHG emissions raise a cumulative concern, analysis of such emissions in a long-range planning document lends itself to tiering and use in later project-specific environmental review. (Pub. Resources Code, § 21093.) The Legislature has created several tiering and streamlining methods, reflected in various provisions of the existing State CEQA Guidelines, that can reduce duplication in the analysis of GHG emissions. Subdivision (a) clarifies that existing provisions in the State CEQA Guidelines regarding tiering and streamlining may be applied to the analysis of GHG emissions.

<u>Greenhouse Gas Emissions Reduction Plans</u>

Many jurisdictions are beginning to address GHG emissions reductions in "climate action plans" and "gas emissions reduction plans." (OPR, Book of Lists, at pp. 92-100; see also, Scoping Plan, Appendix C, at p. C-49.) ARB's Scoping Plan specifically encourages local governments to develop such plans, and has created a local government operations protocol to assist in that effort. (Scoping Plan, at p. 26.) A community-wide emissions protocol is also under development.

Some comments raised during OPR's public involvement process expressed concern that due to a lack of legislative criteria for such plans, existing provisions in the CEQA Guidelines regarding cumulative impacts may be misused. (See, e.g., Letter from Center for Biological Diversity, et al., to OPR, February 2, 2009, at p. 2.) For example, without specific guidance, a lead agency could erroneously rely on a plan with purely aspirational intent to determine that a later project's cumulative impact is less than significant pursuant to section 15064(h)(3). The proposed subdivision (b) provides criteria to assist lead agencies in determining whether an existing greenhouse gas reduction plan is an appropriate document to use in a cumulative impacts analysis under CEQA.

The existing CEQA Guidelines allow lead agencies to rely on plans for cumulative analysis where the plan has been adopted in a public review process and contains specific requirements to avoid or substantially lessen a cumulative problem. (State CEQA Guidelines, § 15064(h)(3).) The criteria set out in proposed subdivision (b)(1) are designed to ensure that a greenhouse gas reduction plan would satisfy the requirements described in sections 15064(h)(3) and 15130(d), for the reasons described below.

Criteria (A) and (C) are necessary to define the scope of GHG emissions within the defined geographic area and the incremental contribution of activities that will occur within that area to those emissions. (State CEQA Guidelines, § 15064(h)(3) (plan addresses cumulative impacts "within the geographic area in which the project is located").) Criterion (B) establishes a benchmark to assist the lead agency in determining whether the plan provisions will avoid or substantially lessen cumulative effects of the area's GHG emissions. (*Ibid*. (plan "provides specific requirements that will avoid or substantially lessen the cumulative problem").) Criteria (D) and (E) are necessary to demonstrate that the plan will actually avoid or substantially lessen the cumulative effects of those emissions. (*Ibid*.) Finally, criterion (F) reflects the requirement in sections 15064(h)(3) and 15130(d) that the plan be adopted through a public review process, as well as case law requiring that mitigation plans themselves undergo environmental review. (*California Native Plant Society v. County of El Dorado* (2009) 170 Cal. App. 4th 1026, 1053 (mitigation "programs may offer the best solution to environmental planning challenges, by providing some certainty to developers while adequately protecting the environment" but "in order to provide a lawful substitute for the 'traditional' method of mitigating CEQA impacts, that is, a project-by-project analysis, the fee program must be evaluated under CEQA").) Notably, the criteria provided in subdivision (b) are largely consistent with the elements that ARB recommends be included in a greenhouse gas reduction plan. (ARB, Scoping Plan, Appendix C, at p. C-49.)

Subdivision (b)(2) describes the uses and limitations of plans for the reduction of greenhouse gas emissions in a cumulative impacts analysis for later projects. Specifically, it provides a safeguard to ensure that the later activity was actually addressed in the plan for the reduction of greenhouse gas emissions, and that any applicable requirements of the plan are incorporated into the later project. This requirement is similar the requirement in case law that a lead agency determine that a particular threshold appropriately addresses the impact of concern. (*Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1109 ("in preparing an EIR, the agency must consider and resolve every fair argument that can be made about the possible significant environmental effects of a project, irrespective of whether an established threshold of significance has been met with respect to any given effect").) Finally, subdivision (b)(2) makes specific the requirement that, while the existence of an applicable plan for the reduction of greenhouse gas emissions may create a presumption that compliance with that plan will reduce the incremental contribution of later activities to a less than cumulatively considerable level, the existence of substantial evidence supporting a fair argument to the contrary may still require preparation of an EIR.

<u>Special Situations</u>

Subdivision (c) provides necessary clarification of the partial exemption provided in sections 21155.2 and 21159.28 of the Public Resources Code, enacted as part of SB375 (see description above). The limitation on analysis of global warming applies only to the effects caused by GHG emissions from cars and light duty trucks. That limitation should be read in conjunction with section 21083.05 of the Public Resources Code and State CEQA Guideline sections 15064.4 and 15126.4 which require analysis of all sources of GHG emissions and mitigation if those emissions are significant. Thus, projects that qualify for the limitation in sections 21155.2 and 21159.28 must still analyze emissions resulting from, as applicable, energy use, land conversion, and other direct and indirect sources of emissions. This clarification is reasonably necessary to effectuate the legislative directive in section 21083.3 that OPR and Resources develop guidelines on the analysis of GHG emissions and to avoid confusion regarding the streamlining provisions provided by SB375.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) The Legislature has also directed that EIRs be tiered wherever possible, and that duplication be minimized. (*Id*. at §§ 21003, 21093, 21094.) Section 15183.5, which provides guidance on tiering and streamlining of GHG emissions analyses, is therefore reasonably necessary to carry out these directives.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Natural Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the Amendments are proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Natural Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Natural Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analysis and mitigation of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the Amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the amendments to this section are intended to reduce the costs of environmental review on lead agencies and project applicants by encouraging the use of existing environmental analysis where available. (Pub. Resources Code, § 21003(d) (use information in existing EIRs in order to reduce duplication), (f) (environmental review should proceed in the most efficient manner possible).)

SECTION 15364.5. GREENHOUSE GAS

Specific Purposes of the Amendment

The Legislature has not included a definition of “greenhouse gases” in CEQA, though it did include a definition in AB32. (Health & Saf. Code, § 38505(g).) Thus, new section 15364.5 adds a definition of greenhouse gases. The specified gases are consistent with existing law as they are defined to include those identified by the Legislature in section 38505(g) of the Health and Safety Code.

Notably, the definition in AB32 states that GHG “includes all of the following….” In so stating, the Legislature implies that other gases may also be considered GHGs. The ARB’s Scoping Plan also acknowledges that other gases contribute to climate change. (Scoping Plan, at p. 11.) In fact, the EPA’s Endangerment Finding explained that several other gases share attributes with GHGs but would not be appropriate for regulation under the Clean Air Act at this time. (EPA Endangerment Finding, at pp. 18896-98.) Therefore, similar to the statutory definition of GHGs in AB32, the definition in the Amendments is not exclusive to the six primary GHGs. The purpose of a more expansive definition is to ensure that lead agencies do not exclude from consideration GHGs that are not listed, so long as substantial evidence indicates that such non-listed gases may result in significant adverse effects. This approach is consistent with the Supreme Court’s directive that CEQA be interpreted to provide the fullest possible protection to the environment. (*Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal. 3d 376, 390.)

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) Section 15364.5 is necessary to make specific the instruction to analyze GHG emissions because it states which gases are considered to be “greenhouse gases” and should be included in the analysis.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency’s Reasons for Rejecting Those Alternatives

The Natural Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Natural Resources Agency’s determination that the Amendments are necessary to implement the Legislature’s directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Natural Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analysis and mitigation of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the Amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the addition of this section is intended to reduce the costs of environmental review on lead agencies and project applicants by assisting lead agencies in determining which gases should be included in an analysis.

APPENDIX F. ENERGY CONSERVATION

Specific Purposes of the Amendment

CEQA's requirement to analyze and mitigate energy impacts of a project is substantive, and is not merely procedural. (*People v. County of Kern* (1976) 62 Cal.App.3d 761, 774.) Despite the requirement, lead agencies have not consistently included such analysis in their EIRs. (Remy et al., Guide to CEQA, 11th Ed. 2007, at pp. 1007-1008, n. 34.) The following revisions to Appendix F are, therefore, reasonably necessary to ensure that lead agencies comply with the substantive directive in section 21100(b)(3).

<u>Introduction</u>

The revisions to the introduction section include a cross-reference to section 21100(b)(3) of the Public Resources Code to direct lead agencies to the statutory directive underlying Appendix F. This section also includes an addition to make clear that energy impacts that have already been analyzed may not need to be repeated in later EIRs. This sentence is consistent with the Legislative intent in CEQA that information in existing environmental review be used to "reduce delay and duplication in preparation of subsequent environmental impact reports." (Pub. Resources Code, § 21003(d).)

<u>EIR Contents</u>

The amendments to Appendix F revise the section on EIR Contents to clarify that lead agencies "shall" analyze energy conservation in their EIRs. The word "shall" indicates that the duty is mandatory, and makes Appendix F consistent with Public Resources Code section 21100(b)(3). While Appendix F is revised to make clear that an energy analysis is mandatory, the amendments to this section would also make clear that the energy analysis is limited to effects that are applicable to the project.

<u>"Lifecycle"</u>

The amendments to Appendix F remove the term "lifecycle." No existing regulatory definition of "lifecycle" exists. In fact, comments received during OPR's public workshop process indicate a wide variety of interpretations of that term. (Letter from Terry Rivasplata et al. to OPR, February 2, 2009, at pp. 5, 12 and Attachment; Letter from Center for Biological Diversity et al. to OPR, February 2, 2009, at pp. 17.) Thus, retention of the term "lifecycle" in Appendix F could create confusion among lead agencies regarding what Appendix F requires.

Moreover, even if a standard definition of the term "lifecycle" existed, requiring such an analysis may not be consistent with CEQA. As a general matter, the term could refer to emissions beyond those that could be considered "indirect effects" of a project as that term is defined in section 15358 of the State CEQA Guidelines.

Depending on the circumstances of a particular project, an example of such emissions could be those resulting from the manufacture of building materials. (CAPCOA White Paper, at pp. 50-51.) CEQA only requires analysis of impacts that are directly or indirectly attributable to the project under consideration. (State CEQA Guidelines, § 15064(d).) In some instances, materials may be manufactured for many different projects as a result of general market demand, regardless of whether one particular project proceeds. Thus, such emissions may not be "caused by" the project under consideration. Similarly, in this scenario, a lead agency may not be able to require mitigation for emissions that result from the manufacturing process. Mitigation can only be required for emissions that are actually caused by the project. (State CEQA Guidelines, § 15126.4(a)(4).) Conversely, other projects may spur the manufacture of certain materials, and in such cases, consideration of the indirect effects of a project resulting from the manufacture of its components may be appropriate. A lead agency must determine whether certain effects are indirect effects of a project, and where substantial evidence supports a fair argument that such effects are attributable to a project, that evidence must be considered. However, to avoid potential confusion regarding the scope of indirect effects that must be analyzed, the term "lifecycle" has been removed from Appendix F.

Types of Energy Use

The amendments to Appendix F clarify that project design may achieve energy savings through measures related to water use and solid waste disposal. (California Energy Commission, Water Supply-Related Electricity Demand in California, CEC 500-2007-114 (November 2007), at p. 3 (reporting that water related energy use, including water movement, treatment and heating, annually accounts for approximately 20 percent of California's electricity consumption); Scoping Plan, Appendix C, at pp. C-158 to C-160.) The addition of these potential sources of energy reductions is consistent with the direction in section 21100(b)(3) to identify mitigation measures to reduce inefficient consumption of energy.

Grammar and Syntax

Finally, several minor revisions to Appendix F were made to improve grammar and syntax. Such revisions qualify as a "change without regulatory effect" pursuant to section 100(a)(4) of the Office of Administrative Law's regulations governing the rulemaking process. (Cal. Code Regs., tit. 1, § 100(a)(4).)

Necessity

The Legislature directed OPR and the Natural Resources Agency to develop guidelines on the analysis and mitigation of GHG emissions. (Pub. Resources Code, § 21083.05.) Since a significant source of GHG emissions results from energy use (consumption), these Amendments appropriately addressed energy use and conservation as a subject for CEQA analysis. Additionally, the legislature requires that lead agencies analyze energy use in their EIRs. (*Id*. at § 21100(b)(3).) The amendments to Appendix F are, therefore, necessary to ensure that lead agencies implement these directives.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Natural Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Natural Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Natural Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA's requirements for analysis and mitigation of energy use. Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California.

APPENDIX G. INITIAL STUDY CHECKLIST

Specific Purposes of the Amendment

The Amendments include revisions to several portions of Appendix G, which contains a sample environmental checklist that lead agencies may use to satisfy the requirement to prepare an initial study. The amendments and their necessity are described below.

<u>Note Regarding Use of the Checklist</u>

The amendments would add a note to the beginning of Appendix G to clarify the checklist contained therein is only a sample that may be modified as necessary to suit the lead agency and to address the particular circumstances of the project under consideration. The addition is necessary for two reasons. First, several lead agencies have expressed concern that the checklist does not reflect the circumstances existing in that particular agency. (See, e.g., Letter from Napa County – Department of Conservation, Development, and Planning to OPR, January 26, 2009; Letter from County of San Bernardino - Land Use Services Department to OPR, February 2, 2009.) Second, the Third District Court of Appeal recently issued an opinion that clarified that all substantial evidence regarding potential impacts of a project must be considered, even if the particular potential impact is not listed in Appendix G. (*Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1109.) Thus, the note emphasizes that Appendix G does not mandate a particular form that must be used for an Initial Study; rather, it provides merely an example.

<u>Forest Resources</u>

The amendments would add several questions addressing forest resources in the section on Agricultural Resources. Forestry questions are appropriately addressed in the Appendix G checklist for several reasons. First, forests and forest resources are directly linked to both GHG emissions and efforts to reduce those emissions. For example, conversion of forests to non-forest uses may result in direct emissions of GHG emissions. (See, e.g., California Energy Commission Baseline GHG Emissions for Forest, Range, and Agricultural Lands in California (March, 2004) at p. 19.) Such conversion would also remove existing carbon stock (i.e., carbon stored in vegetation), as well as a significant carbon sink (i.e., rather than emitting GHGs, forests remove GHGs from the atmosphere). (Scoping Plan, Appendix C, at p. C-168.) Thus, such conversions are an indication of potential GHG emissions. Changes in forest land or timberland zoning may also ultimately lead to conversions, which could result in GHG emissions, aesthetic impacts, impacts to biological resources and water quality impacts, among others. Thus, these additions are reasonably necessary to ensure that lead agencies consider the full range of potential impacts in their initial studies. In the same way that an EIR must address conversion of prime agricultural land or wetlands as part of a project (addressing the whole of the action requires analyzing land clearance in advance of project development), so should it analyze forest removal.

During OPR's public involvement process, some commenters suggested that conversion of forest or timber lands to agricultural uses should not be addressed in the Initial Study checklist. (Letter from California Farm Bureau Federation to OPR, February 2, 2009; Letter from County of Napa, Conservation, Development and Planning Department, to OPR, January 26, 2009.) As explained above, the purpose of the Amendments is to implement the Legislative directive to develop Guidelines on the analysis and mitigation of GHG emissions. Although some agricultural uses also provide carbon sequestration values, most agricultural uses do not provide as much sequestration as forest resources. (Climate Action Team, *Carbon Sequestration* (2009), Chapter 3.3.8 at p. 3.21; California Energy Commission, *Baseline GHG Emissions for Forest, Range, and Agricultural Lands in California* (2004), at p. 2.) Therefore, such a project could result in a net increase in GHG emissions, among other potential impacts. Thus, such potential impacts are appropriately addressed in the Initial Study checklist. See the Thematic Responses, below, for additional discussion of this issue.

<u>Greenhouse Gas Emissions</u>

The additions also include two questions related to GHG emissions. These questions are necessary to satisfy the Legislative directive in section 21083.05 that the effects of GHG emissions be analyzed under CEQA. The questions are intended to provoke a full analysis of such emissions where appropriate. More detailed guidance on the context of such an analysis is provided in other sections throughout the Guidelines. Despite the detailed provisions in the Guidelines themselves, questions related to GHG emissions should also appear in the checklist because some lead agencies will not seriously consider an environmental issue unless it is specifically mentioned in the checklist. (*Protect the Historic Amador Waterways*, *supra*, 116 Cal. App. 4th at 1110.)

<u>Transportation</u>

The Amendments make four primary changes to the questions involving transportation and traffic.

First, question (a) changes the focus from an increase in traffic at a given location to the effect of a project on the overall circulation system in the project area. This change is appropriate because an increase in traffic, by itself, is not necessarily an indicator of a potentially significant *environmental* impact. (Ronald Miliam, AICP, *Transportation Impact Analysis Gets a Failing Grade When it Comes to Climate Change and Smart Growth*; *see also* Land Use Subcommittee of the Climate Action Team LUSCAT Submission to CARB Scoping Plan on Local Government, Land Use, and Transportation Report (May, 2008) at pp. 31, 36.) Similarly, even if some projects may result in a deterioration of vehicular level of service – that is, delay experienced by drivers – the overall effectiveness of the circulation system as a whole may be improved. (*Ibid*.) Such projects could include restriping to provide bicycle lanes or creating dedicated bus lanes. Even in such cases, however, any potential adverse air quality or other impacts would still have to be addressed as provided in other sections of the checklist. Finally, the change to question (a) also recognizes that the lead agency has discretion to choose its own metric of analysis of impacts to intersections, streets, highways and freeways. (Pub. Resources Code, § 21081.2(e); *Eureka Citizens for Responsible Gov't v. City of Eureka, supra,* 147 Cal.App.4th at 371-373 (lead agency has discretion to choose its methodology).) Thus, "level of service" may or may not be the applicable measure of effectiveness of the circulation system.

Second, the revision to question (b) clarifies the role of a congestion management program in a CEQA analysis. Specifically, it clarifies that a congestion management program contains many elements in addition to a level of service designation. (Gov. Code § 65088 et seq.) The clarification is also necessary to address any projects within an "in-fill opportunity zone" that may be exempted from level of service requirements. (*Id*. at § 65088.4.)

Third, the amendments eliminate the existing question (f) regarding parking capacity. Case law recognizes that parking impacts are not necessarily environmental impacts. (*San Franciscans Upholding the Downtown Plan v. City and County of San Francisco, supra,* 102 Cal.App.4th at 697.) The focus of the Initial Study checklist should be on direct impacts of a project. Therefore, the question related to parking is not relevant in the initial study checklist. As noted above, however, if there is substantial evidence indicating adverse indirect environmental impacts from a project related to parking capacity, the lead agency must address such potential impacts regardless of whether the checklist contains parking questions. (*Ibid*.) Additional discussion of this issue is included in the Thematic Responses, below.

Finally, the amendments revise existing question (g), now question (f), to address the performance and safety of certain modes of alternative transportation. These revisions were made in response to comments received on the Amendments. While the primary objective of the Amendments is to provide guidance on the analysis and mitigation of greenhouse gas emissions, this revision was determined to be necessary to support the use of alternative transportation.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) An initial study may be used to assist in the determination of whether a project may have a significant effect on the environment. (*Protect the Historic Amador Waterways*, *supra*, 116 Cal. App. 4th at 1110.) Appendix G of the State CEQA Guidelines is intended to provide a sample of an initial study that lead agencies may use. (*Ibid*.) Amendment of Appendix G to include questions that will assist a lead agency in determining whether a project may result in significant impacts related to GHG emissions is, therefore, necessary to carry out the Legislature's directive in section 21083.05 of the Public Resources Code.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Natural Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Natural Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Natural Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analysis and mitigation of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the

amendments to Appendix G are intended to reduce the costs of environmental review on lead agencies and project applicants by assisting lead agencies in determining which topics should be addressed in an Initial Study.

NON-SUBSTANTIAL CHANGES

On October 23, 2009, the Natural Resources Agency made available for public review certain changes to its originally proposed amendments. Those changes were described in the Notice of Proposed Changes. In response to comments on those changes, the Natural Resources Agency has made two non-substantial changes. Because those changes clarify the text that was made available for public review, and do not alter the requirements, rights, responsibilities, conditions, or prescriptions contained in the originally proposed text, the revisions are nonsubstantial and need not be circulated for additional public review. (Government Code, § 11346.8(c); Cal. Code Regs., tit. 1, § 40.) Those revisions are described below.

Section 15126.2(a)

As explained in the Notice of Proposed Changes, the revisions to the proposed text included a clarifying sentence in section 15126.2 indicating that an environmental impact report should analyze the effect of placing a project in areas susceptible to hazardous conditions. That revision specifically lists types of areas (including floodplains, coastlines and wildfire risk areas) that may be most impacted by the effects of a changing climate. The revision would also clarify that analysis of such hazards is appropriate where such areas are specified in authoritative hazard maps, risk assessments or land use plans.

The Natural Resources Agency further revised section 15126.2(a) in response to comments. That section was revised as follows:

> Similarly, the EIR should evaluate **~~the~~** **any potentially significant** impacts of locating development in other areas susceptible to hazardous conditions (e.g., floodplains, coastlines, wildfire risk areas) as identified in authoritative hazard maps, risk assessments or in land use plans addressing such hazards areas.

This change does not alter the rights, responsibilities, conditions, or prescriptions contained in the originally proposed text because the Public Resources Code already provides that an EIR is only required for those impacts that are potentially significant. (Public Resources Code, § 21002.1(a).) Because this revision clarifies the last sentence in section 15126.2(a), consistent with the Public Resources Code, this revision is nonsubstantial and need not be circulated for additional public review. (Government Code, § 11346.8(c); Cal. Code Regs., tit. 1, § 40.)

Section 15126.4(c)

The Natural Resources Agency also further revised text related to mitigation that was made publicly available as described in the October 23, 2009, Notice of Proposed Changes in response to comments on that text. The revision clarifies that the qualification that measures to mitigate greenhouse gas emissions must not otherwise be required applies in the context of offsets and is not intended to contradict case law recognizing that changes in a project that are required to comply with existing environmental standards may qualify as mitigation. Thus, section 15126.4(c) was revised as follows:

> (c) Mitigation Measures Related to Greenhouse Gas Emissions.
>
> Consistent with section 15126.4(a), lead agencies shall consider feasible means, supported by substantial evidence and subject to monitoring or reporting, of mitigating the significant effects of greenhouse gas emissions**.** ~~**Reductions in emissions that are not otherwise required may constitute mitigation pursuant to this subdivision.**~~ Measures to mitigate the significant effects of greenhouse gas emissions may include, among others:
>
> (1) Measures in an existing plan or mitigation program for the reduction of emissions that are required as part of the lead agency's decision;
>
> (2) Reductions in emissions resulting from a project through implementation of project features, project design, or other measures, such as those described in Appendix F;
>
> (3) Off-site measures, including offsets **that are not otherwise required**, to mitigate a project's emissions;
>
> (4) Measures that sequester greenhouse gases;
>
> (5) In the case of the adoption of a plan, such as a general plan, long range development plan, or plans for the reduction of greenhouse gas emissions, mitigation may include the identification of specific measures that may be implemented on a project-by-project basis. Mitigation may also include the incorporation of specific measures or policies found in an adopted ordinance or regulation that reduces the cumulative effect of emissions.

This change does not alter the rights, responsibilities, conditions, or prescriptions contained in the originally proposed text because the Public Resources Code already provides that to be considered mitigation, a measure must be tied to impacts resulting from the project. Section 21002 of the Public Resources Code, the source of the requirement to mitigate, states that "public agencies should not approve projects as proposed if there are … feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects[.]" Similarly, section 21081(a)(1) specifies a finding by the lead agency in adopting a project that "[c]hanges or alterations have been required in, or incorporated into, the project which mitigate or avoid the significant effects on the environment." Both statutory provisions expressly link the changes to be made (i.e., the "mitigation measures") to the significant effects of the project. Because this revision clarifies section 15126.4(c), consistent with the Public Resources Code, this revision is nonsubstantial and need not be circulated for additional public review. (Government Code, § 11346.8(c); Cal. Code Regs., tit. 1, § 40.)

THEMATIC RESPONSES

Several themes emerged in the comments submitted on the Natural Resources Agency's proposed amendments to the CEQA Guidelines addressing greenhouse gas emissions. While the Natural Resources Agency has responded individually to each comment it received, the following provides general responses to several issues that were raised repeated in the comments.

Quantitative versus Qualitative Analysis

Many comments focused on section 15064.4's recognition of lead agency discretion in determining whether to analyze a project's greenhouse gas emissions using either qualitative or quantitative methods, or both. Some comments suggested that a qualitative analysis would not satisfy CEQA's informational mandates. Other comments indicated that qualitative analysis is consistent with CEQA, and may be particularly appropriate in the context of a negative declaration. Other comments asked for examples of how performance standards could be used in such an analysis. As explained in the Initial Statement of Reasons, the Natural Resources Agency finds that CEQA leaves to lead agencies the choice of the most appropriate methodology to analyze a project's impacts, and that rule should continue to apply in the context of greenhouse gas emissions. The reasoning supporting this determination is set forth below.

First, nothing in CEQA prohibits use of a qualitative analysis or requires the use of a quantitative analysis. As explained in the Initial Statement of Reasons, CEQA directs lead agencies to consider qualitative factors. (Initial Statement of Reasons, at p. 19; Public Resources Code, § 21001(f).) Further, the existing CEQA Guidelines recognize that thresholds of significance, which are used in the determination of significance, may be expressed as quantitative, qualitative or performance-based standards. (State CEQA Guidelines, § 15064.7.) Moreover, even where quantification is technically or theoretically possible, "CEQA does not require a lead agency to conduct every test or perform all research, study, and experimentation recommended or demanded by commentors." (State CEQA Guidelines, § 15204(a); see also *Ass'n of*

Irritated Residents v. County of Madera (2003) 107 Cal.App.4th 1383, 1396-1398; *San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1996) 27 Cal.App.4th 713, 728.)[12]

Second, the comments do not appropriately distinguish between the determination of significance and the informational standards governing the preparation of environmental documents. The purpose of section 15064.4 is to assist the lead agency in determining whether a project's greenhouse gas emissions may be significant, which would require preparation of an EIR, and if an EIR is prepared, to determine whether such emissions are significant, which would require the imposition of feasible mitigation or alternatives. The existing CEQA Guidelines contain several provisions governing the informational standards that apply to various environmental documents. Conclusions in an initial study, for example, must be "briefly explained to indicate that there is <u>some evidence</u> to support" the conclusion. (State CEQA Guidelines, § 15063(d) (emphasis added).) Similarly, if an EIR is prepared, a determination that an impact is not significant must be explained in a "statement <u>briefly</u> indicating the reasons that various possible significant effects of a project" are in fact not significant. (State CEQA Guidelines, § 15128 (emphasis added).) If the impact is determined to be significant, the impact "should be discussed with emphasis in proportion to their severity and probability of occurrence." (State CEQA Guidelines, § 15143.) The explanation of significance in an EIR must be "prepared with a sufficient degree of analysis to provide decisionmakers with information which enables them to make a decision which intelligently takes account of environmental consequences" and must demonstrate "adequacy, completeness, and a good faith effort at full disclosure." (State CEQA Guidelines, § 15151.) In sum, while proposed section 15064.4(a) reflects the requirement that a lead agency base its significance determination on substantial evidence, whether quantitative, qualitative or both, it does not, as some comments appear to fear, alter the rules governing the sufficiency of information in an environmental document.

Third, the discretion recognized in section 15064.4 is not unfettered. A lead agency's analysis, whether quantitative or qualitative, would be governed by the standards in the first portion of section 15064.4. The first sentence applies to the context of greenhouse gas emissions the general CEQA rule that the determination of significance calls for a careful judgment by the lead agency. (Proposed § 15064.4(a) ("[t]he determination of the significance of greenhouse gas emissions calls for a careful judgment by the lead agency consistent with the provisions in section 15064").) The second sentence sets forth the requirement that the lead agency make a good-faith effort to describe, calculate or estimate the amount of greenhouse gas emissions

[12] Notably, as administrative regulations, the development of the proposed regulations is governed by the Administrative Procedures Act. Government Code section 11340.1(a) states the Legislature's intent that administrative regulations substitute "performance standards for prescriptive standards wherever performance standards can be reasonably expected to be as effective and less burdensome, and that this substitution shall be considered during the course of the agency rulemaking process." Thus, absent authority in CEQA that would prohibit a qualitative analysis, section 15064.4 appropriately recognizes a lead agency's discretion to determine what type of analysis is most appropriate to determine the significance of a project's greenhouse gas emissions.

resulting from a project. That sentence has been further revised, as explained in greater detail below, to provide that the description, calculation or estimation is to be based "to the extent possible on scientific and factual data." The third sentence advises that the exercise of discretion must be made "in the context of a particular project." Thus, as provided in existing section 15146, the degree of specificity required in the analysis will correspond to the degree of specificity involved in the underlying project. In other words, even a qualitative analysis must demonstrate a good-faith effort to disclose the amount and significance of greenhouse gas emissions resulting from a project.

Fourth, the discretion recognized in proposed section 15064.4 would not enable a lead agency to ignore evidence submitted to it as part of the environmental review process. For example, if a lead agency proposes to adopt a negative declaration based on a qualitative analysis of the project's greenhouse gas emissions, and a quantitative analysis is submitted to that lead agency supporting a fair argument that the project's emissions may be significant, an EIR would have to be prepared. The same holds true if a lead agency proposes to adopt a negative declaration based on a quantitative analysis, and qualitative evidence supports a fair argument that the project's emissions may be significant. (*Berkeley Keep Jets Over the Bay Com. v. Board of Port Comm*. (2001) 91 Cal.App.4th 1344, 1382; *Oro Fino Gold Mining Corp. v. County of El Dorado* (1990) 225 Cal. App. 3d 872, 881-882 (citizens' personal observations about the significance of noise impacts on their community constituted substantial evidence that the impact may be significant and should be assessed in an EIR, even though the noise levels did not exceed general planning standards).) Similarly, even if an EIR is prepared, a lead agency would have to consider and resolve conflicts in the evidence in the record. (State CEQA Guidelines, § 15151 ("EIR should summarize the main points of disagreement among the experts"); *Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1109.)

Finally, regarding performance standards, several examples exist of the types of performance standards that might appropriately be used in determining the significance of greenhouse gas emissions. Proposed section 15183.5(b)(1)(D), for example, contemplates that a plan for the reduction of greenhouse gas emissions may contain performance based standards. Where such standards are developed as part of such a plan, a lead agency would have evidence indicating that compliance with such standards would indicate that the impact of greenhouse gas emissions would be less than significant. Further, in adopting SB375, the Legislature acknowledged that regional transportation plans, and the environmental impact reports prepared to analyze those plans, may contain performance standards that would apply to transit priority projects. (See, e.g., Public Resources Code, § 21155.2.) Other potential examples[13] include the Bay Area Air Quality Management District's proposed Best Management Practices for Construction Greenhouse Gas Emissions (calling for use of alternative fuels, local building materials and recycling), and the California Public Utilities Commission's Performance Standard for Power Plans (requiring emissions no greater

[13] The Natural Resources Agency does not necessarily endorse the use of these performance standards. Lead agencies must determine whether a particular standard is appropriate based on the substantial evidence supporting it and the context of the particular project.

than a combined cycle gas turbine plant). As with either a qualitative or quantitative analysis, reliance on performance standards must be supported with “scientific or factual data” indicating that compliance with the standard will ensure that impacts of greenhouse gas emissions are less than significant.

In sum, the proposed section 15064.4(a) appropriately reflects the standards in CEQA governing the determination of significance and the discretion CEQA leaves to lead agencies to determine how to analyze impacts. Mandating that lead agencies must quantify emissions whenever quantification is possible would be a departure from the CEQA statute.

Existing Environmental Setting

Several comments focused on the phrase “existing environmental setting” in section 15064.4(b)(1). Some comments urged, for example, that only “net” emissions should be considered. Comments from energy producers suggested that the phrase “existing environmental system” should encompass the entire energy system, which extends beyond California’s borders. Some comments suggested that section 15064.4 should include a lifecycle analysis.

Section 15064.4(b)(1) advises lead agencies to consider the extent to which a project would increase or decrease greenhouse gas emissions compared to the existing environmental setting. In performing this analysis, a lead agency must account for all project phases, including construction and operation, as well as indirect and cumulative impacts. (State CEQA Guidelines, §§ 15063(a) (“[a]ll phases of project planning, implementation, and operation must be considered in the initial study…”), 15064(h) (addressing cumulative impacts), 15126 (“[a]ll phases of a project must be considered when evaluating its impact on the environment: planning, acquisition, development, and operation”), 15358(a)(2) (defining “effects” to include indirect effects), 15378.) The “setting” to be described varies depending on the project and the potential environmental resources that it may affect. In *Friends of the Eel River v. Sonoma County Water Agency* (2003) 108 Cal. App. 4th 859, for example, the lead agency failed to adequately describe the environmental setting by limiting its discussion primarily to the southern portions of its water system. Framing the setting narrowly resulted in impacts to the northern portion of the water system being ignored. Finding that section 15125 is to be construed broadly to ensure the fullest protection to the environment, the court in that case held that the lead agency was required to disclose that increased use of the southern portion of the water system would require greater diversions from the northern portion, and to analyze the impacts on species in the northern portion of the system. (*Id*. at pp. 873-875.) In the context of power generation, to the extent that a project may cause changes in greenhouse gas emissions in an existing power system, and substantial evidence substantiates such changes, those changes may be considered pursuant to section 15064.4(b)(1).

Similarly, if an agency has performed an analysis that demonstrates that a particular process for waste treatment does not result in an increase in greenhouse gas emissions compared to biogenic emissions that already occurs in the atmosphere, that evidence may support a conclusion that the project would not cause an increase in greenhouse gas emissions. Thus, to the extent a lead agency does not consider biogenic emissions to be new emissions, and its analysis is supported with substantial evidence, the text in section 15064.4(b)(1) would be broad enough to encompass those emissions, subject to the limitation that such analysis could not be used in a way that would mask the effects of emissions associated with the project. For example, if the emissions occurring in the short-term will have impacts that differ from emissions occurring in the future, those differences may need to be analyzed.

Finally, some comments suggested that the Guidelines should authorize a "net" or "lifecycle" analysis for projects that operate within a closed system. Nothing in section 15064.4 precludes such analysis where such analysis complies with the provision of section 15064, and where substantial evidence supports the ultimate conclusions and findings. However, since a "net" analysis may only be appropriate or possible in limited cases, the Natural Resources Agency deliberately chose to draft section 15064.4 broadly. Additionally, in some situations, a true "net" analysis may not be technically feasible or scientifically possible, and determination of an appropriate baseline for determining a "net" effect may be difficult.

As explained below, the Natural Resources Agency has deliberately avoided the term "lifecycle," however, to the extent an agency equates "lifecycle" with what occurs in the existing environmental setting, section 15064.4 authorizes lead agencies to consider such evidence.

Thresholds of Significance

Some comments expressed concern that the proposed amendments did not establish a statewide threshold of significance. Others suggested that most lead agencies are not qualified to establish their own thresholds, and if they do adopt thresholds, they should be required to adopt the most stringent threshold possible.

The CEQA Guidelines do not establish thresholds of significance for other potential environmental impacts, and SB97 did not authorize the development of a statewide threshold as part of this CEQA Guidelines update. Rather, the proposed amendments recognize a lead agency's existing authority to develop, adopt and apply their own thresholds of significance or those developed by other agencies or experts. As set forth in the existing section 15064.7, a threshold is "an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which means the effect normally will be determined to be less than significant." Because a threshold would be used in the determination of significance, the threshold would need to be supported with substantial evidence. (State CEQA Guidelines, § 15064.7(b).)

As explained in a recent decision of the Third District Court of Appeal, "[p]ublic agencies are … encouraged to develop thresholds of significance for use in determining whether a project may have significant environmental effects." (*Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1108.) Nothing in CEQA requires that thresholds be developed by experts or expert agencies; however, "thresholds can be drawn from existing environmental standards, such as other statutes or regulations." (*Id*. at p. 1107.) Regardless of who develops the threshold, if an agency adopts a threshold, it must be supported with substantial evidence. (State CEQA Guidelines, § 15064.7(b).) Additionally, "thresholds cannot be used to determine automatically whether a given effect will or will not be significant[;]" "[i]nstead, thresholds of significance can be used only as a measure of whether a certain environmental effect "will *normally* be determined to be significant" or "*normally* will be determined to be less than significant" by the agency. (Guidelines, § 15064.7, subd. (a), italics added.)" (*Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at pp. 1108-1109.) Proposed subdivision (c) of section 15064.7 recognizes the principles described above by expressly recognizing that experts and expert agencies may be developing thresholds that other public agencies may find useful in their own CEQA analyses, but requiring, as a safeguard, that any such threshold be supported with substantial evidence.

Notably, nothing in either AB32 or SB97 requires a finding of significance for any particular level of increase in greenhouse gas emissions. AB32, and regulations implementing that statute, will require reductions in emissions from certain sectors in the economy, but do not preclude new emissions. Moreover, as explained in the Initial Statement of Reasons, the proposed amendments do not establish a zero emissions threshold of significance because "there is no 'one molecule rule' in CEQA. (*CBE*, *supra*, 103 Cal.App.4th at 120.)" (Initial Statement of Reasons, at p. 20.)

Some comments suggested that any numeric thresholds that are developed should not be set at such a low level that adverse economic impacts would result. While economic issues are appropriate in the determination of feasibility of mitigation and alternatives, it is not appropriate in the determination of significance (see, e.g., Public Resources Code, § 21002), so a threshold should not be designed with economic impacts in mind. Moreover, even a "high" threshold would not relieve agencies of the requirement to consider any evidence indicating that a project may have a significant effect despite falling below a threshold. (*Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1109; *Mejia v. City of Los Angeles* (2005) 130 Cal.App.4th 322, 342.)

Mitigation Hierarchy

CEQA's substantive mandate requires that "public agencies should not approve projects as proposed if there are … feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects[.]" (Public Resources Code, § 21002.) The statute defines feasible to mean "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors." (Public Resources Code, § 21061.1.) The Legislature further provided that a lead agency may use its lawful discretion to mitigate significant impacts to the extent provided by other laws:

> In mitigating or avoiding a significant effect of a project on the environment, a public agency may exercise only those express or implied powers provided by law other than this division. However, a public agency may use discretionary powers provided by such other law for the purpose of mitigating or avoiding a significant effect on the environment subject to the express or implied constraints or limitations that may be provided by law.

(Public Resources Code, § 21004.) Cities and counties may rely on their constitutional police powers, for example, while the ability of other agencies to require mitigation may be limited by the scope of their statutory authority. Mitigation is also subject to constitutional limitations; i.e., there must be a nexus between the mitigation measure and the impact it addresses, and the mitigation must be roughly proportional to the impact of the project. (*Nollan v. California Coastal Comm'n* (1987) 483 U.S. 825; *Dolan v. City of Tigard* (1994) 512 U.S. 374; State CEQA Guidelines, § 15126.4(a)(4).)

CEQA itself imposes very few limitations on a lead agency's discretion to impose mitigation. For example, agencies may not mitigate the effects of a housing project by reducing the proposed number of units if other feasible mitigation measures are available. (Public Resources Code, § 21159.26.) Similarly, the Legislature has prescribed specific types of mitigation in only very limited circumstances; i.e., impacts to archeological resources and oak woodlands. (Public Resources Code, §§ 21083.2, 21083.4.)

SB 97 specifically called for guidelines addressing the mitigation of greenhouse gas emissions. In doing so, however, the Legislature did not alter a lead agency's discretion, authority or limitations on the imposition of mitigation where the impacts of a project's greenhouse gas emissions are significant. Thus, as explained in the Initial Statement of Reasons, the existing CEQA rules apply to the mitigation of greenhouse gas emissions.

Within the scope of a lead agency's existing authority, the CEQA Guidelines already contain provisions that recognize a lead agency's obligation to balance various factors in determining how or whether to carry out a project. (State CEQA Guidelines, § 15021(d).) Further, the Guidelines already require that "[w]here several measures are available to mitigate an impact, each should be discussed and the basis for selecting a particular measure should be identified." (State CEQA Guidelines, § 15126.4(a)(1)(B).)

Additionally, public agencies are directed to adopt their own implementing procedures, consistent with CEQA and the State CEQA Guidelines, which could set forth the types of mitigation that a particular agency finds to be most appropriate for projects subject to its approval. (State CEQA Guidelines, § 15022.) The Natural Resources Agency cannot, however, state in the State CEQA Guidelines that all lead agencies have the authority to prioritize types of mitigation measures, or to establish any particular priority order for them. Each lead agency must determine the scope of its own authority based on its own statutory or constitutional authorization.

Reliability and Effectiveness of Mitigation

Some comments expressed concern about the reliability and efficacy of some mitigation strategies. In response to such comments, the Natural Resources Agency further revised section 15126.4(c) to expressly require that any measures, in addition to being feasible, must be supported with substantial evidence and be capable of monitoring or reporting. (See Revised Section 15126.4(c) (October 23, 2009).) This addition reflects the requirements in Public Resources Code section 21081.5 that findings regarding mitigation be supported with substantial evidence and the monitoring or reporting requirement in section 21081.6.

The text of proposed section 15126.4(c), addressing mitigation of greenhouse gas emissions, also requires that mitigation measures be effective. The first sentence of that section requires that mitigation be "feasible." Further, the statue defines "feasible" to mean "<u>capable of being accomplished in a successful manner within a reasonable period of time</u>, taking into account economic, environmental, social, and technological factors." (Public Resources Code, § 21061.1 (emphasis added); see also State CEQA Guidelines § 15364 (adding "legal" factors to the definition of feasibility.) A recent decision of the Third District Court of Appeal confronting questions regarding the effectiveness of a mitigation measure explained: "concerns about whether a specific mitigation measure 'will actually work as advertised,' whether it 'can … be carried out,' and whether its 'success … is uncertain' go to the feasibility of the mitigation measure[.]" (*California Native Plant Society v. City of Rancho Cordova* (2009) 172 Cal. App. 4th 603, 622-623.) Thus, by requiring that lead agencies consider feasible mitigation of greenhouse gas emissions, section 15126.4(c) already requires that such measures be effective.

Off-site Mitigation and Offsets

Relatively little authority addresses the question of how close of a causal connection must exist between off-site emissions reductions and project implementation in order to be adequate mitigation under CEQA. CEQA requires lead agencies to mitigate or avoid the significant effects of proposed projects where it is feasible to do so. While the CEQA statute does not define mitigation, the State CEQA Guidelines define mitigation to include:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

(c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

(State CEQA Guidelines, § 15370.) As subdivision (e) implies, off-site measures may constitute mitigation under CEQA, and such measures have been upheld as adequate mitigation in CEQA case law. (See, e.g., *California Native Plant Society v. City of Rancho Cordova* (2009) 172 Cal. App. 4th 603, 619-626.)

Whether on-site or off-site, to be considered mitigation, the measure must be tied to impacts resulting from the project. Section 21002 of the Public Resources Code, the source of the requirement to mitigate, states that "public agencies should not approve projects as proposed if there are … feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects[.]" Similarly, section 21081(a)(1) specifies a finding by the lead agency in adopting a project that "[c]hanges or alterations have been required in, or incorporated into, the project which mitigate or avoid the significant effects on the environment." Both statutory provisions expressly link the changes to be made (i.e., the "mitigation measures") to the significant effects of the project. Courts have similarly required a link between the mitigation measure and the adverse impacts of the project. (*Save Our Peninsula Comm. v. Monterey County Bd. of Supervisors* (2001) 87 Cal. App. 4th 99, 128-131 (EIR must discuss "the history of water pumping on [the off-site mitigation] property and its feasibility for providing an actual offset for increased pumping on the [project] property").) The text of sections 21002 and 21081, and case law requiring a "nexus" between a measure and a project impact, together indicate that "but for" causation is a necessary element of mitigation. In other words, mitigation should normally be an activity that occurs in order to minimize a particular significant effect. Or, stated another way and in the context of greenhouse gas emissions, emissions reductions that would occur without a project would not normally qualify as mitigation.

Notably, this interpretation of the CEQA statute and case law is consistent with the Legislature's directive in AB32 that reductions relied on as part of a market-based compliance mechanism must be "in addition to any greenhouse gas emission reduction otherwise required by law or regulation, and any other greenhouse gas emission reduction that otherwise would occur." (Health and Safety Code, § 38562(d)(2).) While AB32 and CEQA are separate statutes, the additionality concept may be applied analytically in the latter as follows: greenhouse gas emission reductions that are otherwise required by law or regulation would appropriately be considered part of the existing baseline. Pursuant to section 15064.4(b)(1), a new project's emissions should be compared against that existing baseline.

Thus, in light of the above, and in response to concerns raised in the comments, the Natural Resources Agency has revised section 15126.4(c)(3) to state that mitigation includes: "Off-site measures, including offsets that are not otherwise required, to mitigate a project's emissions[.]" This provision is intended to be read in conjunction with the statutory mandate in Public Resources Code sections 21002 and 21081 that mitigation be tied to the effects of a project.

This provision would not limit the ability of a lead agency to create, or rely on the creation of, a mechanism, such as an offset bank, created prospectively in anticipation of future projects that will later rely on offsets created by those emissions reductions. The Initial Statement of Reasons referred, for example, to community energy conservation projects. (Initial Statement of Reasons, at p. 38.) Such a program could, for example, identify voluntary energy efficiency retrofits that would not occur absent implementation of the program, and then fund the retrofits through the sale of offsets that would occur as a result of the retrofit. Emissions reductions that occur as a result of a regulation requiring such reduction, on the other hand, would not constitute mitigation.

Some comments opined that offsets are highly uncertain and of questionable legitimacy. The Initial Statement of Reasons, however, cites several sources discussing examples of offsets being used in a CEQA context. Further, the ARB Scoping Plan describes offsets as way to "provide regulated entities a source of low-cost emission reductions, and … encourage the spread of clean, efficient technology within and outside California." (Scoping Plan, Appendix C, at p. C-21.) The Natural Resources Agency finds that the offset concept is consistent with the existing CEQA Guidelines' definition of "mitigation," which includes "[r]ectifying the impact by repairing, rehabilitating, or restoring the impacted environment" and "[c]ompensating for the impact by replacing or providing substitute resources or environments." (State CEQA Guidelines, §§ 15370(c), (e).)

While the proposed amendments recognize offsets as a potential mitigation strategy, they do not imply that offsets are appropriate in every instance. The efficacy of any proposed mitigation measure is a matter for the lead agency to determine based on the substantial evidence before it. Use of the word "feasible" in proposed Section 15126.4(c) requires the lead agency to find that any measure, including offsets, would be "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors." (State CEQA Guidelines, § 15364.)

Thus, the Natural Resources Agency finds that by expressly requiring that any mitigation measure be feasible, supported with substantial evidence, and capable of monitoring or reporting, section 15126.4(c) adequately addresses the concern stated in the comment that offsets may be of questionable legitimacy.

Use of Plans for the Reduction of Greenhouse Gas Emissions in a Cumulative Impacts Analysis

Section 15183.5 was developed to address tiering and streamlining the analysis of greenhouse gas emissions. Subdivision (a) highlights existing tiering and streamlining mechanisms in CEQA that may be used to address the analysis and mitigation of greenhouse gas emissions. Those mechanisms are often used for general plans and other long range planning documents. Subdivision (a) therefore recognizes that lead agencies may choose to include a programmatic analysis of greenhouse gas emissions in those long range plans. That subdivision did not create any new tiering or streamlining provisions; rather, it cross-references existing mechanisms. Each mechanism has its own benefits and drawbacks, and the use of any analysis of greenhouse gas emissions contained in such a document would be governed by the specific provisions cited in subdivision (a).

Subdivision (b), on the other hand, acknowledges that, in addition to the long range documents mentioned in subdivision (a), some agencies are voluntarily developing stand-alone plans focused specifically on the reduction of greenhouse gas emissions. Subdivision (b) is not a tiering mechanism. Tiering is governed by section 15152 of the existing CEQA Guidelines. The purpose of section 15183.5(b) is much narrower. Because climate action plans and greenhouse gas reduction plans are voluntary, and not subject to any legislative criteria or requirements, subdivision (b) was developed "to assist lead agencies in determining whether an existing greenhouse gas reduction plan is an appropriate document to use in a cumulative impacts analysis under CEQA." (Initial Statement of Reasons, at p. 54.) Specifically, a project that is consistent with a plan that satisfies the criteria in subdivision (b) may benefit from the presumption created in sections 15064(h)(3) and 15130(d) that the project's cumulative impacts are less than significant due to compliance with the plan. Subdivision (b) does not create or authorize any plans; rather, it provides a tool to determine whether a plan for the reduction of greenhouse gas emissions may be used in a cumulative impacts analysis as provided in section 15064(h)(3) or 15130(d). Section 15183.5(b) does not require that public agencies develop plans for the reduction of greenhouse gas emissions, nor does it prohibit public agencies from developing individual ordinances and regulations to address individual sources of greenhouse gas emissions.

As an example, if a general plan EIR analyzed and mitigated greenhouse gas emissions, a lead agency would likely use the specific streamlining provision applicable to general plan EIRs in section 15183, and not the more general provision in 15183.5(b). A stand alone "climate action plan" that was not analyzed in a program EIR, master EIR, or other mechanism identified in 15183.5(a) may still be used in a cumulative impacts analysis pursuant to sections 15064(h)(3) or 15130(d), but only if that climate action plan contains the elements listed in section 15183.5(b)(1).

Some comments suggested that section 15183.5(b) should identify specific types of plans to which it would apply. That section was developed precisely because plans for the reduction of greenhouse gas emissions are not specified in law and are so varied. They have been variously titled “climate action plans”, “sustainability plans”, “greenhouse gas reduction plans”, etc. Contents of such plans also vary widely. Thus, the Natural Resources Agency cannot specifically identify which plans satisfy the criteria in subdivision (b). That determination must be made by the individual lead agency based on whether the specific plan under consideration satisfies each of the criteria in subdivision (b)(1).

Notably, public agencies are required to develop their own procedures to implement CEQA. (State CEQA Guidelines, § 15022.) If a lead agency determines that it does not have a plan for the reduction of greenhouse gas emissions that contains the criteria set forth in section 15183.5(b), but its collective policies, ordinances and other requirements nevertheless ensure that the incremental contribution of individual projects is not cumulatively considerable, and substantial evidence supports that determination, it could include such an explanation and support in its own implementing procedures.

Some comments questioned how a Sustainable Communities Strategy or Alternative Planning Strategy should be treated in light of section 15183.5. SB375 encourages programmatic analysis and planning for greenhouse gas emissions from cars and light-duty trucks, and provides specific CEQA streamlining benefits for certain types of projects that are consistent with a Sustainable Communities Strategy (SCS) or an Alternative Planning Strategy (APS). Given the specificity of those statutory provisions, sections 21155 through 21155.3 and 21159.28 of the Public Resources Code in particular, the Office of Planning and Research and the Natural Resources Agency did not find that additional guidance on those provisions was necessary at this time. Proposed section 15183.5(c), however, clarifies that while certain projects consistent with an SCS or APS may not need to analyze greenhouse gas emissions from cars and light-duty trucks, emissions from other sources still may require analysis and mitigation. As SB97 requires the CEQA Guidelines to be updated every two years to incorporate new information, additional guidance regarding the relationship between CEQA and SB375 may be developed as necessary. (See also the discussion of AB32, SB375 and CEQA, above.)

Definition of Greenhouse Gas Emissions

Several comments objected to the definition of greenhouse gas emissions in the Guidelines. Some suggested that it should be strictly limited to the gases identified in AB32. Other thought it should include all potential greenhouse gas emissions. Still others wanted to exclude biogenic emissions from the definition.

As explained in the Initial Statement of Reasons, the definition of greenhouse gases in AB32 states that GHG "includes all of the following…." (Health and Safety Code, § 38505(g).) The Legislature thus implied that other gases may also be considered GHGs. Further, the ARB Scoping Plan also acknowledged that other gases contribute to climate change. (Scoping Plan, at p. 11.) Consistent with the definition in the Health and Safety Code, the proposed definition in the Proposed Amendments is not exclusive to the six primary GHGs. The purpose of a more expansive definition is to ensure that lead agencies do not exclude from consideration GHGs that are not listed, so long as substantial evidence indicates that such non-listed gases may result in significant adverse effects. This approach is consistent with the Supreme Court's directive that CEQA be interpreted to provide the fullest possible protection to the environment. (*Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal. 3d 376, 390.)

While the definition could not be strictly limited to the six gases identified in AB32, the Natural Resources Agency concluded that specific mention of other potential greenhouse gases was also not appropriate. Notably, the federal Environmental Protection Agency limited its proposed endangerment finding to those same six listed gases. It did so because the six gases are well studied, and have been the focus of climate change research. (Federal Register, v. 74, 18886, 18895 (April 24, 2009).) It is not necessary to list each of the known potential greenhouse gases because the proposed definition in section 15364.5 is written broadly, stating that the greenhouse gas emissions "are not limited to" the listed examples. As further explained in the Initial Statement of Reasons, the "purpose of a more expansive definition is to ensure that lead agencies do not exclude from consideration GHGs that are not listed, so long as substantial evidence indicates that such non-listed gases may result in significant adverse effects." (Initial Statement of Reasons, at p. 58.) Because the CEQA Guidelines must be updated periodically to reflect developments relating to greenhouse gas emissions, the Natural Resources Agency may expand the definition of greenhouse gas emissions if necessary to reflect the most current science and practice.

The Natural Resources Agency also concluded that the definition of greenhouse gas emissions should not differentiate between biogenic and anthropogenic emissions. SB97 does not distinguish between the sources of greenhouse gas emissions. Notably, neither AB32 nor the Air Resources Board's Scoping Plan distinguishes between biogenic and anthropogenic sources of greenhouse gas emissions. On the contrary, the Scoping Plan identifies methane from, among other sources, organic wastes decomposing in landfills as a source of emissions that should be controlled. (Scoping Plan, at pp. 62-63.)

Forestry

Some comments objected to the inclusion of questions related to forest resources in the Appendix G questions in the section on agricultural resources.

SB97 called for guidance on the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions. (Public Resources Code, § 21083.05.) As explained in the Initial Statement of Reasons, forest conversions may result in direct greenhouse gas emissions. Further, such conversions remove existing forest stock and the potential for further carbon sequestration. (Initial Statement of Reasons, at p. 63.) Sequestration is recognized as a key mitigation strategy in the Air Resources Board's Scoping Plan. (Scoping Plan, Appendix C, at p. C-168.)

The addition of questions related to forestry does not target the establishment of agricultural operations. The questions ask about *any* conversion of forests, not just conversions to other agricultural operations. Moreover, analysis of impacts to forestry resources is already required. The Legislature has declared that "forest resources and timberlands of the state are among the most valuable of the natural resources of the state" and that such resources "furnish high-quality timber, recreational opportunities, and aesthetic enjoyment while providing watershed protection and maintaining fisheries and wildlife." (Public Resources Code, § 4512(a)-(b).) Because CEQA defines "environment" to include "land, air, water, minerals, flora, fauna, noise, [and] objects of historic or aesthetic significance" (Public Resources Code, section 21060.5), and because forest resources have been declared to be "the most valuable of the natural resources of the state," projects affecting such resources must be analyzed, whether or not specific questions relating to forestry resources appear in Appendix G. (*Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1109.) In effect, suggestions that the Appendix G questions be limited to conversions to "non-agricultural uses" ask the Natural Resources Agency to adopt changes that are inconsistent with CEQA, which it cannot do.

Questions related to greenhouse gas emissions in Appendix G are not sufficient to address impacts related to forestry resources. As explained in the Initial Statement of Reasons, not only do forest conversions result in greenhouse gas emissions, but may also "remove existing carbon stock (i.e., carbon stored in vegetation), as well as a significant carbon sink (i.e., rather than emitting GHGs, forests remove GHGs from the atmosphere)." (Initial Statement of Reasons, at p. 63.) Further, conversions may lead to "aesthetic impacts, impacts to biological resources and water quality impacts, among others." The questions related to greenhouse gas emissions would not address such impacts. Thus, the addition of forestry questions to Appendix G is appropriate both pursuant to SB97 and the Natural Resources Agency's general authority to update the CEQA Guidelines pursuant to Public Resources Code section 21083(f).

"Level of Service" and Transportation Impact Analysis

The Natural Resources Agency acknowledges the concern expressed by some comments that the use of level of service metrics in CEQA analysis has led to an auto-centric focus. The Office of Planning and Research and the Natural Resources Agency have participated in extensive outreach with stakeholder groups to revise question (a) in the transportation section of Appendix G to accomplish the following goals:

- Assess traffic impacts on intersections, streets, highways and freeways as well as impacts to pedestrian, non-vehicular and mass-transit circulation

- Recognize a lead agency's discretion to choose methodology, including LOS, to assess traffic impacts

- Harmonize existing requirements in congestion management programs, general plans, ordinances, and elsewhere

In response to public comments submitted on proposed amendments, the Natural Resources Agency further refined question (a) to shift the focus from the capacity of the circulation system to consistency with applicable plans, policies that establish objective measures of effectiveness.

Some comments advocated leaving the existing text in question (a) of the transportation section of Appendix G intact. As explained in the Initial Statement of Reasons,

> [Q]uestion (a) changes the focus from an increase in traffic at a given location to the effect of a project on the overall circulation system in the project area. This change is appropriate because an increase in traffic, by itself, is not necessarily an indicator of a potentially significant environmental impact. (Ronald Miliam, AICP, Transportation Impact Analysis Gets a Failing Grade When it Comes to Climate Change and Smart Growth; see also Land Use Subcommittee of the Climate Action Team LUSCAT Submission to CARB Scoping Plan on Local Government, Land Use, and Transportation Report (May, 2008) at pp. 31, 36.) Similarly, even if some projects may result in a deterioration of vehicular level of service – that is, delay experienced by drivers – the overall effectiveness of the circulation system as a whole may be improved. (*Ibid*.) Such projects could include restriping to provide bicycle lanes or creating dedicated bus lanes. Even in such cases, however, any potential adverse air quality or other impacts would still have to be addressed as provided in other sections of the checklist. Finally, the change to question (a) also recognizes that the lead agency has discretion to choose its own metric of analysis of impacts to intersections, streets, highways and freeways. (Pub. Resources Code, § 21081.2(e); *Eureka Citizens for Responsible Gov't v. City of Eureka*, *supra*, 147 Cal.App.4th at 371-373 (lead agency has discretion to choose its methodology).) Thus, "level of service" may or may not be the applicable measure of effectiveness of the circulation system.

(Initial Statement of Reasons, at pp. 64-65.) Further, evidence presented to the Natural Resources Agency indicates that "mitigation" of traffic congestion may lead to even greater environmental impacts than might result from congestion itself. (See, e.g., Cervero, Robert. (July, 2001). *Road Expansion, Urban Growth, and Induced Travel: A Path Analysis*. Journal of the American Planning Association, Vol. 69 No. 2. American Planning Association (confirming “induced demand” phenomenon associated with capacity improvements).)

While the terms “volume to capacity ratio” and “congestion at intersections” no longer appear in question (a), nothing precludes a lead agency from including such measures of effectiveness in its own general plan or policies addressing its circulation system. Though the Office of Planning and Research originally recommended specifying “vehicle miles traveled” as a question in Appendix G, it later revised its recommendation to allow lead agencies to choose their own measures of effectiveness. (Letter from OPR Director, Cynthia Bryant, to Secretary for the Natural Resources Agency, Mike Chrisman, April 13, 2009.) Thus, as revised, question (a) accommodates lead agency selection of methodology, including, as appropriate, vehicle miles traveled, levels of service, or other measures of effectiveness.

Other comments objected to any mention of the phrase “level of service” in question (b) of the transportation section of the Appendix G checklist. That question, as revised, would ask whether a project would conflict with the provisions of a congestion management program. The Government Code, beginning at section 65088, requires Congestion Management Agencies, in urbanized areas, to adopt Congestion Management Programs covering that agency’s cities and county, and in consultation with local governments, transportation planning agencies, and air quality management districts. A CMP must, pursuant to statute, contain level of service standards for certain designated roadways. A CMP must also include a land use analysis program to assess the impact of land use decisions on the regional transportation system. A CMA may require that land use analysis to occur through the CEQA process. Thus, level of service standards cannot be deleted from the Appendix G checklist altogether. The proposed amendments did, however, amend question (b) to put level of service standards in the broader context of the entire CMP, which should also contain travel demand measures and other standards affecting the circulation system as a whole. Beyond this amendment, however, the Natural Resources Agency cannot remove level of service standards entirely from the Appendix G checklist.

Notably, the primary purpose of the proposed amendments is to update the CEQA Guidelines on the analysis and mitigation of greenhouse gas emissions. While certain changes to Appendix G were proposed pursuant to the Natural Resources Agency’s general authority to update the CEQA Guidelines, those changes were modest and were intended to address certain misapplications of CEQA in a way that hinders the type of development necessary to reduction of greenhouse gas emissions. Transportation planning and impact analysis continues to evolve, as new multimodal methods of analysis and guidelines on the integration of all modes of transportation and users into the circulation system are being developed. Additional updates to Appendix G may be appropriate in the future to address those developments.

Parking

As explained in the Initial Statement of Reasons, the Natural Resources Agency concluded that the question related to parking adequacy should be deleted from the Appendix G checklist in part as a result of the decision in *San Franciscans Upholding the Downtown Plan v. City and County of San Francisco* (2002) 102 Cal.App.4th 656. The court in that case distinguished the social impact of inadequate parking from actual adverse environmental impacts. In particular, that court explained:

> [T]here is no statutory or case authority requiring an EIR to identify specific measures to provide additional parking spaces in order to meet an anticipated shortfall in parking availability. The social inconvenience of having to hunt for scarce parking spaces is not an environmental impact; the secondary effect of scarce parking on traffic and air quality *is*. Under CEQA, a project's social impacts need not be treated as significant impacts on the environment. An EIR need only address the *secondary physical* impacts that could be triggered by a social impact.

(*Id*. at p. 698 (emphasis in original).) The Natural Resources Agency is aware of no authority requiring an analysis of parking adequacy as part of a project's environmental review. Rather, the Agency concurs with the court in the *San Franciscans* case that inadequate parking is a social impact that may, depending on the project and its setting, result in secondary effects. Consistent with existing CEQA Guidelines section 15131(a), deletion of the parking adequacy question from Appendix G checklist will ensure that the "focus of the analysis shall be on the physical changes." Specifically, the Appendix G checklist contains questions asking about possible project impacts to air quality and traffic.

Some comments pointed to examples of potential adverse impacts that could result from parking shortages, such as double-parking and slower circulation speeds, and referred specifically to a study of "cruising" behavior by Donald Shoup that noted that cruising could result in emissions of carbon dioxide. The relationship between parking adequacy and air quality is not as clear or direct as some comments imply. Mr. Shoup, for example, submitted comments to the Natural Resources Agency supporting the deletion of the parking question. (See, Letter from Donald Shoup, Professor of Urban Planning, University of California, Los Angeles, October 26, 2009.) In those comments, Mr. Shoup opines that cruising results not from the number of parking spaces associated with a project, but rather from the price associated with those parking spaces. (*Ibid*.) The Natural Resources Agency also has evidence before it demonstrating that providing parking actually causes greater emissions due to induced demand. The California Air Pollution Control Officers Association CEQA White Paper, for example, suggests reducing available parking as a way to reduce greenhouse gas emissions. (Greg Tholen, et al. (January, 2008). CEQA & Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act. California Air Pollution Control Officers Association, at Appendix B, pp. 8-9.)

Moreover, parking analyses do not typically address either air quality or traffic impacts; rather, such analyses often focus on the number of parking spaces necessary to satisfy peak demand, which is often established by a local agency as a parking ratio (i.e., one space per 250 square feet of office space). (See, e.g., Shoup, Donald. (1999). In Lieu of Required Parking. Journal of Planning Education and Research, Vol. 18 No. 4. Association of Collegiate Schools of Planning, at p. 309.) Thus, the question in Appendix G related to parking adequacy does not necessarily lead to the development of information addressing actual environmental impacts.

In sum, nothing in the CEQA statute, or cases interpreting that statute, require an analysis of parking demand. Further, parking supply is not a reasonable proxy for direct physical impacts associated with a project because parking supply may in some circumstances adversely affect air quality and traffic while in other circumstances, it may create air quality and traffic benefits. Thus, maintaining the parking question in the general Appendix G checklist is not necessary to effectuate the purposes of the CEQA statute.

The Natural Resources Agency acknowledges, however, that parking supply may lead to social impacts that agencies may wish to regulate. Cities and counties can, and do, include parking related policies in their municipal ordinances and general plans. (See, e.g., Office of Planning and Research, General Plan Guidelines, at pp. 59-60.) To the extent an agency has developed parking related policies in a general plan, zoning ordinance, or other regulation, consistency with those policies could be analyzed as a potential land use impact. Public agencies must, moreover, develop their own procedures to implement CEQA, and so may include parking-related questions in their own checklist if appropriate in their own circumstances. (State CEQA Guidelines, §§ 15022, 15063(f).)

AB32, SB375 and CEQA

Many comments suggested various links between CEQA, AB32 and SB375. While there is some overlap between the statutes, each contains its own requirements and serves its own purposes. While recognizing the role of regulatory programs in addressing cumulative impacts analysis in CEQA, the Proposed Amendments deliberately avoided linking the determination of significance under CEQA to compliance with AB32. The following addresses the CEQA effect of compliance with AB32 and SB375.

<u>The Effect of Consistency with the Scoping Plan and the Regulations Implementing AB32</u>

The Initial Statement of Reasons explained that the Scoping Plan "may not be appropriate for use in determining the significance of individual projects … because it is conceptual at this stage and relies on the future development of regulations to implement the strategies identified in the Scoping Plan." (Initial Statement of Reasons, at p. 14.) Compliance with the regulations implementing the Scoping Plan, on the other hand, might be relevant in determining the significance of a project's emissions, if the particular regulation or regulations specifically addresses the emissions from the project. (*Ibid*.) Compliance with regulations is specifically addressed in section 15064(h)(3) and 15064.4(b)(3).

Specifically, both sections provide that a lead agency may consider compliance with such regulations, and if relying on regulations to determine that an impact is less than significant, the lead agency must explain how that particular regulation addresses the impact of the project. Both sections also recognize that a lead agency must still consider whether any evidence supports a fair argument that a project may still have a significant impact despite compliance with the regulation.

<u>The Effect of Consistency with Plans for the Reduction of Greenhouse Gas Emissions, Sustainable Communities Strategies and Alternative Planning Strategies.</u>

Several comments questioned whether the references in the Proposed Amendments to "greenhouse gas reduction plans" were intended to include a Sustainable Communities Strategy (SCS) or Alternative Planning Strategy (APS).

SB375 created both the SCS and APS as strategies to be adopted by metropolitan planning organizations for the purpose of achieving greenhouse gas emissions reductions targets established by the California Air Resources Board. SB375 inserted specific provisions into CEQA governing the review of projects that are consistent with an APS or SCS. (See, e.g., Public Resources Code, §§ 21155-21155.3, 21159.28.) Because of the specificity of those provisions, the Office of Planning and Research and the Natural Resources Agency determined that no further guidance was needed in the Proposed Amendments to address the use of an SCS or APS.

As explained in the Initial Statement of Reasons, however, OPR and the Natural Resources Agency observed that many jurisdictions were adopting plans specifically for the purpose of addressing and reducing greenhouse gas emissions. (Initial Statement of Reasons, at pp. 12-13.) Those plans may be titled Climate Action Plans, Greenhouse Gas Reduction Plans, Sustainability Plans, etc. While recognizing the great variety of such plans, as well as the lack of legislative or other direction regarding the content of such plans, OPR and the Natural Resources Agency proposed the addition of a new Guidelines section 15183.5(b) to establish criteria for those plans if they are to be used in a CEQA cumulative impacts analysis as provided in sections 15064(h)(3) and 15130(d). The proposed amendments to section 15064(h)(3) and addition of section 15183.5(b) were not intended to limit or affect the use of an APS or SCS as provided in the Public Resources Code.

SB375 included provisions that would exempt certain types of projects from CEQA, and would apply the substantial evidence standard of review to other types of projects reviewed under a Sustainable Communities Environmental Assessment. Some comments raised concerns that the proposed amendments, and section 15064(h)(3) in particular, may conflict with those provisions of SB375. The last sentence of Section 15064(h)(3), which acknowledges the application of the fair argument standard in the determination of whether to prepare an EIR, complies with existing law. (*CBE*, *supra*, 103 Cal.App.4th at 115-116.) SB375's specific statutory provisions, and not section 15064(h)(3), would control for a project that satisfies the conditions in those provisions. Thus, there is no conflict between the existing language in Section 15064(h)(3) and SB375.

Comments were also raised about the application of section 15125(d), which requires a discussion of a project's consistency with applicable regional plans, to an APS or SCS. One comment suggested that, for CEQA purposes, an SCS and APS are interchangeable. The Natural Resources Agency disagrees. An Alternative Planning Strategy is not a land use plan with which land use consistency should be analyzed under CEQA. (Government Code, § 65080(b)(2)(H)(v).) For that reason, the Natural Resources Agency deliberately did not propose to add "Alternative Planning Strategy" to the list of plans to be considered in an environmental setting pursuant to section 15125. There is no similar statement precluding analysis of consistency with a Sustainable Communities Strategy, however. Thus, the reference to a "regional transportation plan" in the existing section 15125(d) remains appropriate. As explained above, and the Initial Statement of Reasons, the reference to "plans for the reduction of greenhouse gas emissions" is intended to cover a broad range of plans that may be adopted by state and local agencies. The specific statutory provisions governing an Alternative Planning Strategy or Sustainable Communities Strategy would, however, control.

Similarly, some comments expressed concern regarding the application of the new Appendix G question asking about a project's consistency with applicable plans for the reduction of greenhouse gas emissions. That Appendix G question, as revised, asks whether a project would: "Conflict with <u>an applicable plan</u>, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?" (Emphasis added.) In response to comments, the Natural Resources Agency replaced the word "any" with the word "an" to clarify that only a plan determined to be applicable by the lead agency, and not any plan developed by any person or entity, should be considered in determining whether a project would result in a significant impact relating to greenhouse gas emissions. Government Code section 65080(b)(2)(H)(v) states: an "alternative planning strategy shall not constitute a land use plan, policy, or regulation, and the inconsistency of a project with an alternative planning strategy shall not be a consideration in determining whether a project may have an environmental effect" for CEQA purposes. By operation of that Government Code Section 65080(b)(2)(H)(v), an alternative planning strategy would not constitute "an applicable plan" for purposes of the Appendix G question. Notably, as explained in the Initial Statement of Reasons, the Appendix G checklist is meant to provide a sample checklist of questions designed to provoke thoughtful consideration of general environmental concerns. (Initial Statement of Reasons, at p. 63.) Because it is provided as a sample only, the Office of Planning and Research and the Natural Resources Agency found that it would not be possible to identify with specificity each plan that or may not apply to a particular jurisdiction or project.

Lead agencies, however, have discretion to revise the checklist in a way that is most appropriate for their own jurisdiction. If an individual agency in a region where an APS was prepared finds it necessary or desirable to restate Government Code Section 65080(b)(2)(H)(v) in its own checklist, it may do so. Further, while inconsistency with an APS is not, by itself, an indication of a potentially significant impact, other project characteristics would need to be considered as indicated in Section 15064.4 and other provisions of the CEQA Guidelines. Because Government Code Section 65080(b)(2)(H)(v) already provides that an APS is not a land use plan for CEQA purposes, and the Appendix G question asks only about "an applicable plan," the question need not specify an exception for an APS.

The Effect of Compliance with Regulations Implementing AB32 or Other Laws Intended to Reduce Greenhouse Gas Emissions

Some comments urged that lead agencies should be able to rely on sector-wide reductions in emissions that may result from implementation of AB32 and other regulations in mitigating an individual project's impacts. Those comments appeared to conflate the requirement that a lead agency consider cumulative impacts (i.e., the impacts resulting from a project's emissions when added to other past, present and reasonably foreseeable future emissions) with the requirement that a lead agency mitigate the significant effects of a project. The proposed amendments contain several provisions addressing the analysis of greenhouse gas emissions as a cumulative effect. For example, Section 15064(h)(3) and 15130(d) would encourage lead agencies to use existing plans for the reduction of greenhouse gas emissions in cumulative impacts analysis. Additionally, Section 15130(b)(1)(B) is proposed for amendment to allow lead agencies to use projections of emissions contained in certain plans and models. Thus, the proposed amendments would allow a lead agency to consider a project in the context of other emissions resulting from the same or other sectors.

To the extent comments suggested that reductions in emissions resulting from implementation of AB32 elsewhere can mitigate the significant effects of a separate project under CEQA, the Natural Resources Agency disagrees. (See discussion below on off-site mitigation.)

A project's compliance with regulations or requirements implementing AB32 or other laws and policies is not irrelevant. Section 15064.4(b)(3) would allow a lead agency to consider compliance with requirements and regulations in the determination of significance of a project's greenhouse gas emissions. Lead agencies should note, however, that compliance with one requirement, affecting only one source of a project's emissions, may not necessarily support a conclusion that all of the project's emissions are less than significant.

Projects That Implement AB32 or Otherwise Assist in Achieving the State's Emissions Reductions Goals

Finally, some comments noted that projects implementing AB32, or that would somehow assist the State in achieving a low-carbon future, should not be considered significant under CEQA, and that requiring such projects to mitigate their emissions would frustrate implementation of AB32. CEQA requires analysis and mitigation of a project's significant adverse environmental impacts, even if that project may be considered environmentally beneficial overall. As the Third District Court of Appeal recently explained:

> "[I]t cannot be assumed that activities intended to protect or preserve the environment are immune from environmental review. [Citations.]" …. There may be environmental costs to an environmentally beneficial project, which must be considered and assessed.

(*Cal. Farm Bureau Fed. v. Cal. Wildlife Cons. Bd.* (2006) 143 Cal. App. 4th 173, 196.) Nothing in SB97 altered this rule. Thus, lead agencies must consider whether the greenhouse gas emissions resulting from beneficial projects may be significant, and if so, whether any feasible measures exist to mitigate those emissions. If such emissions are found to be significant and unavoidable, proposed amendments to section 15093 would expressly allow lead agencies to consider the region-wide and statewide environmental benefits of a project in determining whether project benefits outweigh its adverse environmental impacts.

"Adaptation" and Analysis of the Effects of Climate Change on a Project

Several comments submitted as part of the Natural Resources Agency's SB97 rulemaking process urged it to incorporate the California Climate Adaptation Strategy (Adaptation Strategy) into the CEQA Guidelines. In considering such comments, it is important to understand several key differences between the Adaptation Strategy and the California Environmental Quality Act. First, the Adaptation Strategy is a policy statement that contains recommendations; it is not a binding regulatory document. Second, the Adaptation Strategy focuses on how the State can plan for the effects of climate change. CEQA's focus, on the other hand, is the analysis of a particular project's greenhouse gas emissions on the environment, and mitigation of those emissions if impacts from those emissions are significant. Given these differences, CEQA should not be viewed as the tool to implement the Adaptation Strategy; rather, as indicated in the Strategy's key recommendations, advanced programmatic planning is the primary method to implement the Adaptation Strategies.

There is some overlap between CEQA and the Adaptation Strategy, however. As explained in both the Initial Statement of Reasons and in the Adaptation Strategy, section 15126.2 may require the analysis of the effects of a changing climate under certain circumstances. (Initial Statement of Reasons, at pp. 68-69.) In particular, Section 15126.2 already requires an analysis of placing a project in a potentially hazardous location. Further, several questions in the Appendix G checklist already ask about wildfire and flooding risks. Many comments on the proposed amendments asked for additional guidance, however.

Having reviewed all of the comments addressing the effects of climate change, the Natural Resources Agency revised the proposed amendments to include a new sentence in Section 15126.2 clarifying the type of analysis that would be required. Existing section 15126.2(a) provides an example of a potential hazard requiring analysis: placing a subdivision on a fault line. The new sentence adds further examples, as follows:

> Similarly, the EIR should evaluate any potentially significant impacts of locating development in other areas susceptible to hazardous conditions (e.g., floodplains, coastlines, wildfire risk areas) as identified in authoritative hazard maps, risk assessments or in land use plans addressing such hazards areas.

According to the Office of Planning and Research, at least sixty lead agencies already require this type of analysis. (California Governor's Office of Planning and Research, State Clearinghouse, The California Planners' Book of Lists (January, 2009), at p. 109.) This addition is reasonably necessary to guide lead agencies as to the scope of analysis of a changing climate that is appropriate under CEQA.

As revised, section 15126.2 would provide that a lead agency should analyze the effects of bringing development to an area that is susceptible to hazards such as flooding and wildfire, both as such hazards currently exist or may occur in the future. Several limitations apply to the analysis of future hazards, however. For example, such an analysis may not be relevant if the potential hazard would likely occur sometime after the projected life of the project (i.e., if sea-level projections only project changes 50 years in the future, a five-year project may not be affected by such changes). Additionally, the degree of analysis should correspond to the probability of the potential hazard. (State CEQA Guidelines, § 15143 ("significant effects should be discussed with emphasis in proportion to their severity and probability of occurrence").) Thus, for example, where there is a great degree of certainty that sea-levels may rise between 3 and 6 feet at a specific location within 30 years, and the project would involve placing a wastewater treatment plant with a 50 year life at 2 feet above current sea level, the potential effects that may result from inundation of that plant should be addressed. On the other extreme, while there may be consensus that temperatures may rise, but the magnitude of the increase is not known with any degree of certainty, effects associated with temperature rise would not need to be examined. (State CEQA Guidelines, § 15145 ("If, after thorough investigation, a lead agency finds that a particular impact is too speculative for evaluation, the agency should note its conclusion and terminate the discussion of the impact").) Lead agencies are not required to generate their own original research on potential future changes; however, where specific information is currently available, the analysis should address that information. (State CEQA

Guidelines, § 15144 (environmental analysis "necessarily involves some degree of forecasting. While seeing the unforeseeable is not possible, an agency must use its best efforts to find out and disclose all that it reasonably can").)

The decision in *Baird v. County of Contra Costa* (1995) 32 Cal.App.4th 1464, does not preclude this analysis. In that case, the First District Court of Appeal held that a county was not required to prepare an EIR due solely to pre-existing soil contamination that the project would not change in any way. (*Id*. at 1468.) No evidence supported the petitioner's claim that the project would "expose or exacerbate" the pre-existing contamination, which was located several hundred to several thousand feet from the project site. (*Id*. at n. 1.) Moreover, the project would have no other significant effects on the environment, and other statutes exist to protect residents from contaminated soils. Thus, the question confronting that court was whether pre-existing contamination near the project was, by itself, enough to require preparation of an EIR. It held that, in those circumstances, an EIR was not required. That court also acknowledged, however, that where there is a potential for ultimately changing the environment, an EIR could be required. (*Id*. at p. 1469.) Thus, unlike the circumstances in the *Baird* case, the analysis required in section 15126.2(a) would occur if an EIR was otherwise required. Similarly, the addition to that section contemplates hazards which the presence of a project could exacerbate (i.e., potential upset of hazardous materials in a flood, increased need for firefighting services, etc.).

Finally, while the revision in section 15126.2 is consistent with the general objective of the Adaptation Strategy and is consistent with the limits of CEQA, not all issues addressed in the Adaptation Strategy are necessarily appropriate in a CEQA analysis. Thus, the revision in section 15126.2 should not be read as implementation of the entire Adaptation Strategy. Unlike hazards that can be mapped, other issues in the Adaptation Strategy, such as the health risks associated with higher temperatures, are not capable of an analysis that links a project to an ultimate impact. Habitat modification and changes in agriculture and forestry resulting from climate change similarly do not appear to be issues that can be addressed on a project-by-project basis in CEQA documents. Water supply variability is an issue that has already been addressed in depth in recent CEQA cases. (*See*, *e.g.*, *Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova* (2007) 40 Cal.4th 412, 434-435 ("If the uncertainties inherent in long-term land use and water planning make it impossible to confidently identify the future water sources, an EIR may satisfy CEQA if it acknowledges the degree of uncertainty involved, discusses the reasonably foreseeable alternatives—including alternative water sources and the option of curtailing the development if sufficient water is not available for later phases—and discloses the significant foreseeable environmental effects of each alternative, as well as mitigation measures to minimize each adverse impact.").) Further, legislation has been developed to ensure that lead agencies identify adequate water supplies to serve projects many years in the future under variable water conditions. (See, e.g., Water Code, § 10910 *et seq*.; Government Code, § 66473.7.) Thus, the analysis called for in section 15126.2(a) should be directed primarily at hazards, and not all aspects of the Adaptation Strategy.

Additional Changes

Several comments suggested revisions or requested clarification of issues that were not addressed in this rulemaking package. The Initial Statement of Reasons explained:

> [T]he Proposed Amendments suggest relatively modest changes to various portions of the existing CEQA Guidelines. Modifications address those issues where analysis of GHG emissions may differ in some respects from more traditional CEQA analysis. Other modifications are suggested to clarify existing law that may apply both to analysis of GHG emissions as well as more traditional CEQA analyses. The incremental approach in the Proposed Amendments is consistent with Public Resources Code section 21083(f), which directs OPR and the Resources Agency to regularly review the Guidelines and propose amendments as necessary.

(Initial Statement of Reasons, at p. 9.) Additionally, Public Resources Code section 21083.05(c) requires that the CEQA Guidelines be updated periodically "to incorporate new information or criteria established by the State Air Resources Board pursuant to" AB32. Therefore, the CEQA Guidelines will continually be updated to reflect evolving information and practice and to address developments regarding analysis of greenhouse gas emissions in the courts.

Determination Regarding Impacts on Local Government and School Districts

The Natural Resources Agency has determined that the Amendments to the State CEQA Guidelines do not impose additional requirements or costs on local government or school districts. Among other things, Public Resources Code section 21083.05 (reflected in amendments to State CEQA Guidelines sections 15064.4, 15064.7(c), 15126.4(c), 15130, 15183.5, 15364.5, and Appendix G) clarifies that CEQA requires analysis of a project's greenhouse gas emissions. Public Resources Code sections 21002 and 21004 (reflected in State CEQA Guidelines section 15126.4) require a lead agency to impose feasible mitigation where a project will cause significant adverse environmental impacts. Public Resources Code sections 21003 and 21093 (reflected in the amendments to State CEQA Guidelines sections 15064, 15125, 15130, 15150 and 15183, and new State CEQA Guidelines sections 15064.4 and 15183.5) encourage lead agencies to tier environmental impact reports wherever possible and to use existing analyses to reduce duplication and expense. The decision in Berkeley Keep Jets Over the Bay Com. v. Board of Port Comm. (2001) 91 Cal.App.4th 1344, 1370, 1382 (reflected in proposed State CEQA Guidelines section 15064.4), requires that potential adverse impacts be quantified where it is possible to do so and quantification will assist in the determination of significance of the impact.

The Amendments to the State CEQA Guidelines described above merely reflect existing legislative requirements and judicial decision interpreting those requirements. Therefore, this rulemaking activity does not itself impose any costs on local government or school districts.

Determination Regarding Potential Economic Impacts Directly Affecting Business

The Natural Resources Agency has determined that the Amendments will not have a significant, statewide adverse economic impact directly affecting business. The guidelines required by sections 21083 and 21083.05 of the Public Resources Code are promulgated in the California Code of Regulations, title 14, sections 15000-15387 (the "State CEQA Guidelines"). The Natural Resources Agency has determined that most of the amendments will have no impacts on business.

CEQA applies to activities of public agencies, including projects that are funded, proposed, or approved by public agencies. Thus, the amendments to the State CEQA Guidelines would apply to public agencies, and not directly to businesses. The Natural Resources Agency is aware, however, that certain requirements reflected in the amendments that have been enacted by the Legislature and developed in case law interpreting CEQA could have an indirect economic impact on business. Among other things, project proponents could incur additional costs in assisting lead agencies to comply with the requirement to quantify greenhouse gas emissions, if possible, as part of an analysis of the effects of such emissions. Project proponents may also incur costs in implementing mitigation measures to reduce such emissions. However, the amendments to the Guidelines merely reflect existing requirements. (See, e.g., Pub. Resources Code, §§ 21004 ("a public agency may use discretionary powers … for the purpose of mitigating or avoiding a significant effect on the environment"), 21083.05 (requiring the development of guidelines on the analysis and mitigation of greenhouse gas emissions "as required by this division"); *Berkeley Keep Jets Over the Bay Com. v. Board of Port Comm*. (2001) 91 Cal.App.4th 1344, 1370, 1382 (potential hazardous emissions and noise impacts must be quantified where it is possible to do so and quantification will assist in the determination of significance of the impact).)

Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating greenhouse gas emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al., Riverside Co*. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans.*, Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-

1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (See, e.g., *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad.*, 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Additionally, some of amendments included in this rulemaking activity may tend to reduce costs associated with environmental analysis of greenhouse gas emissions. For example, the amendments to the Guidelines encourage tiering and streamlining of existing environmental analyses to the extent possible in order to reduce duplication. Such tiering and streamlining mechanisms are also consistent with existing law. (See, e.g., Pub. Resources Code, § 21093 (lead agencies shall tier environmental impact reports wherever possible).)

The amendments update the State CEQA Guidelines to be consistent with legislative enactments and judicial decisions that have modified CEQA, but do not themselves impose any new requirements. Therefore, the amendments do not have a significant, adverse economic impact directly affecting business.

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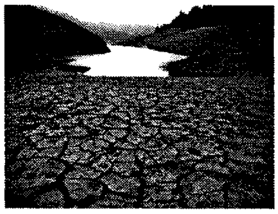
California's 100-year drought

MEGADROUGHTS A THREAT TO CIVILIZATION

Megadroughts are extreme dry spells that can last for a decade or longer. They have parched the West, including present-day California, long before Europeans settled the region in the 1800s.

Lamont Doherty Earth Observatory of Columbia University; U.S. Drought Monitor; Cornell University
Doyle Rice, Frank Pompa and Julie Snider, USA TODAY

Doyle Rice, USA TODAY 9:23 a.m. EDT September 3, 2014



(Photo: Justin Sullivan, Getty Images)

California is in the third year of one of the state's worst droughts in the past century, one that's led to fierce wildfires, water shortages and restrictions, and potentially staggering agricultural losses.

The dryness in California is only part of a longer-term, 15-year drought across most of the Western USA, one that bioclimatologist Park Williams said is notable because "more area in the West has persistently been in drought during the past 15 years than in any other 15-year period since the 1150s and 1160s" — that's more than 850 years ago.

"When considering the West as a whole, we are currently in the midst of a historically relevant megadrought," said Williams, a professor at the Lamont-Doherty Earth Observatory of Columbia University in New York.

Megadroughts are what Cornell University scientist Toby Ault calls the "great white sharks of climate: powerful, dangerous and hard to detect before it's too late. They have happened in the past, and they are still out there, lurking in what is possible for the future, even without climate change." Ault goes so far as to call megadroughts "a threat to civilization."

WHAT IS A MEGADROUGHT?

Megadroughts are defined more by their duration than their severity. They are extreme dry spells that can last for a decade or longer, according to research meteorologist Martin Hoerling of the National Oceanic and Atmospheric Administration.

Megadroughts have parched the West, including present-day California, long before Europeans settled the region in the 1800s.

Most of the USA's droughts of the past century, even the infamous 1930s Dust Bowl that forced migrations of Oklahomans and others from the Plains, "were exceeded in severity and duration multiple times by droughts during the preceding 2,000 years," the National Climate Assessment reported this year.

The difference now, of course, is the Western USA is home to more than 70 million people who weren't here for previous megadroughts. The implications are far more daunting.

Overall, "the nature of the beast is that drought is cyclical, and these long periods of drought have been commonplace in the past," according to Mark Svoboda, a climatologist at the National Drought Mitigation Center in Lincoln, Neb. "We are simply much more vulnerable today than at any time in the past. People can't just pick up and leave to the degree they did in the past."

Ault agrees that this long-term Western dry spell could be classified as a megadrought. "But this is not as bad as it could get," he warned.

How do scientists know how wet or dry it was centuries ago? Though no weather records exist before the late 1800s, scientists can examine paleoclimatic "proxy data," such as tree rings and lake sediment, to find out how much — or little — rain fell hundreds or even thousands of years ago.

At the most simplistic level, tree rings are wider during wet years and narrower during dry years.

"Prolonged droughts — some of which lasted more than a century — brought thriving civilizations, such as the ancestral Pueblo (Native Americans) of the Four Corners region, to starvation, migration and finally collapse, " Lynn Ingram, a geologist at the University of California-Berkeley, wrote in her recent book *The West Without Water.*

Ault says decade-long droughts happen once or twice a century in the Western USA, but much worse droughts, ones that last for multiple decades, occur once or twice per millennium.

Has California reached megadrought status? Not yet: "This one wouldn't stand out as a megadrought," Hoerling said. Even so, "this is the state's worst consecutive three years for precipitation in 119 years of records," he said.

As of Aug. 28, 100% of the state of California was considered to be in a drought, according to the L
"exceptional" drought, the worst level. Record warmth has fueled the drought as the state sees its h al
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Because of the dryness, Calif. Gov. Jerry Brown declared a statewide drought emergency this year d
to drop, and as of late August, they were down to about 59% of the historical average.

Regulations restricting outdoor water use were put in place in late July for the entire state. People aren't allowed to hose down driveways and sidewalks, nor are they allowed to water lawns and landscapes (if there is excess runoff). There are reports of wells running dry in central California.

About 1,000 more wildfires than usual have charred the state, including some unusual ones in the spring.

The drought is likely to inflict $2.2 billion in losses on the agricultural industry, according to a July study from the University of California-Davis.

HOW BAD CAN IT GET IN CALIFORNIA?

"If California suffered something like a multi-decade drought," University of Arizona climate scientist Gregg Garfin said, "the best-case scenario would be some combination of conservation, technological improvements (such as desalinization plants), multi-state cooperation on the drought, economic-based water transfers from agriculture to urban areas and other things like that to get humans through the drought.

"But there would be consequences for ecosystems and agriculture," he said.

"In the worst-case scenario, there might be out-migration and/or ghost towns," Garfin said. As a way to avoid this, "we could simply suck down more and more groundwater, which would have its own set of ramifications for local aquifers and the environment."

Even in the worst case of severe multi-decade drought, "it is hard for me to imagine people and businesses being banned from moving into urban areas of California," he said.

"We have much better resilience now than in the 'ghost town days,' with the ability to drill deeper, along with various ways of importing water and trading for water," Garfin said. "A more subtle way of restricting people (not banning them) is what Santa Fe has done — where new housing developments must either come with their own new source of water, or they must offset the water through conservation."

Overall, if the drought worsened, "we'd have to learn how to use water more efficiently," Ault said. "This is a glimpse of the future."

ROLE OF CLIMATE CHANGE

What role does climate change play in this drought or in future droughts?

Scientists such as Hoerling and Ault say they don't have the tools to tease out how much of this specific drought might be attributed to climate change.

"As of now, probably very little of the California drought can be attributed to climate change with any certainty," said tree-ring scientist Edward Cook of Lamont-Doherty.

Overall, past droughts have probably been due to subtle changes in water temperatures in the tropical Pacific Ocean. Cooler water temperatures — known as La Niñas — tend to produce drier conditions in the West.

Droughts in North America's "Medieval Warm Period" (roughly 950-1250) were associated with high temperatures in the Southwest and were probably caused by persistently cool La Niña-like conditions in the tropical Pacific Ocean. Since 2000, the dominant climate pattern has been La Niña.

Hoerling noted that some computer models from the Intergovernmental Panel on Climate Change, a United Nations science panel, show that California could actually see more, not less, winter rain and snow because of climate change.

However, overall rising temperatures would tend to favor more droughts, University of Arizona scientist Jonathan Overpeck said.

"It's been anomalously hot recently, which was not likely to have occurred without global warming," Overpeck said. "The odds are only going up that we could have a megadrought as the Earth warms."

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Trends toward warmer temperatures could lead to a long-term dry spell in the region, according to a 2004 study led by Cook in the journal *Science*.

What's troubling is that the 20th century — during which time California's population increased from about 1.5 million to almost 40 million — may well have been an outlier, an unusually wet century: "Overall, the 20th century experienced less drought than most of the preceding four to 20 centuries," the *Science* study said.

Ault continues to investigate the relationship between climate change and megadroughts and the likelihood that an even more severe megadrought might hit in the next hundred years in the Southwest — one that's worse than any other drought in the past 1,000 years.

Specifically because of global warming, Ault says, the chances of the Southwestern USA experiencing a decade-long drought is at least 50% (but may be closer to 80%-90%), and the chances of a three-decade-long megadrought range from 20% to 50% over the next century. Ault is writing a study about this that will be published in a forthcoming issue of the American Meteorological Society's *Journal of Climate*.

"For the Southwestern U.S., I'm not optimistic about avoiding real megadroughts," Ault said. "As we add greenhouse gases into the atmosphere — and we haven't put the brakes on stopping this — we are weighting the dice for megadrought conditions.

"The risks would be lower if we didn't warm the planet as much as is expected to occur, but they aren't zero, because we know these things happen naturally," he said.

This is serious stuff: "Megadroughts are a threat to civilization," Ault said at an American Geophysical Union conference this year. "They could possibly be even worse than anything experienced by any humans who have lived in that part of the world for the last few thousand years."

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ADMINISTRATION
RIVERSIDE COUNTY
PLANNING DEPARTMENT

CENTER for BIOLOGICAL DIVERSITY

San Bernardino Valley
Audubon Society

via electronic mail and USPS

April 6, 2015

Kristi Lovelady
Principal Planner
4080 Lemon St., 12th Floor
Riverside, CA 92501
kloveIad@rctlma.org

Re: Recirculated Draft Environmental Impact Report and Climate Action Plan for General Plan Amendment No. 960

Dear Ms. Lovelady:

The Center for Biological Diversity (the Center) and San Bernardino Valley Audubon Society (SBVAS) submit the following comments concerning the Recirculated Draft Environmental Impact Report (RDEIR) and Climate Action Plan (CAP) for General Plan Amendment No. 960 (GPA 960, Plan, or Project) for Riverside County (the County). For the reasons detailed below, we urge approval of GPA 960 be denied or that revisions be made to the RDEIR and CAP to better analyze, mitigate or avoid the Project's significant environmental impacts.

The Center is a non-profit, public interest environmental organization dedicated to the protection of native species and their habitats through science, policy, and environmental law. The Center has 825,000 members and online activists, including those in Riverside County, California, and the United States. The Center has worked for many years to protect imperiled plants and wildlife, open space, air and water quality, and overall quality of life for people in Riverside County.

The SBVAS is a local chapter of the National Audubon Society, a 501(c)3 corporation. The SBVAS chapter area covers almost all of Riverside and San Bernardino Counties and includes the project area. SBVAS has about 2,000 members. Part of the chapter's mission is to preserve habitat in the area, not just for birds, but for other wildlife, and to maintain the quality of life in and around Riverside County.

I. The DEIR and Associated CAP Lack an Adequate Analysis of the General Plan's GHG Emissions and Necessary Mitigation Measures to Meet Emission Reduction Goals

GPA 960 allows for incredible growth within Riverside County. However, the Plan and its accompanying DEIR and CAP do not adequately address the emissions that would result from such growth. While the CAP and DEIR for the GPA take important strides in acknowledging the significant impacts of climate change facing California and the need for significant reductions in greenhouse gas (GHG) emissions, neither document goes far enough to truly address the climate crisis ahead of us. The GPA contains vague policies on how to mitigate GHG emissions, and the DEIR fails to inventory important emissions that would result, directly and indirectly, from implementation of the Plan.

Troublingly, the information in the GPA, DEIR and CAP is often inconsistent, resulting in dubious claims on the County's ability to minimize the significant GHG emissions that will result both directly and indirectly from the GPA. While the County establishes promising reduction goals, the mitigation measures proposed to meet those goals are flawed and lack necessary enforcement mechanisms. The County also at times overestimates the emission reductions likely to result from mitigation measures. Many of the issues raised in CBD's prior comment letter, particularly the continued reliance on a Business-As-Usual baseline remain in the environmental documents. Therefore, the conservation groups urges the County to revise the GHG analysis in the GPA, DEIR and CAP to address the issues raised below in order to ensure that growth in the Riverside County will not come at the cost of significant new emissions of GHGs.

A. The Climate Action Plan's Conclusion that Greenhouse Gas Emissions will be Less than Significant is Dubious and Conflicts with CEQA's Requirements

In order to fully address climate impacts arising from the GPA, the County has created a Climate Action Plan (CAP), which details the specific measures the County would take in order to minimize the GHG emissions impacts of GPA 960. The CAP proposes measures to reduce GHG emissions to less than significant levels and serves as a basis for tiering by future development projects. These measures however, contain numerous flaws that violate the mandates of CEQA: they rely upon an improper baseline, are unenforceable, defer mitigation, and fail to include all feasible measures. Furthermore, the CAP and DEIR overestimate the reductions the mitigation measures will achieve and omit information necessary for informed decision-making, also in violation of CEQA. Finally, the CAP and its Screening Tables, which are meant to be the basis for tiering by future projects, fail as tiering documents because of their numerous CEQA violations and because they reward meaningless reductions. These numerous flaws show that the DEIR's finding of less than significant impacts for GPA 960 is invalid.

i. Business as Usual" Calculations Do Not Serve as a Proper Baseline for Future Project Emissions

According to CEQA Guidelines, the appropriate baseline against which to measure significance is the "existing environmental setting." (§ 15064.4.) This means that hypothetical future conditions do not constitute a proper baseline under CEQA. (*Communities for a Better Env't v. South Coast Air Quality Mgmt. Dist.* (2010) 48 Cal.4th 310, 322 (*CBE*).) The business as usual (BAU) projection found in the CAP relies on hypothetical future conditions in which important state measures reducing greenhouse gas emissions do not exist. Although the BAU projection does not serve as the baseline for analysis of emissions resulting from the GPA, it can be used by future development projects to prove that their GHG emissions are not significant: "[t]he target to be met is a GHG emissions reduction of 25% below emissions for the adjusted BAU scenario." (DEIR 4.7-53.) Therefore, new developments can entirely avoid the CAP's stronger threshold of a 15% reduction from 2008 levels and the screening table approach when conducting their GHG significance analysis.

The BAU scenario does not serve as an appropriate baseline against which to compare future projects because it does not represent the existing environmental settings. For example, as recognized throughout the CAP, state laws like AB 1493 have been passed to reduce GHG emissions statewide. (See, e.g., CAP 4-3.) These laws represent existing environmental settings because Riverside County and its occupants are required to comply with them. The BAU, however, does not include GHG reductions from statewide programs in its projected 2020 emissions: "[r]eduction initiatives coming from the state or other agencies are not included in the BAU scenario." (CAP 3-6.) By failing to take these initiatives into account, the BAU represents a hypothetical, rather than existing, setting. Such hypothetical settings are not a proper baseline for analysis of environmental impacts. (See *Save Our Peninsula Comm. v. Bd. of Supervisors*, (2001) 87 Cal. App. 4th 99, 121 ["the impacts of the project must be measured against the 'real conditions on the ground.'"]) Rather than using recent historical or current emission levels as a baseline, as CEQA requires, the BAU approach relies on a legally impermissible baseline to determine significance levels. Because the BAU violates regulatory and statutory mandates and could never legally occur, it is not a proper baseline against which to measure the impacts of future development.

ii. The Mitigation Measures Improperly Rely on "Business as Usual" Calculations as a Baseline

In order to reduce the impacts of greenhouse gas emissions to less than significant levels, Riverside County has had to adopt two mitigation measures in the DEIR, both of which primarily address new development. Measure 4.7.A-N1 allows future developers to demonstrate achievement of a target level of GHG emissions set at 25% below Business-As-Usual levels. (DEIR 4.7-53.) CEQA requires, however, that a baseline represent existing environmental settings, and BAU levels are not a proper baseline against which to measure the significance of anticipated GHG emissions. (See Guidelines, § 15064.4.)

The DEIR should explicitly state that existing environmental conditions, not future hypothetical conditions will be the basis for calculating baseline conditions. This is because future hypothetical conditions create "unwarranted barriers to the public understanding of the EIR." (*Neighbors for Smart Rail v. Exposition Metro Line Const. Authority* (2013) 57 Cal. 4th 439, 455 (*Neighbors*).) Using an existing environmental baseline would ensure that the County's calculations are accurate, attainable and most accessible to courts and members of the public. (*Neighbors*, (2013) 57 Cal. 4th 439, 455 ["Existing conditions as a baseline makes the analysis more accessible to decision makers and especially to members of the public, who may be familiar with the existing environment, but not technically equipped to assess a projection into the distant future."])

Instead, the DEIR gives the County wide discretion to adopt "alternative methods" as long as they are "scientifically defensible." (DEIR 4.7-32.) Scientific defensibility is not foolproof because it can be used to manipulate the public into thinking that the County's baseline calculations are accurate. The *Neighbors* court further highlighted this concept of manipulability, "[i]in a hypothetical future world, the environment is what the statisticians say it is." (*Neighbors*, (2013) 57 Cal. 4th 439, 455.)

Because the BAU scenario in the CAP does not include statewide reduction strategies, it inflates projected GHG emissions. (See CAP 3-6.) Therefore, a 25% reduction from such an inflated and improper baseline would not achieve meaningful reductions.

Furthermore, public agencies have criticized the use of BAU as a baseline against which to assess the significance of GHG emissions. The California Air Pollution Control Officers Association (CAPCOA), for example, has stated that such an approach has "low" GHG emission reduction effectiveness and consistency with state targets. (CAPCOA 2008.) The California Resources Agency has also cautioned against this approach, warning that "a comparison of the project against a 'business as usual' scenario as defined by [California Air Resources Board (ARB)] in the Scoping Plan . . . would confuse 'business as usual' projections used in ARB's Scoping Plan with CEQA's separate requirement of analyzing project effects in comparison to the environmental baseline." (Resources Agency 2009.) Therefore, the BAU scenario is not a proper baseline against which to determine the significance of emissions from future development.

Even if the BAU scenario used by Riverside County were accurate, a 25% reduction from BAU levels is insufficient to meet the threshold of significance established by the DEIR. This flaw invalidates the finding that emissions by future developers that are 25% below BAU levels would be less than significant. As the DEIR states, GHG emissions have a less than significant impact if they fall below the threshold of significance, 15% below 2008 levels. (4.7-38.) This is equivalent to a **50.9% reduction** from 2020 BAU emissions. (CAP 5-2.) Thus, the anticipated reductions needed to fall below the significance threshold are twice the reductions called for by Measure 4.7.A-N1.

Developers attempting to comply with this measure, as opposed to alternative Measure 4.7.A.N2, will not be required to reduce emissions to the threshold of significance of 50% below BAU. Therefore, it is likely many developers will likely opt to reach the target of 25% below BAU, since this threshold requires fewer reductions. Because this approach does not meet the threshold of significance established in the DEIR – 15% below 2008 levels – emissions from future projects that use this approach will cause significant harmful impacts not accounted for in the GPA or DEIR. Therefore, Mitigation Measure 4.7.A-N1 fails to reduce the impacts of the Plan to less than significant levels. Rather to allowing developers to employ this ineffective measure as an alternative, the Screening Tables in Measure 4.7-A-N2 require more substantial reductions and should be mandatory for all new development projects in the County.

iii. The Mitigation Measures in the DEIR Violate CEQA Because They Are Voluntary, Vague, and Thus Unenforceable

Not only does the County defer mitigation until the future, but the mitigation measures proposed in the CAP are not enforceable. To comply with CEQA, mitigation measures must be "fully enforceable through permit conditions, agreements, or other legally-binding instruments." (Guidelines, § 15126.4 subd. (a)(2).) Furthermore, they must be "incorporated into the project or required as a condition of project approval in such a way that [would] ensure their implementation." (*Fed'n of Hillside and Canyon Assoc. v. City of Los Angeles*, (2000) 83 Cal. App. 4th 1252, 1262 (*Federation*)). These enforceability requirements ensure the effectiveness of mitigation measures as applied to both the General Plan and future projects. (See Guidelines, § 15183.5 subd. (b)(2).)

The mitigation measures of the DEIR rely primarily upon the implementation measures (IM's) described in the CAP. These are the measures that, apart from preexisting local policies and statewide regulations, are meant to reduce GHG emissions from both the GPA as a whole and from individual future projects. Many of the IM's are voluntary. These voluntary measures do not require actual reductions in GHG emissions: rather, they rely on a certain level of voluntary participation of developers and individual residents in order to achieve reductions. Nonetheless, the County attributes emission reduction estimates in the future from these voluntary, vague implementation measures.

Furthermore, no "legally-binding instrument" or "other measure" gives the County the power to enforce these voluntary IM's. (Guidelines, § 15126.4 subd. (a)(2); Pub. Resources Code §21081.6 subd. (b).) Instead, a developer might choose not to incorporate a single one in the final form of the development. The County provides little explanation on how it will get developers to commit to implementing the County's more stringent emission reduction measures. Such voluntary measures violate CEQA's requirement that mitigation measures actually be incorporated and implemented by a project. (See *Federation, supra*, 83 Cal. App. 4th at p. 1262.) Not only are many IM's voluntary, but they and others contain vague descriptions that limit the degree to which they can be enforced. Many of these measures do not specify how they should be implemented, how many reductions they must achieve or how failure to comply will be regulated. The County assures the public and decisionmakers it will "monitor implementation of the reduction measures" but provides no detail or specificity on how it will monitor or enforce the reduction measures. (DEIR 4.7-53.) Such explanation is necessary information for citizens seeking to understand and evaluate the County's CAP and is therefore required under CEQA. (See *Dry Creek*, 70 Cal. App. 4th at p. 26.) Therefore, the mitigation measures and the IM they rely upon are unenforceable and violate CEQA.

iv. The Climate Action Plan Fails to Adopt All Feasible Mitigation Measures

In addition to the mandate that mitigation measures be enforceable, CEQA requires the adoption of all feasible mitigation measures that would reduce the environmental impacts of a project. (Pub. Res. Code § 21002; Guidelines, § 15126.4 subd. (c); *City of Marina v. Bd. of Trs. of the Cal. State University* (2006) 39 Cal.4th 341, 369-70.) The mitigation measures proposed by Riverside County rely on enforcement of IM's contained in the CAP. These IM's fail to include many feasible mitigation measures, some of which are discussed below and included as attachments to this comment letter.

a. The Updated DEIR Hardly Addresses Specific Mitigation Measures for GHG Emissions in the Transportation and Construction Sectors.

The updated DEIR's mitigation measures for reducing GHG emissions in the transportation and construction sectors are neither well developed nor specific.(See Circulation Element 4.7-27, 4.7-28; Air Quality Element 4.7-30, 4.7-33, 4.7-34.) First, the DEIR does not discuss mitigation measures for transportation emissions in its Green House Gases Section even though vehicle use contributes to a significant portion of greenhouse gases in the atmosphere. (See generally DEIR 4.7.) Rather, the transportation related mitigation measure that the County articulates in its Transportation and Circulation Section does not directly address emissions: "Work with incorporated cities to mitigate the cumulative impacts of incorporated and unincorporated development on the countywide transportation system." (See Policy C 7.1 in DEIR 4.18-34.) This measure is underdeveloped because it does not address how the County plans on mitigating cumulative impacts of transportation emissions specifically.

The County could include more specific and well-developed transportation related measures in its Greenhouse Gases Section 4.7 (not just its Transportation and Circulation Section 4.18). In *Sierra Club*, the court found Tahoe Regional Planning Agency's "Mitigation Program" to be an "established program with well-developed guidelines" because it included specific measures designed to "attract and retain users." (F. Supp. 2d 1098, 1138 (E.D. Cal. 2013).) The Planning Agency's Program also included cost estimates and project objectives for transportation related measures. Even though the Agency in *Sierra Club* did not address measures related to GHG emissions, the case is instructive because court lauded the Mitigation Program's high level of specificity. Here, as in *Sierra Club*, the County might add a section in the Greenhouse Gases Section 4.7 of the DEIR specifically discussing how it plans on mitigating emissions from activities such as "accelerat[ed] construction of transportation infrastructure," and "design[ing], construct[ing] and maintain[ing]" Riverside County roadways. (See Policies C 2.2, C 2.6, C 3.1 in DEIR 4.18-32.) These measures would be beneficial in keeping decision makers and the public duly informed. Also, including these measures in the Greenhouse Gases Section would make the County's mitigation measures accessible and clear to members of the public who read only that Section.

b. The DEIR Fails to Address Emissions and Mitigation Measures of Agricultural and Irrigation Related Development.

The DEIR also fails to address specific mitigation measures for construction emissions. (Impacts of Construction Emissions discussed in DEIR 4.7-49.) As discussed in the Center's previous Comment, construction emissions from building development contribute to significant GHG emissions. The three mitigation measures the County proposes in the Greenhouse Gases Section do not address construction emissions directly. (See DEIR 4.7-52; 4.7-53.) CBD's previous Comment addressed the first two measures at length. (See DEIR 4.7-53.) The new Mitigation Measure 4.7.A-N3 reiterates information that is already present in the County's CAP. (DEIR 4.7-53; CAP Table 7-2 post-2020 plan.) Taken together, the updated DEIR's new mitigation measures generally do not identify mitigation methods for construction emissions or lay out standards for enforcing those methods. In sum, the DEIR's mitigation measures fail to reach the level of specificity that California courts required in *San Joaquin* and *City of Richmond* cases. The Center urges the County to include specific mitigation measures that live up to those described by other counties and agencies in their development projects. Enumerating specific mitigation measures would allow decision makers and the public to remain informed. And, if necessary, members of the public could hold the County accountable for any oversight in mitigating future project-specific impacts of construction related emissions.

There are several specific measures that the County could address. With respect to transportation emissions, the County might come up with measureable standards for reducing vehicle miles traveled (VMT) based on the total number of people who drive on Riverside's roadways. But, if the County proposes reducing transportation emissions by decreasing the total number of vehicle miles traveled (VMT), then it should address where and how it plans on achieving its goal. For example, one way the County could reduce VMT is by incentivizing drivers to take alternative modes of transportation like bicycling. In that respect, the County should also address alternative measures in case a particular measure (e.g., bicycling) is unsuccessful. As for construction emissions, the County could maximize the use of older buildings and limit construction of new ones. Accordingly, the County could adopt a measure that places a numerical cap on the number of buildings that are constructed each year. Enumerating detailed, specific and comprehensive measures in the Greenhouse Gases Section would allow the public to easily access and, in turn, assess the County's plan for reducing GHG emissions.

Agricultural and large irrigation related developments contribute to significant GHG emissions, and are also the highest consumers of water resources. (*See* DEIR 4.19-154; Table 4.19-T.) The overlap between agricultural development, water consumption and greenhouse gases is significant. For example, a large number of activities on agricultural lands including fertilizer application and methods of irrigation as well as tillage contribute to the production of emissions. Specifically, irrigation pumps require energy to operate, and so, most are powered by diesel fuel. As a consequence of the lack of precipitation in California, Riverside's agricultural industry will increasingly need to rely on irrigation systems for water supply. The implications of using more large scale irrigation systems, which rely on diesel fuel, are significant for GHG emissions. (*See* CARB 2006). Also, black carbon emissions from agricultural fires contribute to the greenhouse gases in the atmosphere. Management of agricultural soils, therefore, is crucial to reducing GHG emissions. In this respect, the DEIR fails to address mitigation measures related to the emissions from management of agricultural soils and irrigation related activities.

B. The CAP and DEIR Must Include Clear Enforcement, Monitoring of Emission Reduction Measure in order to be Effective

The Center is encouraged by the County's efforts to take into account long-term emission reduction goals that extend through the life of the GPA and set targets of increasing emission reductions from 2008 levels in 2020, 2035 and 255. However, the Center remains concerned about the commitment of the County to follow through on these goals because of the CAP and DEIR weak and vague implementation measures and the absence of concrete enforcement and monitoring measures. The County also appears to overestimate the likely emission reduction from these vague implementation measures. To ensure that the County actually reaches its targets, it should revise the DEIR and CAP to eliminate the Business-As-Usual baseline analysis option for new development, incorporate strict, enforceable mitigation measures for GHG emission reduction and fund long-term monitoring mechanisms to confirm the County is on track to meet its GHG reduction goals. Without such assurances and actions, the County's goals will likely remain only an aspiration.

II. The DEIR uses a flawed and inadequate baseline to evaluate Project impact on water supply.

It is well established that the purpose of an EIR is to provide public agency decision-makers and members of the public with an informational document that explains potentially significant environmental impacts and feasible mitigation measures. (Cal. Pub. Res. Code § 21002.1; Guidelines § 15121; *Carmel Valley View, Ltd. v. Board of Supervisors* (1976) 58 Cal.App.3d 817, 821-822.) In order to be useful, however, the EIR must accurately identify what significant impacts exist. "[T]he significance of a project's impacts can be ascertained only if the agency first establishes the physical conditions against which those impacts are to be measured." Michael H. Remy et al., *Guide to CEQA California Environmental Quality Act*, 198 (11th ed., Solano Press 2007). The idea is to compare "what will happen if the project is built with what will happen if the site is left alone." (*Woodward Park Homeowners Assn, Inc. v. City of Fresno* (2007) 58 Cal.Rptr.3d 102, 119.)

The rule for what constitutes an environmental baseline is set forth in Guidelines section 15125(a), which provides that:

> An EIR must include a description of the physical environmental conditions in the vicinity of the project, as they exist at the time the notice of preparation is published, or if no notice of preparation is published, at the time environmental analysis is commenced, from both a local and regional perspective. This environmental setting will normally constitute the baseline physical conditions by which a Lead Agency determines whether an impact is significant. (Guidelines § 15125(a).) Even when an EIR relies upon an adopted plan, the EIR must still analyze the existing physical conditions as they exist at the time the Notice of Preparation is published. (Guidelines § 15125(a).)

A. The baseline analysis fails to and must quantify current and likely long-term redaced water supply from extended drought periods due to climate change.

GPA 960 and the DEIR concludes that water supply for the county is unreliable, but does not adequately address or quantify the likely massive reductions of State Water Project water deliveries due to prolonged drought periods due to climate change, including the current drought. The DEIR's brief and qualified analysis of current hydrological conditions violates Section 15151 of CEQA, where, to the extent reasonably feasible, an EIR "should be prepared with a sufficient degree of analysis to provide decision makers with information which enables them to make a decision which intelligently takes account of environmental consequences." (CEQA Guidelines § 15151.)

Although the DEIR has been updated to discuss the ongoing drought and its potential impacts on water supply reliability for the county, it still uses outdated assumptions for projecting water supply availability for the county through 2035. Notably, the DEIR uses Metropolitan Water District ("MWD")'s water availability estimate assuming multiple dry-years similar to those of 1990-1992. (DEIR, at 4.9-157 & 158.) However, California is currently already in its fourth year or drought where hydrological conditions are the driest recorded (NOAA 2014; Scientific American 2014; U.S. Drought Monitor Center 2015.) By relying on outdated water supply estimates from MWD, the direct purveyor or broker of the vast majority of the county's potable and non-potable water, the DEIR severely underestimates the quantity of water that is and will be available for the county through 2035. Thus the DEIR presents a flawed environmental baseline that relies on an inaccurate physical condition, in violation of § 15125(a).

The DEIR should be revised to take into account the current as well as likely worse and extended drought conditions in order to accurately assess Project impacts on water supply. Studies have shown that Southwestern United States, which includes California, is very likely in or will very likely enter a megadrought over the length of 10 years due to climate change. (Ault et al. 2014; *see also* Rice 2014.) Additionally, there is an 80% chance that the Southwest will experience an unprecedented megadrought that would last more than three decades, between 2050 and 2099. (Cook 2015.) In the mean time, this region will experience additional droughts leading up to the megadrought. (Cook 2015.) A recent study regarding droughts in California concluded that anthropogenic climate change has resulted in and will continue to result in the co-occurrence of warm and dry periods in California, which in turn will exacerbate water shortages, groundwater overdraft, and species extinction. (Diffenbaugh 2015.)

Since the DEIR already discusses that climate change will increase the unpredictability of water supply reliability in the county, it should also discuss the likely future climate-induced extended drought conditions as part of its baseline analysis. (*Neighbors for Smart Rail v. Exposition Metro Line Construction Authority* (2013) 57 Cal.4th 439 ("nothing in CEQA law precludes an agency, as well, from considering both types of baseline--existing and future conditions--in its primary analysis of the project's significant adverse effects.").)

III. The DEIR provides an inadequate analysis and mitigation of Project impacts on water resources and water quality.

The analysis of water supply and availability is inadequate and requires further analysis and recirculation. The DEIR recognizes that GPA 960 will result in significant and unavoidable impacts to water resources because it would result in an insufficient water supply, substantially deplete groundwater supplies, and interfere substantially with groundwater recharge. (DEIR, at

4.19-298; 4.19-303) However, the EIR's analysis and mitigation of those impacts falls short of CEQA's requirements.

A. *The EIR fails to provide substantial evidence in discussing the impacts of potential water infrastructure projects, water management strategies, and additional imported water supply.*

The DEIR provides that a high level of uncertainty surrounds water supply availability beyond 2035 to meet demands of anticipated new development and land use changes in the county. (DEIR, at 5-13, 5-14.) The EIR discusses the potential for infrastructure projects, water management strategies (including conservation, outreach and education, groundwater recharge areas, and water supply monitoring), and additional imported water supply to satisfy water supply shortfalls the county will likely face. (DEIR, at 5-14.)

However, the DEIR fails to assess the reasonably foreseeable impacts of all of these options as required by CEQA. The DEIR merely states that "in the absence of a definitive identification of future water supply, potential impacts associated with water supply and demand must be considered significant and unavoidable." (DEIR, at 5-14.) The DEIR's failure to analyze these impacts, for instance the amount of water the , or how water conservation strategies will help offset the impacts of securing additional imported water supply, constitutes a violation of CEQA's requirement to analyze and discuss significant environmental impacts. (CEQA § 15126.2.) Without this information the county cannot meaningfully analyze and mitigate the reasonably foreseeable impacts of the project. (*Watsonville Pilots Association v. City of Watsonville* (2010) 183 Cal.App.4th 1059, 1090, 1094 (EIR must address the "reasonably foreseeable impacts of supplying water to the project" since "[t]he purpose of an EIR is to identify and discuss the impact of the proposed project on the existing environment."); *Napa Citizens for Honest Government v. Napa County Bd. Of Supervisors* (2001) 91 Cal. App. 4th 342, 371-373.)

B. *The DEIR proposes inadequate mitigation measures to alleviate Project impacts on surface water and groundwater resources and quality.*

The EIR's admission that the Project would result in significant water supply impacts required the County to adopt all "feasible alternatives or mitigation measures available which would substantially lessen" these impacts. (Pub. Res. Code § 21002; CEQA Guidelines § 15021(a); *Napa Citizens for Honest Gov't v. Napa County Bd. of Supervisors* (2001) 91 Cal.App.4th 342, 360.) Mitigation measures must be feasible and enforceable. (CEQA Guidelines § 15126.4(a)(1), (2).) As mitigation measures that are feasible and that will reduce the negative effects on water supplies and quantity, the County should adopt policies and regulations that do the following:

- Reduce residential densities in areas where water supplies are being overdrawn by current development, or where water supplies are compromised by natural or man-made contaminants.
- Enact policies to assure that additional projects do not deplete groundwater resources.
- Create ordinances that prohibit development that will result in a direct, indirect, or cumulative impact on water supply availability.

- Discourage and restrict uses with heavy water demands from locating in those same areas.
- Mandate water conservation.
- Adopt landscape regulations that prohibit plants with heavy water demands. Require the use of native, drought-tolerant vegetation.
- Adopt standards for and encourage installation of gray-water systems.
- Require use of pervious surfaces for driveways and parking lots, to reduce run-off and maintain some recharge capacity for the site.

C. *The DEIR improperly defers analysis of mitigation measures regarding Project impacts on water supply.*

Since the EIR fails to provide substantial evidence in discussing the impacts of potential water infrastructure projects, water management strategies, and additional imported water supply (as stated above), the DEIR also improperly defers formulation of mitigation measures, to a later time when development of specific projects is considered. This deferral of developing feasible and enforceable mitigation measures for additional water supply impacts frustrates informed decision-making and violates CEQA. (CEQA Guidelines § 15126.4(a)(1), (2).)

i. The DEIR improperly defers analysis of mitigation measures regarding Project impacts on water quality.

The DEIR concludes in Section 4.19 that Project impacts on water quality will be less than significant after adopting the various ongoing and proposed mitigation measures. However, the DEIR improperly defers identification and analysis of many of the project's impacts regarding water quality and waste discharge, as well as formulation of mitigation measures, to a later time when development of specific projects is considered.

For instance, the DEIR defers further impact and mitigation analysis for water quality effects of the Project by proposing mitigation measure 4.17.5C & D that "where development may contribute to a worsening of local or regional ground or surface water quality (as determined by the Riverside County Department of Environmental Health and/or RWQCB), a water quality analysis shall be prepared." (DEIR, at 4.19-307.) The water quality analysis will then be submitted to the county and the RWCQB for review and be approved prior to the issuance of any entitlement that would result in physical modification of the project site. (DEIR, at 4.19-308.) Only after this impact analysis will the project applicant then submit to the county and RWQCB evidence that the specific measures to limit or eliminate potential water quality impacts resulting from the entire development process, will be implemented as set forth in the water quality analysis, which shall be approved prior to physical modification of the site. (DEIR, at 4.19-308.) The DEIR provides the same formula that defers determining impacts and mitigation measures regarding waste discharge impacts. (DEIR, at 4.9-312 & 313.)

These mitigation measures processes are inadequate since they do not meet the CEQA requirement for the Project proponent to develop performance criteria upon which mitigation measures will be based. (CEQA Guidelines § 15126.4(a)(1)(B) (Formulation of mitigation measures should not be deferred until some future time. However, measures may specify performance standards which would mitigate the significant effect of the project and which may be accomplished in more than one specified way.); *City of Long Beach v. Los Angeles Unified Sch. Dist.* (2009) 176 Cal.App.4th 889, 915 ("Impermissible deferral of mitigation measures occur when the EIR puts off analysis or orders a report without either setting standards or demonstrating how the impact can be mitigated in the manner described in the EIR."); *Preserve Wild Santee v. City of Santee* (2012) 210 Cal.App.4th 260, 281 (a performance standards (in this case draft habitat conservation plan for managing a preserve) can be relied on if it contains specific details including assurance that standards will be satisfied at a particular time and manner); *Endangered Habitats League, Inc. v. County of Orange* (2005) 131 Cal.App.4th 777, 793-94 (mitigation measure is inadequate when it "does no more than require a report be prepared and followed, or allow approval by a county department without setting any standards"); *Communities for a Better Env't v. City of Richmond* (2010) 184 Cal.App.4th 70, 95 (rejecting mitigation measure that required project applicant to develop plan for reducing GHG emissions because it did not contain any objective criteria for measuring success).)

Additionally, the EIR does not provide that mitigation measures will be implemented prior to Project activities, and by deferring the approval of mitigation measures to just prior to Project activities the EIR implies that mitigation measures will not be implemented prior to the activities. (*POET, LLC v. State Air Resources Bd.* (2013) 218 Cal.App.4th 681, 740 (agency improperly delayed implementing mitigation measures while project went forward.))

The EIR violates Section 15126.4(a)(1)(B) by failing to fully analyze the water quality impacts of GPA 960 and providing specific Project-specific mitigation measures, or measurable performance criteria, to reduce those significant impacts.

IV. The Riverside County Area Plans Do Not Follow GPA 960

Policies proposed in the area plans are inconsistent with those of GPA 960. For instance, despite the GP Amendment 960 acknowledging that water supply is unreliable in the county especially in the Coachella Valley area, (GPA 960, at OS-4, 8), the area plans for the Eastern Coachella Valley area does not provide for specific water supply policy, and instead resorts to a general policy to conserve and protect watersheds and water supply through adherence to policies stated in the general plan (ECVAP, at 9.1; Draft General Plan Amendment 960-Eastern Coachella Valley Area Plan, 48.) The Western Coachella Valley Area Plan does not contain any discussion regarding water resources and ensure that the development of this area is based on reliable water supplies. And while GPA 960 and the DEIR discusses how the Coachella Valley Water District and other districts are adopting water-efficiency measures into their land use actions, these measures are not reflected in the Western and Eastern Coachella Valley Area Plans. The Palo Verde Valley Area Plan, which covers one of the most productive agricultural areas in the state, does not address the GPA 960 policy to encourage efficient water use in agriculture. (DEIR, at 4.7-30.)

A. The county will not likely achieve its greenhouse gas emissions reduction goals from purchased water under the current Climate Action Plan.

The CAP intends to reduce GHG emissions from purchased water by 37.8% (from 2008 levels) by 2020, from 152,470 to 109,021 MTCO2e. (CAP, at 5-7.) The CAP has adopted several measures that it projects will reduce GHG emissions from purchased water, including complying with the statewide renewable energy portfolio related to water conveyance ("R1-W1") and implementing a water use reduction initiative ("R2-W1"). However, these measures will not allow the county to achieve its GHG emissions reduction goals related to purchased water, for reasons we highlight below.

The CAP concludes that by adopting the Renewable Portfolio Standard of reducing GHG emissions by 33% by 2020, the county would reduce emissions from electricity used for water supply and conveyance in California by 33,315 MTCO2e by 2020. (CAP, at 5.1.) However, the CAP does not explain the difference between these GHG emissions reductions under R1-W1 and those that it projects will be achieved through R1-E1, GHG emissions reductions that would also be met through complying with the 33% RPS by 2020 goal. (CAP, at Appendix E.) Without distinguishing how GHG emissions reductions would be achieved from these two measures that seek to comply with the same standard, it appears that the CAP has double-counted reductions between water supply-related emissions and reductions in emissions via electricity generation, thus over-estimating GHG emissions reductions. Furthermore, it is questionable whether the 33% RPS by 2020 goal will be met in reality, since the CAP itself acknowledges that the feasibility of the goal is not certain due to current limitations in production and transmission of renewable energy. (CAP, at 4-8.)

The CAP adopts R2-W1, the Water Use Reduction Initiative, which would apparently reduce GHG emissions associated with electricity consumption for water treatment and reduction. (CAP, at 5-3.) The CAP projects that implementing R2-W1 will reduce total GHG emissions related to purchased water by 16.2% by 2020 (CAP, at 5-3.) However, these reductions are calculated relying on vague and voluntary not mandatory measures discussed in Appendix E. Specifically, the CAP "encourages the County to adopt a per capita water use reduction goal" in support of E.O. S-14-08 mandating the reduction of water use by 20 % per capita. The 20% reduction per capita is a goal, and therefore not mandatory. This reduction goal would then be promoted by a variety of programs including incentives for developers to comply with the new California Green Building Standards Code requirements (e.g. to reduce indoor potable water use by 20%), water efficiency pricing programs, training and education, and recycled water use programs--all of which are voluntary. Despite the voluntary and amorphous nature of these programs and goals, the CAP assumes these actions would result in an assumed emissions reductions of 20%. (CAP, at 4-17 and 4-18.) Even if the county implements all of these measures it will be unable to track their effectiveness since most of these measures are not quantifiable and therefore not measurable.

Additionally, the CAP provides that R2-W1 regarding water use reductions will only be implemented during Phase 1 (between 2010 and 2014), when it should be continuous through Phases 2 (2014-2017) & 3 (2017), especially since many of these programs have not even been established yet, let alone implemented. (CAP, at 7-6.)

B. The assumption that implementing the CAP will directly reduce water usage by 30% is ansubstantiated and not incorporated into the GPA 960.

The CAP also assumes these water reduction actions would reduce direct water usage by 30%, providing no rationale or calculation for this percentage in reduction. A reduction in direct water usage is not part of the GPA 960 or the DEIR.

C. The CAP and DEIR do not sufficiently discuss financing related to GHG emissions reductions related to purchased water.

The CAP and the DEIR do not discuss how it reductions in GHG emissions related to purchased water will be financed. The only specific water conservation and treatment financing source the CAP identifies assists reductions in water pollution, not water consumption or reducing GHG emissions from water supply and conveyance. (CAP, at 7-5.)

D. The CAP does not sufficiently discuss monitoring related to GHG emissions reductions related to purchased water.

The CAP does not sufficiently discuss monitoring related to GHG emissions reductions related to purchased water. The CAP simply provides that the county will "create a system for monitoring the implementation of this CAP and adjusting the plan as opportunities arise." (CAP, at 7-8.)

E. The EIR's Fails to take into account Water when Analyzing the County's Energy Needs

The RDEIR's energy analysis also does not appear to analyze the energy requirements to provide water to the growing region. Moving water around the state utilizes a large portion of the state's energy output, and this will only become a more difficult problem with climate change. The RDEIR's energy analysis should consider the energy needs related to providing more water to the region, and it is not clear that the document has done this already.

Conclusion

Thank you for the opportunity to submit comments on this Plan. In light of the significant greenhouse gas emissions and water impacts that will result from the Plan, we do not recommend that it be approved in its current form. We look forward to working with Riverside County to ensure that the Plan sufficiently addresses, mitigates, and avoids environmental impacts and conforms to applicable state law. Please do not hesitate to contact Aruna Prabhala (aprabhala@biologicaldiversity.org) at the Center with any questions.

Sincerely,

Aruna Prabhala
Staff Attorney
Center for Biological Diversity

351 California St, Suite 600
San Francisco, CA 94104
Ph: (415) 436-9682

Drew Feldman

Drew Feldman
Conservation Chair
San Bernardino Valley Audubon Society

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California's Drought May Be Worst in a Millennium

The record in trees suggests this drought is the worst to hit the Golden State in as much as 1,200 years

ClimateWire

December 5, 2014 | By Niina Heikkinen and ClimateWire

The findings also raise concerns about what California could experience in the future, as well as how the state should plan to conserve its limited groundwater resources.
Credit: Maryphillips1952 via Wikimedia Commons

When Daniel Griffin first heard media reports earlier in the fall that California's drought was the worst in the past few centuries, he didn't quite buy it.

Griffin, an assistant professor in the Department of Geography, Environment and Society at the University of Minnesota, had a decade of experience studying paleoclimate and environmental science using tree-ring data. From his research on blue oak trees, he knew that periods without a lot of precipitation weren't that uncommon in the state's history.

"I was kind of skeptical that this year would be different," he said.

Still, Griffin was curious to see if the blue oaks he was studying could provide clues about the state's three-year drought. The trees are particularly sensitive to changes in water availability, and their rings clearly showed changes in moisture levels over the trees' lifetime.

"When it's very dry, they grow very slow; when it's a wet year, they grow like gangbusters," he said.

The trees are long-lived. They can be up to 500 years old, and deadwood like stumps can stay in the ground for around 700 years, providing an extended record of water availability over centuries. They are also native to Southern and Central California, where the drought has been the most severe.

Griffin, along with Kevin Anchukaitis, an assistant scientist at Woods Hole Oceanographic Institution, began taking pencil-thin tree-ring samples from trees to see how they were responding to the drought compared to previous years.

The researchers compared their tree-ring data with National Oceanic and Atmospheric Administration precipitation measurements from between 1920 and 2014, and used that information to reconstruct precipitation history before rain gauge measurements began.

To compare the present drought to the magnitude of past events, the researchers used the Palmer Drought Severity Index, a proxy for soil moisture that includes temperature effects, from the North American Drought Atlas, which was developed by the Lamont-Doherty Earth Observatory at Columbia University and extends back 1,200 years.

Their analysis showed that a number of other droughts in California's history had less precipitation than the one the state is currently experiencing. However, the most recent drought stood out because of how exceptionally hot it was compared to other droughts over the past 1,200 years.

Even when they accounted for errors associated with combining the different data sets, they saw that "what's really different is the record high temperatures," Griffin said.

"That kind of knocked my socks off, I wasn't expecting that result," he said.

The "hot drought" was worse because the heat drew more moisture from the soil into the atmosphere, according to Griffin. For every 1 degree Celsius increase in air temperature, the atmosphere's capacity to retain moisture increases by 7 percent, as defined by the Clausius-Clapeyron equation.

A record that may not last for long

"Low precipitation is compounded by record high temperatures to create extreme drought," said Griffin.

Griffin and Anchukaitis published their findings in Geophysical Research Letters.

"This study really established how exceptional and severe this last drought was even in the last thousand years," said Benjamin Cook, a climate scientist at NASA's Goddard Institute for Space Studies who studies the drought on the West Coast. He was not involved in the study.

According to Cook, the modest declines in precipitation levels have not been enough to explain why the drought in California has been so bad. The study teased out how precipitation and temperature interacted to make dry conditions worse.

"The conclusion that I think is the most compelling is that warming from anthropogenic greenhouse gas emissions really made the drought more severe than it would have been," Cook said. "California is on track for the warmest year on their record."

The findings also raise concerns about what California could experience in the future, as well as how the state should plan to conserve its limited groundwater resources, said Park Williams, a professor at the Lamont-Doherty Earth Observatory.

"Regardless of how much of this year's heat was man-made or natural in origin, 2014 serves as an important reminder that heat can seriously exacerbate drought events," wrote Williams in an email. "If temperatures continue rising, we should expect record-breaking drought years to become increasingly common."

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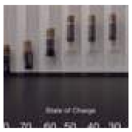
- 1.  Bounce A Battery To Learn If It Is Still Good—Really a day ago scientificamerican.com ScientificAmerican.com More Science
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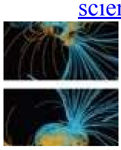 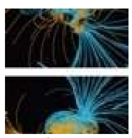

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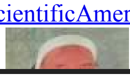

Comments

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Chryses December 5, 2014, 5:48 PM

If temperatures continue rising, we should expect record-breaking drought years to become increasingly common.

That's a safe bet.

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Concepts4America December 6, 2014, 12:01 AM

Maybe we need to look at desalination for CA drinking water use. Also the Pacific Coast Rainforests have an overabundance of water East of Seattle which might be captured and then piped south. But this would not be suggested for agricultural use.

Report as Abuse | Link to This

moss boss ↪ **Concepts4America** December 6, 2014, 7:44 PM

It has already started:

http://www.mercurynews.com/science/ci_25859513/nations-largest-ocean-desalination-plant-goes-up-near

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Chryses December 6, 2014, 7:58 PM

the Pacific Coast Rainforests have an overabundance of water East of Seattle which might be captured and then piped south

It would be wise to review your plans with the residents of Washington State before proposing to take the rainfall from their state for use in another.

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Concepts4America ↱ **Chryses** December 7, 2014, 10:36 AM

Right, hence the word "might." The salmon need looked at too. Oregon also has a big

freshwater river that dumps into the Pacific on it's Northern border so maybe that's the path of least resistance. No likely issues there, the water is leaving the state.

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jimmy boy December 7, 2014, 8:35 PM

when i was a kid in Idaho, CA tried to convince Idaho to ship some of the snake river to CA, then charge the local farmers more for the irrigation water. It failed to pass. So be careful on any pipeline, they will expect that water even if you have a drought and it is the land of suits keep that in mind too.

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addeddum ↱ **Concepts4America** December 8, 2014, 5:56 AM

'freshwater river that dumps into the Pacific on it's Northern border so maybe that's the path of least resistance. No likely issues there, the water is leaving the state.'

I doubt that either Washington or Oregon would take kindly to having their water resources plundered to quench California's thirst.

Ecology is a complex subject. Think before you leap. If the Californian salmon need tending to, let the Californians tend to them. Rumor has it that salmon also swim in the rivers of both Washington and Oregon.

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Concepts4America ↱ **addeddum** December 8, 2014, 7:47 AM

Okay, fine, no worries. Everyone is correct to look at water diversion issues and perhaps desalination is better for Cali anyway. Less politics. On the Eco-side I doubt that this would affect anything but it might therefore a study would be needed. Note that I would NOT support water diversion for irrigation, CA's central valley farmers have some water-wasting crops they might switch out for more sustainable species.

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addeddum December 9, 2014, 5:46 AM

'On the Eco-side I doubt that this would affect anything but it might therefore a study would be needed.'

The needed study might indicate the large water reallocation scheme you're suggesting is a bad idea. Here's a reference to an example of why it may be unwise to tinker with the water flowing through an extensive ecosystem. https://courseware.e-education.psu.edu/courses/earth105new/content/lesson06/04.html

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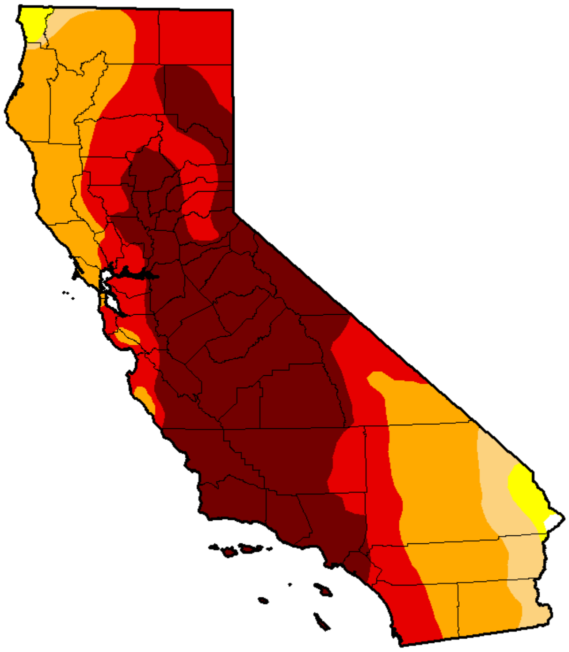
United States Drought Monitor

U.S. Drought Monitor

California



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March 31, 2015

(Released Thursday April 2, 2015)

Valid 8 a.m. EDT

Statistics type: Traditional (D0-D4, D1-D4, etc.) Categorical (D0, D1, etc.)

Drought Condition (Percent Area):

Week	Date	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	2015-03-31	0.15	99.85	98.11	93.44	66.60	41.41
Last Week	2015-03-24	0.15	99.85	98.11	93.44	66.60	41.41
3 Months Ago	2014-12-30	0.00	100.00	98.12	94.34	77.94	32.21
Start of Calendar Year	2014-12-30	0.00	100.00	98.12	94.34	77.94	32.21
Start of Water Year	2014-09-30	0.00	100.00	100.00	95.04	81.92	58.41
One Year Ago	2014-04-01	0.00	100.00	99.81	95.21	68.76	23.49

Population Affected by Drought: **37,007,923** View More Statistics

Intensity:

- D0 - Abnormally Dry
- D1 - Moderate Drought
- D2 - Severe Drought
- D3 - Extreme Drought
- D4 - Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying ***text summary*** *for forecast statements.*

Author(s):

Eric Luebehusen, U.S. Department of Agriculture

The National Drought Mitigation Center | 3310 Holdrege Street | P.O. Box 830988 | Lincoln, NE 68583–0988
phone: (402) 472–6707 | fax: (402) 472–2946 | **Contact Us**

Attachments to Comment Letter No. 33 (San Gorgonio Chapter of the Sierra Club via Shute, Mihaly & Weinberger)

The list of known or suspected potential harm to children is long and getting longer. It includes low birth weight, birth defects, autism, asthma and other lung disorders, learning problems and obesity.

This report was produced in part with a grant from the Lucile Packard Foundation for Children's Health Journalism Fund, awarded by The California Endowment Health Journalism Fellowships at the USC Annenberg School of Journalism.

future.child.graphic

SHUTE, MIHALY & WEINBERGER LLP

396 HAYES STREET, SAN FRANCISCO, CA 94102
T: (415) 552-7272 F: (415) 552-5816
www.smwlaw.com

March 30, 2015

Via Federal Express

Kristi Lovelady
County of Riverside
TLMA Planning Department
4080 Lemon Street, 12th Floor
Riverside, CA 92501
klovelad@rctlma.org

Re: Riverside County General Plan Update -- Recirculated Draft Environmental Impact Report (Public Review Draft: February 2015)

Dear Ms. Lovelady:

We have been retained by the San Gorgonio Chapter of the Sierra Club to review and comment on the recirculated draft environmental impact report ("RDEIR") for the Riverside County General Plan Update ("Project" or "Plan").[1] Our review of the RDEIR reveals serious violations of the California Environmental Quality Act ("CEQA") (Public Resources Code section 21000 *et seq.*) and CEQA Guidelines (California Code of Regulations, title 14 section 15000 *et seq.*).

The RDEIR's failure to provide an adequate description of the Project – one that accounts for the land uses and types of development actually permitted by the proposed Plan – fatally undermines its analysis of environmental impacts as well as its discussion of potential mitigation measures. The RDEIR also fundamentally fails to identify or analyze mitigation for environmental impacts. The countless vague, voluntary, and unenforceable policies cited as mitigation measures in the RDEIR fail to comply with CEQA, which requires enforceable, concrete commitments to mitigation. As a result, the RDEIR fails to describe measures that could avoid or substantially lessen the proposed Plan's numerous significant impacts.

[1] In addition to our comments on the RDEIR, some comments relate to the General Plan Update itself.

The pervasive flaws in the RDEIR, identified below and in the attached List of Area Plan Issues (*see* Exhibit A) demand that the EIR be substantially modified and recirculated for review and comment by the public and public agencies.

I. Introduction

The County's General Plan update process is a critically important planning exercise because so much is at stake. The climate change crisis alone mandates a dramatic refocus on the County's business-as-usual approach. While the Plan and the RDEIR discuss climate change, the Plan appears to have been drafted without any real commitment to tackling this ecological and social crisis. For example, the proposed Plan provides the County with the opportunity to direct growth to the cities and selected unincorporated communities that have infrastructure and services to accommodate future development. Directing growth to urban areas has numerous benefits in that it reduces energy consumption, reduces road and infrastructure costs, reduces vehicle miles traveled, air pollution and greenhouse gas ("GHG") emissions, preserves the County's farmland, open space, and plant and wildlife habitat, and protects water quality and quantity.

Unfortunately, the proposed Plan fails to provide any such direction, instead offering a blueprint for continued sprawl and haphazard development patterns. In many instances, the proposed Plan weakens the protections afforded by the existing General Plan. Indeed, as evidenced by the numerous admitted significant unavoidable impacts, the Plan will create long term environmental damage, affecting residents and future generations throughout the region.

II. The Proposed Plan Takes the County's Land Use in the Wrong Direction.

The County touts its proposed Plan as a model that concentrates future growth and reduces sprawl, while respecting the County's diverse environmental resources and its rural, agricultural, and open space areas. Proposed Plan at LU-17. The Plan asserts that new growth patterns will no longer reflect a pattern of random sprawl. Proposed Plan at LU-20. Yet, our review of the proposed Plan finds that it veers wildly from these sustainable visions.

Rather than clearly guide development toward the existing incorporated cities within the County, the proposed Plan seeks to facilitate development in unincorporated County areas. *See, e.g.*, RDEIR at 4.13-75: "The Proposed project's update to the General Plan includes [land use changes] that would allow for the conversion of rural, semi-rural, agricultural and vacant lands into suburban or urban uses in areas throughout the county." While the proposed Plan notes that decentralized development patterns cause impacts on environmental resources and increase the costs of providing community infrastructure and services, the County nonetheless makes no concerted attempt to direct the growth to existing cities. This approach to land use development is the polar opposite of established smart growth principles and is certainly not sustainable.

One particularly egregious example of the proposed Plan's promotion of decentralized growth is the "Incidental Rural Commercial Policies." With the adoption of the Incidental Rural Commercial Policies, the County will be affirmatively promoting the development of intensive commercial uses in rural locations. This new policy directly conflicts with the existing General Plan, which acknowledges the significant challenges that rural communities face in maintaining their rural character. To this end, the existing General Plan includes policies calling for the preservation of rural communities such as: (1) "the extensive heritage of rural living continues to be accommodated in areas committed to that lifestyle and its sustainability is reinforced by the strong open space and urban development commitments provide for elsewhere in the RCIP," and (2) "concentrate growth near or within existing urban and suburban areas to maintain the rural and open space character of Riverside County to the greatest extent possible." General Plan at V-13 and LU-18, 19. By implementing a new policy that actually *encourages* commercial development in these rural locations, the new Plan would make a mockery of the existing General Plan policies calling for the preservation of the unique character of the County's rural areas.

A second policy component proposed by the Plan, the "Rural Village Overlays," would also encourage decentralized development, posing a further threat to the County's rural areas. This Plan component is particularly disturbing since, as the RDEIR explains, the County actively *sought out* rural areas for their potential to urbanize. RDEIR at 3.0-12. As a case in point, the proposed Plan contemplates massive changes in the Lake Mathews community. It would be an understatement to say that Lake Mathews is a special place. As the Lake Mathews/Woodcrest Area Plan states,

> Winding up the grade out of Temescal Canyon on Cajalco Road or coming out of Riverside on Mockingbird Canyon Road are great ways to first experience the Lake Mathews/Woodcrest area. All of a sudden, a whole new world opens up -- one that has been left behind in most of Southern California. Citrus groves and lazy local roads give the landscape that casual and comfortable feeling of people being close to the land.

> Located in the expansive City of Riverside sphere of influence, this is and seeks to remain a rural enclave, sort of floating above the surrounding patterns of urbanization. Lake Mathews/Woodcrest Area Plan at 4.

It comes as a shock that this idyllic, rural community is one of the locations the County proposes for intensive land use development. The Plan would more than double the acreage of medium density residential land uses (from 1,092 ac to 2,657 ac) and substantially increase commercial retail (from 56 ac to 149 ac). Perhaps most alarming, the Plan would increase light industrial uses from a mere 5 acres to 140 acres. *See* existing and proposed Table 2, Lake Mathews/Woodcrest Area Plan at 18-21. With these proposed changes, the County will destroy the identity and character of this rural community, transforming Lake Mathews into an industrial corridor between March Air Force Base and Corona and making La Sierra and Cajalco the future "downtown" of Lake Mathews.

The influx of decentralized development proposed by the new Plan demonstrates a disturbing failure to promote sustainable land uses and a lack of commitment toward the protection of environmental resources. Given that the Riverside area is currently considered the Country's fourth worst metropolitan area for sprawling land use development, the County is remiss in not using this general plan update as an opportunity to send the region in a more sustainable direction. *See* Measuring Sprawl 2014, Smart Growth America, April 2014, at 6, attached as Exhibit T.

III. The RDEIR Fails to Comply With CEQA.

A. General Comments.

The following are our general comments on the legal inadequacies of the RDEIR. More specific comments on individual sections of the document follow.

1. The RDEIR Improperly Attempts to Avoid Analysis and Mitigation of the General Plan's Impacts by Concluding that They Are Significant and Unavoidable.

Where all available and feasible mitigation measures have been identified but are inadequate to reduce an environmental impact to a less-than-significant level, an EIR may conclude that the impact is significant and unavoidable. *See* Cal. Code Regs., tit. 14 ("CEQA Guidelines"), § 15126.2. If supported by substantial evidence, the lead agency may make findings of overriding considerations and approve the project in spite of its significant and unavoidable impacts. *Id.* at §§ 15091, 15093. However, the lead agency cannot simply conclude that an impact is significant and unavoidable and move on. A conclusion of residual significance does not excuse the agency from (1) performing a thorough evaluation of the impact and its severity before and after mitigation, and (2) proposing *all* feasible mitigation to "substantially lessen the significant environmental effect." CEQA Guidelines § 15091(a)(1); *see also id.* § 15126.2(b) (requiring an EIR to discuss "any significant impacts, *including those which can be mitigated but not reduced to a level of insignificance*" (emphasis added). "A mitigation measure may reduce or minimize a significant impact without avoiding the impact entirely." 1 Kostka & Zischke, *Practice Under the California Environmental Quality Act* § 14.6 (2d ed. 2008).

The RDEIR finds numerous areas of significant and unavoidable impacts, including agricultural resources, air quality, greenhouse gases, noise, transportation and water resources. RDEIR at 1.0-27 – 1.0-58. As detailed below, in numerous instances, the RDEIR fails to thoroughly assess impacts deemed to be significant and unavoidable or to identify all feasible mitigation measures to reduce the severity of the impacts.

2. Changes to the Land Use Designations and Densities and Intensities Proposed in the General Plan Are Feasible Mitigation Ignored in the RDEIR.

For many of the General Plan's significant and unavoidable impacts, the RDEIR concludes that no feasible mitigation is available. Nevertheless, nowhere in the RDEIR does the document consider changes to land use designations or densities and intensities as potential mitigation. CEQA requires the EIR to consider such mitigation.

The County cannot approve projects with significant environmental impacts if any feasible mitigation measure or alternative is available that will substantially lessen the severity of any impact. Pub. Res. Code § 21002; CEQA Guidelines § 15126(a). The County is legally required to mitigate or avoid the significant impacts of the projects it approves whenever it is feasible to do so. Pub. Res. Code § 21002.1(b). "In the case of the adoption of a plan, policy, regulation, or other public project [such as the General Plan], mitigation measures can be incorporated into the plan, policy, regulation, or project design." CEQA Guidelines § 15126.4(a)(2). Mitigation is defined by CEQA to include "[m]inimizing impacts by limiting the degree or magnitude of the action and its implementation." CEQA Guidelines § 15370(b). Nothing in the statute, CEQA Guidelines, or case law limits the County to proposing new "policies" as mitigation, as opposed to proposing changes in where development is planned, what kind is planned, and how dense or intense that development is planned to be, i.e., changes to the land use diagram and land use designations.

There is no indication that the RDEIR considered modifications to land use designations or densities and intensities to mitigate the impacts of the General Plan. Yet those changes are the easiest, most effective, and most obvious ways to lessen or avoid many of the General Plan's impacts. For example, the Plan will result in the conversion of a substantial amount of land in agricultural production. Because much of the Plan's proposed development is removed from incorporated cities and other urban areas, it will result in increased travel, which, in turn, will result in increased criteria air pollutants. Exploring alternative land use scenarios would go a long way toward reducing numerous Plan impacts, such as transportation, air quality, noise, biological resources, agriculture, and wildfire hazards.

3. Merely Hortatory General Plan Polices Are Inadequate as Mitigation for CEQA Purposes.

Mitigation measures proposed in an EIR must be "fully enforceable" through permit conditions, agreements, or other legally binding instruments. Pub. Res. Code § 21081.6(b); CEQA Guidelines § 15126.4(a)(2). Many of the General Plan's policies and programs relied on to mitigate impacts are vague, optional, directory, or otherwise unenforceable. A few examples—out of numerous instances—include the following:

- Policy LU 3.1b: "*assist in and promote the development of infill and underutilized parcels…* " General Plan at LU-20. (This policy is optional and unenforceable; the word "require" should replace "assist in and promote").

- Policy LU 3.1e: "*re-plan existing urban cores and specific plans for higher density, compact development as appropriate…*" *Id.* at LU-20 (This policy is vague, unenforceable and voluntary as it provides no guidance as to how existing urban cores would be re-planned to increase density and compact development, and does not require the agency to take action).

- Policy LU 8.12: "*Improve the relationship and ratio between jobs and housing so that residents have an opportunity to live and work within the county.*" *Id.* at LU-32. (This policy is vague and unenforceable and provides no clarifying information as to how the County intends to promote jobs/ housing balance).

- LU *9.4: "Allow development clustering and/or density transfers in order to preserve open space, natural resources, cultural resources, and* *biologically-sensitive resources*." *Id*. at LU-32. (This policy is optional and unenforceable; the word "require" should replace "allow").

- LU *11.3: "Accommodate the development of community centers and concentrations of development to reduce reliance on the automobile and help improve air quality." Id*. at LU-34. (This policy is optional and unenforceable; the word "require" should replace "accommodate").

- Policy C1.7: "*Encourage and support the development of projects that facilitate and enhance the use of alternative modes of transportation… Id.* at C-6. (This policy is optional and unenforceable; the word "require" should replace "encourage and support").

- Policy OS 2.3: "*Seek opportunities to coordinate water-efficiency policies and programs with water service providers*." *Id*. at OS-10. (This policy is vague and optional and should have been written to identify the specific mechanisms the County would use to ensure water efficiency programs).

- Policy OS 4.9: "*Discourage development within watercourses and areas within 100 feet of the outside boundary of the riparian vegetation…*" *Id*. at OS-13. (This policy optional and unenforceable; the word "require" should replace "discourage").

A general plan's goals and policies are frequently somewhat vague and aspirational. However, the County may rely on such policies to mitigate environmental impacts under CEQA only if they are proposed to be implemented through specific implementation programs that represent a firm, enforceable commitment. *See Napa Citizens for Honest Gov. v. Napa County Bd. of Supervisors* (2001) 91 Cal.App.4th 342, 358 (citing *Rio Vista Farm Bureau Center v. County of Solano* (1992) 5 Cal.App.4th 351, 377). CEQA requires that mitigation measures actually be implemented—not merely adopted and then disregarded. *Anderson First Coalition v. City of Anderson* (2005) 130 Cal.App.4th 1173, 1186-87; *Federation of Hillside & Canyon Assns. v. City of Los Angeles* (2000) 83 Cal.App.4th 1252, 1261.

Here, the proposed Plan's vague and noncommittal policies and programs (and policies for which no implementation programs are identified) allow the County to decide to take no action and thus fail to mitigate impacts. Because the RDEIR cannot ensure that the referenced policies will in fact be implemented to mitigate the proposed Plan's impacts, they cannot serve as CEQA mitigation. *See Anderson First*, 130 Cal.App.4th at 1186-87.

B. The RDEIR's Description of the Project Violates CEQA.

In order for an EIR to adequately evaluate the environmental ramifications of a project, it must first provide a comprehensive description of the project itself. "An accurate, stable and finite project description is the sine qua non of an informative and legally sufficient EIR." *San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal.App.4th 713, 730 (quoting *County of Inyo v. City of Los Angeles* (1977) 71 Cal.App.3d 185, 193). As a result, courts have found that even if an EIR is adequate in all other respects, the use of a "truncated project concept" violates CEQA and mandates the conclusion that the lead agency did not proceed in the manner required by law. *San Joaquin Raptor*, 27 Cal.App.4th at 729-30.

Furthermore, "[a]n accurate project description is necessary for an intelligent evaluation of the potential environmental effects of a proposed activity." *Id.* at 730 (citation omitted). Thus, an inaccurate or incomplete project description renders the analysis of significant environmental impacts inherently unreliable. Here, the RDEIR for the proposed Plan does not come close to meeting these clearly established legal standards.

1. The RDEIR's Use of a Midrange Projection to Represent Build-Out of the Project Is Misleading and Unlawful.

The RDEIR purports to analyze the impacts of the proposed Plan assuming a "midrange" projection for population, dwelling units and floor-area ratios (which affect employment calculations), suggesting that it would be most representative of a reasonably foreseeable future build-out. RDEIR at 4.1-2. This midrange scenario assumes that development will somehow occur at significantly less intensity than actually allowed under the proposed Plan. Such an approach is unlawful and is misleading because it underestimates the environmental impacts that would occur with implementation of the proposed Plan.

(a) CEQA Requires that the EIR Analyze the Potential Impacts of the Development as Permitted Under the General Plan.

Courts have consistently held that an EIR must examine a project's *potential* to impact the environment, even if the development may not ultimately materialize. *Bozung v. Local Agency Formation Com.* (1975) 13 Cal.3d 263, 279, 282. Because general plans serve as the crucial "first step" toward approving future development projects, a general plan EIR must evaluate the amount of development actually allowed by the plan. *City of*

Carmel-By-the-Sea v. Bd. of Supervisors of Monterey County (1986) 183 Cal.App.3d 229, 244; *City of Redlands v. County of San Bernardino* (2002) 96 Cal.App.4th 398, 409. Thus, an agency may not avoid analysis of such development merely because historic or projected land use trends indicate that the development might not occur.

In *San Joaquin Raptor Rescue Center v. County of Merced* (2007) 149 Cal.App.4th 645, ("*County of Merced*") the Court of Appeal confirmed an agency's obligation to analyze the impacts from the whole of the project, and "not some smaller portion of it." *Id*. at 654. The project at issue was a new Conditional Use Permit ("CUP") for an existing aggregate mine and processing operation. The new CUP authorized a maximum production level of 550,000 tons per year, which was an increase over existing levels. However, historic mine production rates indicated that actual production could be less than the theoretical maximum. Based on historic rates and projected future rates, the EIR "estimated average production of about 260,000 tons per year." *Id.* at 655. The court held that the EIR's identification of the estimated average in the project description, rather than the maximum level of production authorized by the CUP, violated CEQA. The court stated: "By giving such conflicting signals to decisionmakers and the public about the nature and scope of the activity being proposed, the Project description was fundamentally inadequate and misleading." *Id.* at 655-56.

The Court of Appeal in *Stanislaus Natural Heritage Project v. County of Stanislaus* (1996) 48 Cal.App.4th 182, reached a similar conclusion in a slightly different context. The county argued that an EIR can avoid providing a full analysis of water supply for future phases of a proposed development project because the EIR included a mitigation measure that would prevent development of those future phases until a water supply had been identified. Rejecting this argument, the court held that a lead agency must assume that a project will be developed *as planned* and must evaluate the impacts of the *planned* project, not a potential, more limited project. *Id.* at 205-06.

Here, the RDEIR attempts to justify its failure to describe and analyze the entirety of the proposed Plan by stating that midrange projections would be most representative of a reasonably foreseeable future build-out. *Id*. The County has taken the "reasonably foreseeable" language from the definition of project under the CEQA Guidelines, but has misinterpreted its meaning. Under CEQA, a project means "*the whole of an action*, which has a potential for resulting in either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment . . . ." CEQA Guidelines § 15378(a). "Reasonably foreseeable" describes the likelihood of indirect impacts; it does not suggest that an EIR need only evaluate the "reasonably foreseeable" aspects of a project. Here, the whole of the action is the level of development permitted under the General Plan.

(b) By Improperly Describing the Project as Midrange Projections, the RDEIR Underestimates the Extent of the General Plan's Impacts.

As explained above, the Project that must be described and analyzed in the RDEIR is the Plan's full build-out, not a midrange scenario. This distinction is not merely academic. Importantly, the Plan's full build-out allows for substantially more development than is assumed under the midrange projection. To use the RDEIR's explanation for its calculation of dwelling units as an example, the County multiplied the number of gross acres by the land use designations' respective dwelling-unit-per-acre (du/ac) factor. "For example, 400 acres of Medium Density Residential, with a density range of 2.0 to 5.0 du/acre, has a midpoint of 3.5 du/acre. Thus, for planning projection purposes, a total of 1,400 dwelling units would be associated with these 400 acres (400 ac x 3.5 du/ac = 1,400 du)." *Id.* at 4.1-4. Had the County assumed full build-out rather than a midrange scenario, the dwelling unit count would have been 2,000, not 1,400 (400 ac x 5.0 du/ac = 2,000 du). The County also assumed a midpoint scenario for its calculation of commercial and industrial land uses. *Id.* at 4.1-6.

The magnitude of this error is enormous. The proposed Plan designates roughly 56,000 acres throughout the County's unincorporated lands as Medium Density Residential. RDEIR at 4.2-39. Using the County's midpoint scenario, this equates to 196,000 dwelling units in the County (56,000 ac x 3.5 du/ac = 196,000). Had the County assumed full build-out, as CEQA requires, the dwelling unit count would have been 280,000 (56,000 ac x 5.0 du/ac = 203,000), an additional 84,000 dwelling units.

Underestimating the amount of potential development results in a serious underestimation of the Plan's impacts in virtually every category. The development of an additional 84,000 dwelling units would result in a substantially greater loss of biological, cultural, and other resources.[2] It would greatly increase traffic, air pollution, GHG emissions and noise, and would result in a far greater consumption of water and energy resources. The list goes on and on.

[2] Effectively conceding the requirement to describe and analyze the entirety of the Project, the RDEIR does in fact analyze full build out for the Project's impact on agricultural resources.

Accordingly, the RDEIR is fundamentally misleading to the public and decisionmakers, in violation of CEQA. "[O]nly through an accurate view of the project may the public and interested parties and public agencies balance the proposed project's benefits against its environmental cost, consider appropriate mitigation measures, assess the advantages of terminating the proposal and properly weigh other alternatives." *City of Santee v. County of San Diego* (1989) 214 Cal.App.3d 1438, 1454. Because the RDEIR fails to describe the Project properly, it fails to serve its purpose as an informational document. *See County of Merced*, 149 Cal.App.3d at 674. If the County desires to limit its analysis to a predicted amount of growth, it must also limit the allowable development to that lower level by placing restrictions on growth in the proposed Plan itself.

2. The RDEIR's Project Description Does Not Show the Big Picture.

As discussed above, the proposed Plan will promote decentralized development throughout the County's unincorporated lands. Yet, neither the RDEIR nor the proposed Plan presents the "big picture" of how the County will change upon the Plan's implementation. Instead, the public must cobble together 19 Area Plans and their myriad tables of data to discern how this Plan would change their communities. Remarkably, the RDEIR does not even bother to identify the Plan's distribution of future land uses throughout the County. While the RDEIR includes a table identifying the distribution of *existing* land uses within unincorporated County lands and incorporated cities (Table 4.2-C at 4.2-4), it does not include a corresponding table showing how these land uses would change upon implementation of the proposed Plan.[3] Nor does the RDEIR include information identifying housing units that have been approved, but not built.[4] Absent this information, there is no way for the public or decisionmakers to fully grasp how the Plan will change land use patterns on unincorporated County land. Moreover, this information is required in order to determine whether the RDEIR accurately evaluates the environmental impacts that would accompany the Plan.

[3] We requested this information on two separate occasions -- in a May 16, 2014 e-mail from Laurel Impett to Kristi Lovelady, and in May 28, 2014 e-mail from Laurel Impett to Phayvanh Nanthavongdouangsy. The County refused to provide this information and informed us that we should submit this request with our comments on the EIR. This, then, constitutes our third request for this information. Please provide this information in the revised DEIR or the FEIR.

[4] The revised EIR must identify this information for the unincorporated areas and for the cities, to the extent this latter data is available.

C. The RDEIR's Analyses of and Mitigation for the General Plan's Environmental Impacts Are Legally Inadequate.

The RDEIR's analysis of environmental impacts is strikingly deficient. In violation of CEQA, the RDEIR provides no indication as to how environmental impacts were determined and fails to describe their nature and extent. Its analyses read more like a set of general discussions of these types of impacts in a generic county anywhere in California, rather than analyses of how *this* General Plan will affect *this* County.

The "programmatic" nature of this RDEIR is no excuse for its lack of detailed analysis. Indeed, the RDEIR grossly misconstrues the requirements of a "program" EIR by repeatedly asserting that because the exact nature and location of the Plan's build-out are unknown, it is impossible to analyze the Plan's impacts. (*See e.g*., RDEIR at 1.0-31, 40; 4.6-45; and 4.6-53). This approach is flawed, at the outset, because CEQA requires that a program EIR provide in-depth analysis of a project, looking at effects "as specifically and comprehensively as possible." CEQA Guidelines § 15168(a), (c)(5). Indeed, because it looks at the big picture, a program EIR must provide "more exhaustive consideration" of effects and alternatives than can be accommodated by an EIR for an individual action, and must consider "cumulative impacts that might be slighted by a case-by-case analysis." CEQA Guidelines § 15168(b)(1)-(2).

Further, it is only at this early stage that the County can design wide-ranging measures to mitigate County-wide environmental impacts. *See* CEQA Guidelines § 15168(b)(4) (programmatic EIR "[a]llows the lead agency to consider broad policy alternatives and program wide mitigation measures at an early time when the agency has greater flexibility. . . ."). A "program" or "first tier" EIR is expressly not a device to be used for deferring the analysis of significant environmental impacts. *Stanislaus Natural Heritage Project,* 48 Cal.App.4th at 199. It is instead an opportunity to analyze impacts common to a series of smaller projects, in order to avoid repetitious analyses.

Thus, it is particularly important that the RDEIR for the proposed Plan analyze the impacts of the complete level of development it is authorizing *now*, rather than deferring that analysis to a later point when individual specific projects are proposed. A general plan, as the "constitution for all future development," dictates the location and type of future development in the County. An EIR for a general plan must take into account all of "the future development permitted by the [general plan]." *City of Redlands,* 96 Cal.App.4th at 409 (citation omitted); *see also City of Carmel-by-the-Sea,* 183 Cal.App.3d at 245. There is no excuse for the County's failure to provide the required analysis.

1. The RDEIR's Analysis of and Mitigation for the General Plan's Climate Change Impacts Is Inadequate.

The DEIR analyzed the significance of the Plan's GHG emissions by comparing the Plan's total 2020 emissions with a GHG emission reduction goal for that year set forth in AB 32. DEIR at 4.7-44 – 46. It also compared the Plan's passenger vehicle emissions in the year 2035 with a GHG emission reduction goal for those vehicles set forth in SB 375. *Id.* The DEIR also quantified the Plan's GHG emissions for the year 2060, the date of the Plan's full implementation/build-out. DEIR at 4.7-45, 4.7-39. Critically, however, the DEIR failed to compare the Plan's 2060 emissions against any relevant, long-term GHG reduction goal, claiming that "to date, targets have not been established to reduce emissions at the year 2060." DEIR at 4.7-39.

In its prior letter, Sierra Club pointed out the problems with the DEIR's approach. For example, the DEIR's failure to analyze the Plan's consistency with the long-term GHG reduction target established by Governor Schwarzenegger's Executive Order S-3-05 was legal error.

Sierra Club appreciates that the County modified the EIR in response to the Club's prior comments so that the document now includes some analysis of the Plan's long-term climate impacts. In particular, the RDEIR now appropriately acknowledges that the state and region must continue to reduce GHG emissions beyond 2020 and 2035, and must reduce such emissions to at least 80% below 1990 levels by 2050. RDEIR at 4.7-46 – 48. Nevertheless, the RDEIR's analysis of climate impacts remains legally inadequate, as explained below.

(a) The RDEIR's Calculation of GHG Emissions in 2060 Appears Incorrect.

While the RDEIR attempts to analyze the Plan's GHG emissions vis-à-vis the 2050 reduction goal, Table 4.7-I, on page 4.7-47, seems to contain an error. The second and third columns (for BAU 2060 and Reduced 2060), contain the same emission numbers. Presumably the RDEIR is supposed to show that the Reduced 2060 emissions would be lower. With this apparent error, it is not possible for the public to understand the extent to which the Plan will help achieve the state's 2050 reduction goal.

(b) The RDEIR's Use of a "Business As Usual" Approach to Determine Significance of GHG Impacts Is Inappropriate.

The RDEIR's climate analysis is also faulty in that it uses an approach to measuring climate change impacts that has been soundly rejected as inappropriate by the California Supreme Court, Attorney General and others. Specifically, the RDEIR does not measure the significance of the Plan's GHG emissions by comparing them to existing conditions, as CEQA generally requires. *Neighbors for Smart Rail v. Exposition Metro Line Construction Authority* (2013) 57 Cal.4th 439. Rather, it compares the Plan's emissions to the emissions that would be emitted under a hypothetical future, "business as usual" ("BAU") scenario in which the Plan would not include any mitigation measures or design features that reduced GHG emissions.

This method of analysis is contrary to CEQA's requirements. In evaluating project impacts, courts have repeatedly held that agencies, as a general rule, should analyze a project's impacts by comparing them to actual existing conditions; they may not assume not hypothetical conditions that may artificially minimize the project's apparent impacts and thus allow the agency to avoid analysis and mitigation. *See, e.g.*, *Woodward Park Homeowners Assn., Inc. v. City of Fresno* (2007) 150 Cal.App.4th 683, 691 ("hypothetical office park was a legally incorrect baseline [against which to measure significance] which resulted in a misleading report of the project's impacts."); *Env't Planning & Information Council,* 131 Cal.App.3d 352 (EIR for area plan invalid because impacts were compared to existing general plan rather than to existing environment).

The California Supreme Court recently reaffirmed this principle in *Neighbors for Smart Rail,* 57 Cal.4th at 457, which held that, "while an agency preparing an EIR does have discretion to omit an analysis of the project's significant impacts on existing environmental conditions and substitute a baseline consisting of environmental conditions projected to exist in the future, the agency must justify its decision by showing an existing conditions analysis would be misleading or without informational value." Here, the County has not even attempted to show how it would be misleading or without informational value to compare the Plan's GHG emissions against existing emissions in order to determine the significance of those emissions. Nor would such a comparison be misleading. To stabilize our climate, we must drastically reduce GHG emissions from current levels; thus, comparing future Plan emissions to existing emissions provides the most informative and accurate assessment of whether the Plan helps the state achieve the GHG emission reductions necessary to stabilize our climate. Accordingly, the RDEIR's failure to analyze the significance of the Plan's GHG emissions by comparing them to actual, existing conditions, and its use of a hypothetical, future baseline instead, violates CEQA. *Id*. ("We hold [] that agencies normally must do what Guidelines section

15125(a) expressly requires—compare the project's impacts to existing environmental conditions . . . to determine their significance.").

The Attorney General has also criticized the use of a BAU approach to measure GHG impacts. As the Attorney General opined, evaluating GHG impacts based on purported reductions from "business as usual" "will not withstand legal scrutiny and may result in significant lost opportunities for . . . local governments to require mitigation of greenhouse gas (GHG) emissions)." Letter from Attorney General to San Joaquin Valley Air Pollution Control District re: Final Draft Staff Report on Greenhouse Gas Emissions Under CEQA (Nov. 4, 2009), attached as Exhibit C. Likewise, the California Resources Agency recently updated the CEQA Guidelines by adopting recommendations on how agencies may analyze the significance of a project's GHG emissions. One of the factors for determining the significance of Project GHG impacts in the Guidelines is whether the project "may increase or reduce greenhouse gas emissions compared to the *existing environmental setting*." CEQA Guideline § 15064.4(b)(1) (emphasis added). As set forth in the Final Statement of Reasons for Regulatory Action on the Amendments to the State CEQA Guidelines Addressing Analysis and Mitigation of Greenhouse Gas Emissions Pursuant to SB 97:

> This section's reference to the 'existing environmental setting' reflects existing law requiring that impacts be compared to the environment as it currently exists. This clarification is necessary to avoid a comparison of the project against a 'business as usual' scenario as defined by ARB in the Scoping Plan. Such an approach would confuse 'business as usual' projections used in ARB's Scoping Plan with CEQA's separate requirement of analyzing project effects in comparison to the environmental baseline.

Final Statement of Reasons at 24-25, attached as Exhibit D and available at http://ceres.ca.gov/ceqa/docs/Final_Statement_of_Reasons.pdf. As the Statement of Reasons articulates, comparison against a theoretical "business as usual" approach may be relevant as part of an EIR's analysis of the "no project" alternative, but is inappropriate when analyzing the significance of a project's GHG emissions. *Id*. at 25 (citing CEQA Guidelines § 15126.6(e)(2) (no project alternative should describe what would reasonably be expected to occur in the future in the absence of the project)).

Here, it is misleading to measure the significance of Plan impacts by comparing the Plan to a hypothetical "what if" scenario rather than to existing conditions. For example, the RDEIR sets out a hypothetical BAU scenario in which the Plan is carried out but other statewide regulations and laws regarding GHG emission reductions have not gone into effect. RDEIR at 4.7-40. Then, the RDEIR calculates the Plan's "reduced" emissions by giving the Plan credit for reducing emissions based on the Plan's compliance with preexisting requirements of state law, as well as County-specific policies. RDEIR at 4.7-42. The RDEIR then compares the BAU scenario to the Plan's impacts and, unsurprisingly, finds that the Plan will have fewer emissions than the artificially inflated BAU scenario. RDEIR at 4.7-44.

Because the Plan would have to comply with existing GHG-related laws and regulations anyway (including CEQA's requirement for mitigation), it is misleading for the RDEIR to state that the Plan will cause a 25% reduction in GHG emissions (RDEIR at 4.7-42). In fact, most of these alleged reductions will be caused by preexisting state requirements and would occur with or without the Plan. Likewise, it is misleading and inappropriate to compare the Plan emissions against an artificially inflated baseline of alleged BAU conditions. Courts have recognized that comparing project impacts to such an artificially inflated baseline results in "illusory comparisons that can only mislead the public as to the reality of the impacts and subvert full consideration of the actual environmental impacts, a result at direct odds with CEQA's intent." *Communities for a Better Env't v. South Coast Air Quality Management Dist.* (2010) 48 Cal 4th 310, 322 ("*CBD v. SCAQMD*"). In fact, the Riverside County Superior Court previously rejected the County's attempt to use a BAU approach when approving a large development project in the San Jacinto Valley. In rejecting the County's comparison of the project's GHG emissions to a hypothetical, BAU scenario, the court ruled that:

> the hypothetical project proposed for the EIR does not accurately reflect business as usual because it uses an unrealistic scenario which ignores local planning and zoning laws, strips all vegetation from the project, and contemplates development on mountainous portions of the project site. In addition, *the hypothetical scenario fails to account for the fact that project approval under CEQA contemplates a process whereby the adverse environmental effects of a project of this nature are identified and analyzed; alternatives are considered; and potential impacts are eliminated or mitigated*. The hypothetical project, which ignores not only local planning and zoning laws as well as potential adverse impacts, is not one that could ever be expected to actually occur in the County let alone on the project site. It does not appear the EIR used a "business as usual" approach but instead adopted a "worst-case" scenario as it began its evaluation of the GHG emissions.

Friends of the Northern San Jacinto Valley v. County of Riverside, Statement of Decision, p. 3, attached as Exhibit E. So too here, the RDEIR's unrealistic BAU scenario fails to account for the fact that state law—including CEQA—already requires agencies to reduce GHG emissions. Just as in the *Friends of the Northern San Jacinto Valley* case, the RDEIR here uses a misleading hypothetical analysis that distorts the analysis of the Plan's impacts; such an approach does not withstand legal scrutiny.

The RDEIR must be revised to compare Plan emissions to County emissions as they currently exist and to base the significance determination on this factor. CEQA Guidelines § 15126.2(a).[5] An accurate comparison with existing conditions is particularly important with regard to climate change because existing conditions are such that we have already exceeded the capacity of the atmosphere to absorb additional GHG emissions without risking catastrophic and irreversible consequences. Therefore, even seemingly small additions of GHG emissions into the atmosphere must be considered cumulatively considerable. *See Communities for Better Env't v. California Resources Agency* (2002) 103 Cal.App.4th 98, 120 ("the greater the existing environmental problems are, the lower the threshold for treating a project's contribution to cumulative impacts as significant."); *Center for Biological Diversity v. National Highway Traffic Safety Administration* (9th Cir. 2007) 508 F.3d 508, 550 ("we cannot afford to ignore even modest contributions to global warming."). Here, the RDEIR reveals that the Plan will cause an approximately 50% increase in GHG emissions above existing, baseline conditions by the year 2060. RDEIR at 4.7-47. This is a significant impact under any rational measure. The County may not hide the significance of the Plan's GHG impacts by measuring the Plan's emission increases against an inappropriate BAU threshold.

(c) Even If the County Could Use a "Business As Usual" Approach, the RDEIR Misapplies the Approach.

Even if BAU were a legitimate means for determining significance, which it is not, there is no evidence supporting the RDEIR's assumption that new development that is 25% below BAU will help achieve California's 2020 emission reduction objectives, much less its longer-term reduction goals. *See* RDEIR at 4.7-41. First, the AB 32 Scoping Plan determined that California's overall emissions must be cut by "approximately 30 percent from business-as-usual emission levels projected for 2020" to meet AB 32 requirements. Exhibit B at ES-1. Thus, a 25% reduction from BAU is not enough to meet this standard. Furthermore, even if the Plan were 30% below BAU, this would still not be enough. The RDEIR's significance determination mistakenly presumes, without any support, that emission reduction expectations are the same for

[5] Or the EIR may compare emissions to 1990 emissions levels, which form the basis for the state's various GHG reduction goals.

existing and new sources of emissions to meet AB 32 targets. But the Scoping Plan does not support this approach. Contrary to the RDEIR's assumptions, as opportunities for reducing emissions from the built environment are more limited and present greater challenges, expectations for minimizing emissions from new development—through energy efficiency, renewables, increased density, mixed use and siting close to transit—should be greater than that of existing development, where emission reduction opportunities may be more constrained.

As the California Air Pollution Control Officers Association's ("CAPCOA") CEQA & Climate Change White Paper recognizes, "greater reductions can be achieved at lower cost from new projects than can be achieved from existing sources." CAPCOA, CEQA & Climate Change at 33, attached as Exhibit F.[6] Similarly, as one of its reasons for finding that a proposed 29% below BAU threshold of significance "will not withstand legal scrutiny," the Attorney General noted that "it seems that new development must be more GHG efficient than this average, given that past and current sources of emissions, which are substantially less efficient than this average, will continue to exist and emit." Exhibit C. Accordingly, there is no scientific or factual basis supporting the RDEIR's assertion that new development that is merely 25% below BAU (or even 30% below BAU) will not interfere with California's near-term emission reduction objectives. *See* Pub. Res. Code § 21082.2(c) ("[a]rgument, speculation, unsubstantiated opinion or narrative, [and] evidence which is clearly inaccurate or erroneous" does not constitute substantial evidence); *see also Californians for Alternatives to Toxics v. Dept. of Food & Agric.* (2005) 136 Cal.App.4th 1, 17 ("[C]onclusory statements do not fit the CEQA bill."). By simply assuming that AB 32's emission reduction targets will be achieved because Plan emissions are purportedly 25% below "business as usual," the EIR's significance criteria does not reflect "careful judgment . . . based to the extent possible on scientific and factual data." CEQA Guidelines § 15064(b).

(d) The RDEIR Fails to Analyze the Plan's Consistency with Applicable Plans for the Reduction of GHG Emissions.

CEQA requires that agencies analyze the consistency of their projects with applicable plans for the reduction of GHG emissions. Guidelines §§ 15064.4(b)(3),

[6] As explained on its website, CAPCOA "is a non-profit association of the air pollution control officers from all 35 local air quality agencies throughout California. CAPCOA was formed in 1976 to promote clean air and to provide a forum for sharing of knowledge, experience, and information among the air quality regulatory agencies around the State."

15125(d). Here, the EIR does not appear to analyze the Plan's consistency with at least two relevant GHG reduction plans. First, we can find no indication that the RDEIR evaluated the proposed Plan's consistency with SCAG's recently adopted 2012-2035 regional transportation plan/sustainable communities strategy ("RTP/SCS"). For example, does the proposed General Plan rely on the same land use patterns and transportation assumptions as those assumed for the RTP/SCS? The EIR must provide a detailed evaluation of the proposed Plan's consistency/inconsistency with this Plan, which SCAG was required by state law to adopt in order to reduce GHG emissions related to passenger vehicles. If the Plan is not consistent with the RTP/SCS, this is evidence that the Plan has significant GHG related impacts, and further underscores the need to adopt all feasible mitigation.

Second, the EIR does not appear to analyze the Plan's consistency with the Western Riverside Council of Governments' ("WRCOG") Subregional Climate Action Plan. This plan sets subregional GHG emissions reduction targets at 15% below 2010 levels by 2020, and 49% below 2010 levels by 2035. *See* Exhibit W at ES-1, available at http://content.mindmixer.com/Live/Projects/WRCOG/files/148765/WRCOG%20Subregional%20CAP_Final%20Draft_May%202014.pdf?635397493994830000. But the Plan EIR fails to analyze consistency with these goals or with other policies of the WRCOG plan. Notably, the Plan acknowledges the RTP/SCS and WRCOG Climate Action Plan and calls for coordinating County GHG emission reduction efforts with those outlined in the RTP/SCS and by WRCOG. RDEIR at 4.6-33, 39. However, it unlawfully fails to analyze consistency with these plans.

Last, the EIR does not analyze the consistency of the County's proposed policies with other state goals and mandates to reduce GHG emissions, including the state's goal of having all new residential buildings be zero net energy by 2020, and commercial buildings by 2030.[7] Although the proposed Climate Action Plan would allocate some "points" to buildings that have on-site alternative energy, and that go above and beyond Title 24 requirements, these measures are not enough to achieve consistency with having zero net energy buildings by 2020.

[7] See http://sefaira.com/resources/how-californias-net-zero-energy-mandate-will-shift-the-us-construction-industry/; http://www.californiaznehomes.com/#!about/cdtl ; http://www.californiaznehomes.com/#!faq/cirw (describing how zero net energy homes are feasible).

(e) The RDEIR Must Clarify its Mitigation for the Plan's Climate Impacts and Include Additional Mitigation Measures.

(i) The RDEIR Should Clarify Various GHG Mitigation Measures.

The RDEIR relies in part on Policy AQ 21.1 to reduce the Plan's GHG impacts. RDEIR at 4.6-33. This measure requires new development projects to incorporate a combination of GHG reduction measures that are worth various "points," and each development must achieve 100 points in order to do its fair share in reducing GHG emissions to a less than significant level. Sierra Club supports the concept of requiring new development to implement certain climate-related mitigation measures while allowing developers some flexibility in how to mitigate these impacts. Sierra Club also supports the requirement that all mitigation measures be incorporated into a project's Conditions of Approval. *See* Policy AQ 21.2. However, Sierra Club has the following concerns related to mitigation measures proposed as part of Policy AQ 21.1.

The CAP allows developers to use on-site photovoltaic panels as mitigation to obtain the necessary points to reduce the climate-related impacts of their projects. Riverside County Climate Action Plan ("CAP"), CEQA Thresholds and Screening Tables, p. 8 (see "E2.A.1 Photovoltaic"). Sierra Club supports the use of on-site photovoltaic panels but believes this measure must be clarified. In particular, the measure assigns a certain number of points if the "total power provided" by the solar panels provides a certain percentage "of the power needs of the project." *Id*. The measure should clarify how the County will measure the solar panels' capacity. Will the developer get 10 points if the solar panels' *nameplate* capacity equals 40 percent of the power needs of the project? Or only if the panel's actual, expected output (given the project's location, average amount of sunlight, etc.) equals 40 percent of the power needs of the project? The former interpretation would not fully mitigate the project's energy and GHG impacts because solar panels never produce their full nameplate capacity due to cloudy weather, nighttime darkness, overheating and other factors. http://www.sunlightelectric.com/pvmodules.php. Accordingly, the measure should be modified to clarify that a project must install sufficient photovoltaic panels to provide actual, expected output equal to a certain percentage of the project's needs. The same comment also applies to on-site wind energy, as well as off-site solar and wind energy. *See* CAP, CEQA Thresholds and Screening Tables, p. 9 (E2.A.2 Wind Turbines, E2.A.3 Off-site renewable energy projects).

In addition, to obtain the points for use of on-site photovoltaic panels, the developer must submit evidence that the panels will be regularly maintained, and replaced as needed, for the life of the project.

Implementation Measure T7.A.1 (Electric Vehicle Recharging) should also be clarified. It states that developers may obtain 8 points by installing electric vehicle charging stations in the garages of residential units. The measure should be clarified to state that the developer must install charging stations in *all* residential units in order to obtain the points, and that the charging stations should provide 240 volt power or greater. Alternatively, the CAP could provide 3 or 4 points for installing 120 volt charging stations, and 8 points for installing 240 volt charging stations.

Additionally, Implementation Measure L1.A.1 (Wood burning) provides 10 points if a project contains no wood burning stoves. However, the South Coast Air District has already adopted Rule 445, which prohibits new wood burning devices in new development. CAP, CEQA Thresholds and Screening Tables, p. 12. Therefore, the County is proposing to allow developers to obtain 10 points (10% of the points necessary to mitigate significant climate impacts) simply by complying with existing law. This is contrary to the other mitigation measures, which provide *no* points if a project merely complies with existing law. *See, e.g.*, Implementation Measures SW2.A.1 (Recycling of Construction/Demolition Debris), ES.A.1 (Insulation), E5.A.2 (Windows), E5.A.3 (Doors). The County should not allow developers to mitigate their climate impacts simply by complying with existing law in this manner.

In addition, there is no substantial evidence that prohibiting wood burning devices provides enough GHG reductions to warrant giving developers 10 points—the same number of points as installing solar or wind power that provides 40% of the power needs of a project. *See* Implementation Measures E2.A.1 and E2.A.2. Many residents would likely not use their wood burning devices much, if at all. And although burning wood does release carbon dioxide, in the long term it can be climate neutral because wood (i.e., trees) grows back, potentially absorbing the same amount of carbon that was released by the wood burning. http://www.theguardian.com/science/2005/oct/15/thisweekssciencequestions.uknews. Thus, reducing wood burning does not provide the same amount of climate mitigation as reducing fossil fuel use.

Last, there is no evidence to support the notion that simply providing outdoor electrical outlets that residents or employees could use for electrically-powered yard tools (e.g., lawn mowers), provides the same amount of GHG reduction (8 points) as using alternative power to provide 30 percent of a project's needs. *See* Implementation

Measures L2.A.1 Landscape Equipment. Allowing so many points for worthwhile, but minor, measures such as this will undermine the County's efforts to effect real change.

(ii) The General Plan and RDEIR Should Describe How Alternative Energy Projects Will Be Sited.

Another new Plan policy, which is described as mitigation for the Plan's climate impacts, sets a goal of facilitating development of renewable energy facilities "in appropriate locations." Policy AQ 26.1. Sierra Club supports renewable energy in Riverside County; however, it is critical that renewable energy projects—and particularly large, utility-scale projects—be sited appropriately. To that end, the Plan is vague, and should provide more detail regarding what constitutes "appropriate locations." Without any information about which locations the County deems most appropriate for alternative energy development, the RDEIR cannot accurately analyze the impacts of the Plan, including the impacts of mitigation measures that will promote construction of renewable energy facilities. *See Stevens v. City of Glendale* (1981) 125 Cal.App.3d 986 (EIR must discuss environmental effects of mitigation measures).

The General Plan update presents an opportunity for the County to both support development of renewable energy and to facilitate that development in the most benign locations. Recent studies establish that California has ample solar resources in the built environment to power the State, and that commercial rooftop solar is competitive with large utility scale solar.[8] *See* Efficient Use of Land to Meet Sustainable Energy Needs, Rebecca R. Hernandez et. al., Nature Climate Change, March 16, 2015, attached as Exhibit Y. Streamlined permitting for distributed solar generation is critical to its deployment. Development of distributed renewable generation will avoid over-reliance on long distance transmission and provide more sustained local employment over time, as opposed to the boom and bust cycle of large-scale solar development in remote desert locations. The RDEIR can minimize impacts of the latter by adopting measure to facilitate distributed generation in the County.

For large-scale wind energy projects, the most appropriate locations for new generation are located in the existing wind resource area in the desert (e.g., San Gorgonio Pass). To the extent the County encourages more wind power development, this site should be re-powered and built out rather than allowing new wind development in new, non-industrialized areas. The power at San Gorgonio Pass could be easily doubled in this manner. Although increasing wind power in this location would have some impacts on

[8] http://www.greentechmedia.com/articles/read/solar-pv-system-prices-continue-to-fall-during-a-record-breaking-2014

avian mortality, prioritizing wind development in this location would have multiple benefits, including efficient use of land. This high wind area uses far less acreage per megawatt of energy generated than do lower wind resource areas.

Although wind energy development has benefits from GHG reductions, it also has impacts, which the County must mitigate in the Plan RDEIR. In particular, wind turbines cause avian and bat mortality. For wind projects located on County land or otherwise permitted by the County, the County should require adequate pre-and post-construction monitoring for birds and bats, and should avoid siting wind turbines on ridgelines and other areas where mortality is higher. The County should also set up a program in concert with the Bureau of Land Management to require adaptive management at wind projects, including operational measures such as curtailment during sensitive times (e.g., migration season) or relocation of lethal turbines, to address impacts on aerial species based on post construction mortality monitoring. In addition, new wind projects should not be developed in areas that are reserved mitigation land for other alternative energy projects' impacts. For example, the Ivanpah solar facility had a huge impact on desert tortoise, and as partial mitigation, tortoise habitat on private land in the Chuckwalla Bench was acquired to be set aside as protected land. The County should prohibit new wind (and solar) development in or adjacent to areas that have been set aside as mitigation land.[9]

The County must also describe appropriate siting and construction criteria for utility scale solar energy facilities and adopt programmatic mitigation for the impacts of promoting this energy resource. Even more importantly, it should adopt policies to promote and require distributed solar generation, which has far fewer environmental impacts than utility scale solar. Because the biological and land use resources are different in the eastern and western parts of the County, the siting criteria for utility scale projects should be different for these areas as well. For instance, the agriculture in the eastern County is very irrigation dependent; it also is given to salinity issues which are not as prevalent elsewhere. Attached as Exhibit H is a white paper called Renewable Siting Criteria for California Desert Conservation Area that was issued by Sierra Club and other organizations. This paper provides criteria that the County should adopt in order to guide future solar energy development on lands over which the County has some approval authority in the County's eastern, desert regions. The criteria include

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[9] Much of the land in the Chuckwalla Bench and other desert areas is under federal ownership; however, the County should implement these recommended policies to guide any energy development on land over which it has permitting and/or jurisdictional authority.

prioritizing development on lands that are already disturbed (e.g., low value agricultural land, land previously used for mining or heavy off-road vehicle use), on brownfields, on lands located adjacent to urban areas, and in areas that will minimize the need to build new roads, substations and other appurtenant facilities. The County should also adopt approval criteria that help ensure that projects will have the lowest impacts feasible. For example, the County should adopt a policy to require dry cooling for concentrating solar facilities. Recent studies have shown that dry cooling can reduce water consumption by 90% or more and that the higher initial costs of dry cooling are offset over a 20-year timeframe owing to cost savings in water use and consumption. *See* http://www.rebeccarhernandez.com/environmental-impacts-of-utility-scale-solar/ (section 2.2).

In the western portions of the County, agricultural land is generally more valuable and more viable in the long term. This land also supports habitat for numerous species and provides critical buffers for protected areas such as the San Jacinto Wildlife Area. Accordingly, the County's criteria for siting large-scale solar projects in the western portions of the County should strongly discourage development on agricultural lands. However, similar to the criteria for the eastern portion of the County, the criteria for the western portion should prioritize development on disturbed land—such as land previously used for mining—as well on brownfields, on land located adjacent to urban areas, and in areas that will minimize the need to build new roads, substations and other appurtenant facilities.

In addition to analyzing the impacts of promoting utility-scale wind and solar development, the County must adopt programmatic mitigation to address the potentially significant impacts of these energy projects. Utility scale solar development has profound impacts on aesthetics, agricultural land, cultural resources, wildlife and habitat resources, water (and often in a sole source aquifer), air quality (during construction), and other areas. *See* Overview of Potential Environmental, Cultural, and Socioeconomic Impacts and Mitigation Measures for Utility-Scale Solar Development, Argonne National Laboratory, available at http://www.evs.anl.gov/downloads/Solar_Environmental_Impact_Summary.pdf. Although mitigation should be developed later for individual projects on a case-by-case basis, it is crucial to develop programmatic mitigation now in order to guide future development and provide region-wide criteria and mitigation measures. CEQA Guidelines §§ 15126.4(a)(1)(B) (an EIR generally may not defer evaluation of mitigation until a later date), 15168(b)(4) ("program wide mitigation" must occur "at an early time when the agency has greater flexibility to deal with basic problems or cumulative impacts"); *Communities for a Better Environment v. City of Richmond* (2010) 184 Cal.App.4th 70, 94-95 (agencies may only defer mitigation in narrow circumstances).

For example, for impacts to farmland, the County should adopt agricultural protection policies and a requirement for conservation easements that will mitigate impacts on agricultural land at specified ratios. For impacts to cultural resources, the County should adopt policies to locate facilities on previously disturbed lands and lands determined by archeological inventories to be devoid of historic properties. It should also restrict or prohibit surface disturbance within the viewshed of traditional cultural properties, sacred sites, or historic trails when their historic eligibility is tied to their visual setting. Chapter 3 of the report Potential Environmental, Cultural, and Socioeconomic Impacts and Mitigation Measures for Utility-Scale Solar Development contains additional mitigation measures that the County should consider adopting at the programmatic stage. *See* http://www.evs.anl.gov/downloads/Solar_Environmental_Impact_Summary.pdf.

(iii) The RDEIR Must Include Additional Mitigation Measures for Climate Impacts.

Because the RDEIR acknowledges that the Plan will have significant GHG impacts, it must include all feasible mitigation measures. One way to determine which measures are feasible and should be adopted is to look at other jurisdictions' climate action plans. For example, the WRCOG plan lists numerous climate policies and improvements that cities within Riverside County are already implementing. Riverside County should include these same policies and mandates in its Plan. Among others, the WRCOG plan lists the following measures, which the County must include in its Plan unless it finds, based on substantial evidence, that it would be infeasible to do so:

- Implement a 50% increase in bicycle lane mileage from baseline levels. WRCOG plan at 3-25. The City of Riverside has already adopted this goal, and the County should set a similar mandate, with a specific deadline. Likewise, it should accelerate construction of bike facilities and paths so as to install 75% of all planned bicycle facility miles by 2020 or 2025. *Id.* at 3-40.

- 100% of traffic and street lights converted to high-efficiency bulbs by 2020. The cities of Banning, Jurupa Valley and Riverside have already adopted this policy, and the County should, too. *See* WRCOG plan at 3-23.

- Amend zoning to require provision of bike parking for all multi-family or mixed-use projects consisting of a mix of residential, retail, and office space. Numerous cities have already adopted this policy, and the County should too. *See* WRCOG plan at 3-26.

- Allocate the equivalent of ½ of a full- time staff person to promote transportation demand management strategies to existing businesses. *See* WRCOG plan at 3-28.

- Work with Riverside Transit Agency to increase fixed-route service miles by 10 - 20% by 2020. *See* WRCOG plan at 3-29.

- Achieve a 25% increase in community-wide household and employment density over baseline conditions by a certain year. *See* WRCOG plan at 3-33.

- Achieve a 25% jobs/housing ratio improvement over baseline conditions. *See* WRCOG plan at 3-34.

- Amend zoning to reduce parking requirements for new non-residential development by 25% over baseline conditions. *See* WRCOG plan at 3-37.

2. The RDEIR's Analysis of Energy-Related Impacts Is Insufficient.

The RDEIR's analysis of the Plan's energy impacts contains numerous errors. First, it supports its determination that the Plan will not result in the wasteful and inefficient use of energy in part by comparing the Plan's energy impacts to the impacts of prior plans, rather than to existing conditions. *E.g.,* RDEIR at 4.10-39 ("Future development accommodated by the proposed project, GPA No. 960, would be less intense than that currently planned in the existing General Plan. Thus, on a relative basis, the project would not increase demand for electricity over current plans."). This analysis is irrelevant under CEQA, which is concerned with whether a plan will cause impacts on the existing environment, not whether it may cause different impacts as compared to other plans. *Env't Planning & Information Council,* 131 Cal. App.3d at 352. Similarly, the RDEIR states that impacts are insignificant because future power needs are already planned for. RDEIR at 4.10-40. However, it never states whether the environmental impacts of these future power needs have already been analyzed in some other document. If not, it is critical that the RDEIR analyze the impacts here. If so, the RDEIR must incorporate the other analysis by reference, summarize the impacts and discuss any new impacts that were not previously analyzed.

The RDEIR also attempts to minimize the Plan's significant energy demand and impacts by stating that "compared to that of Riverside County as a whole, the project would contribute an insignificant incremental amount to the long-term need for additional new or upgraded facilities." RDEIR at 4.10-40. But courts have rejected similar attempts to minimize a project's impacts by comparing them to the impacts of the state or a larger geographic region. *Friends of Oroville v. City of Oroville* (2013) 218 Cal.App.4th 1352, 1359. As the *Friends of Oroville* court held, such a "relative comparison is meaningless . . . ." *Id.* What the RDEIR must do is simply determine whether the Plan will cause the wasteful use of energy, regardless of whether its use of energy may seem small in comparison with existing use of energy in the County as a whole.

Next, the RDEIR fails to support with substantial evidence its conclusion that the Plan's huge increase in energy use will have insignificant impacts. RDEIR at 4.10-40, 43, 46, 48. First, there is no evidence to support the RDEIR's conclusion that the Plan "would not trigger the need for new or altered [electric production or transmission] facilities nor result in substantial environmental impacts due to the construction of such facilities." RDEIR at 4.10-43. In fact, the RDEIR is internally contradictory on this point. Elsewhere, it admits that new facilities will be needed, but attempts to minimize the impacts of constructing the facilities by stating that they are already planned for (RDEIR at 4.10-40) or that transmission lines can be sited within existing rights-of-way (RDEIR at 4.10-41). Given that the RDEIR admits in some places that new facilities will be needed, and describes how electric and natural gas consumption is expected to more than double over the coming decades (RDEIR at 4.10-26 - 39), it is absurd to conclude that the Plan will not trigger the need for new facilities.

The RDEIR's justification that new facilities are already planned is irrelevant. RDEIR at 4.10-38. As described above, the RDEIR must analyze the Plan's energy impacts compared to existing conditions, not other plans.[10] Its other assumptions are

[10] Hidden amongst the other, irrelevant analyses, the RDEIR does compare energy use under the Plan to existing energy use and concludes that the Plan's energy demands "would be insignificant compared to existing baseline levels." RDEIR at 4.10-43. The document offers no substantial evidence to support this conclusion. On the contrary, as described above, the RDEIR concludes that electricity and natural gas consumption will more than double over the life of the Plan. RDEIR at 4.10-26—39. Doubling energy use is hardly insignificant.

faulty and unsupported as well. For example, while some future, low-voltage transmission lines for specific developments may be sited in rights-of-way, there is no evidence demonstrating that transmission lines for all of the new solar and wind energy projects that the Plan encourages can be sited in existing rights-of-way. In fact, the RDEIR's energy resources analysis completely fails to analyze the impacts of new alternative electric (e.g., solar and wind) production and transmission facilities. These facilities are already having a profound impact on the County's wildlife and landscape and will continue to do so, especially in light of County and state policies encouraging construction of such facilities. The RDEIR is legally deficient for failing to analyze the impacts of these facilities under its first threshold of significance. RDEIR at 4.10-37 (analyzing whether the Plan will "result in substantial adverse physical impacts associated with the provision of new or physically altered utilities . . .").

Nor does the RDEIR appear to acknowledge that California's renewable portfolio standards and increasing regulation of GHGs are causing a huge growth in solar and wind development in areas such as Riverside County. Thus, even if the County did not require lots of new energy to power the development contemplated in the Plan—and there is no evidence that this is true—the County would still require lots of new *clean* energy from sources such as wind and solar in order to meet state mandates. As described in the section of this letter regarding the Plan's climate impacts, the provision of these new energy facilities will clearly "result in substantial adverse physical impacts . . . " that must be analyzed and mitigated. RDEIR at 4.10-39. The RDEIR's failure to analyze these impacts is legal error.

The RDEIR's energy analysis also does not appear to analyze the energy requirements to provide water to the growing region. Moving water around the state utilizes a large portion of the state's energy output, and this will only become a more difficult problem with climate change. The RDEIR's energy analysis should consider the energy needs related to providing more water to the region, and it is not clear that the document has done this already.

Finally, the RDEIR's determination that the Plan will have insignificant energy-related impacts is suspect for an additional reason. One of the thresholds of significance is whether the Plan will result in inefficient, wasteful or unnecessary consumption of energy. By definition, if there are feasible ways of reducing the Plan's consumption of energy, then the Plan will result in the inefficient or unnecessary consumption of energy. Here, the Plan does not require all feasible means of reducing energy usage. For example, the CAP contains a "screening table" that lists dozens of measures to reduce GHG emissions (and thus energy). These include providing on-site renewable power, using water more efficiently, enhanced building efficiency standards, promoting mixed-use development, providing bike paths and sidewalks, installing electric vehicle infrastructure, and more. Each of these measures provides a certain point value, depending on the measures' alleged GHG reduction potential.

However, the CAP and these screening tables only require developers to garner 100 "points" in order to meet their obligation to reduce GHG impacts to a level below significance. In other words, even if it was feasible for a developer to implement more than 100 points' worth of GHG-reduction measures (and, consequently, energy-reduction measures), the developer would not have to do so. This methodology leaves potentially feasible energy-reduction measures on the table, so to speak. It results in the wasteful and inefficient use of energy because it does not require implementation of *all* feasible measures to reduce energy usage. Accordingly, the EIR is incorrect that the Plan will not result in the inefficient and wasteful use of energy.

Because the RDEIR concludes that the Plan will not result in the inefficient use of energy or cause substantial energy-related impacts, it does not propose or adopt any mitigation to reduce the Plan's energy impacts.[11] However, because the Plan actually will have significant energy-related impacts, the RDEIR must include mitigation for these impacts. Such mitigation should include, among other measures, a prohibition on sprawling, leapfrog development, which requires more driving and resultant energy use than denser development near city centers. For example, the County should adopt a policy similar to one that Imperial County has adopted, which states:

> "Leapfrogging" or "checkerboard" patterns of development have intensified recently and result in significant impacts to the efficient and economic production of adjacent agricultural land. It is a policy of the County that leapfrogging will not be allowed in the future. All new non-agricultural development will be confined to areas identified in this plan for such purposes or in Cities' adopted Spheres of Influence, *where new development must adjoin existing urban uses. Non-agricultural residential, commercial, or industrial uses will only be permitted if they adjoin at least one side of an existing urban use*, and only if they do not significantly

[11] The draft General Plan's Land Use Element has a few policies intended to mitigate some impacts of wind development, but apparently has no policies to mitigate impacts of solar development. *See* General Plan Land Use Element at LU-40 – 42. The policies for wind development are inadequate and should be bolstered as described in the climate mitigation section of this comment letter.

> impact the ability to economically and conveniently farm adjacent agricultural land.

Imperial County General Plan, Agricultural Element, pp. 39-40, available at http://www.icpds.com/CMS/Media/Agricultural-Element.pdf (emphasis added).

Likewise, San Diego County's General Plan contains policies that prohibit most leapfrog, sprawl development. Among other things, San Diego's policy specifies that any new development that is not adjacent to existing communities must be "designed to meet the LEED-Neighborhood Development Certification or an equivalent." San Diego County General Plan, Land Use Element, p. 3-20, available at http://www.sdcounty.ca.gov/dplu/gpupdate/docs/LUE.pdf. Recommended mitigation listed in this comment letter for GHG emissions would also reduce energy impacts and should be required for that reason as well.

Riverside County should adopt similar policies to prohibit leapfrog development. For example, it should incorporate the LEED-Neighborhood Development Certification standard into its CAP requirements for new development. Although the County's draft CAP contains a requirement that new development obtain a certain number of "points" due to energy saving/climate-friendly attributes, it does not require neighborhood-level policies like those in the LEED-Neighborhood Development standards. Neighborhood-level policies are crucial because, even if a project does not use much energy and its buildings are efficient, those efficiencies are lost if the project is located far from other services and residents are forced to drive long distances to work and for services. In addition, the LEED standard requires that neighborhoods be sited in a manner that protects other resources. For example, it mandates that projects be in smart locations, protect imperiled species, ecological communities, wetlands, and agriculture, and avoid floodplains. LEED 2009 for Neighborhood Development, p. vii, attached as Exhibit P. Given that the Plan has significant impacts on agricultural resources (DEIR at 4.5-37), biological resources (DEIR at 4.8-95)[12] and other resources, requiring new development to meet LEED-Neighborhood Development standards would mitigate a range of relevant Plan impacts. As demonstrated by the fact that other jurisdictions have adopted this requirement, this mitigation measure is also feasible. The RDEIR Fails to Adequately Analyze and Mitigate the General Plan's Air Quality Impacts.

[12] The RDEIR concludes that adopted mitigation reduces impacts to a level that is insignificant. RDEIR at 4.8-97. However, as described in comments on the DEIR by the Center for Biological Diversity, this finding is clearly in error.

The County should also adopt other measures, described in the GHG section of this comment letter, which would reduce the wasteful use of energy. For instance, the County should adopt building efficiency standards that are more stringent than Title 24. As demonstrated by the fact that the proposed Climate Action Plan gives "points" for developments that achieve efficiency greater than required by Title 24, it is feasible for buildings to meet more stringent standards. The County should also adopt an ordinance requiring solar or other alternative, on-site energy for all homes and businesses with roofs of a certain size and that have reasonable exposure to the sun. The cities of Lancaster and Sebastopol have already done this, showing that it is feasible. http://www.greentechmedia.com/articles/read/Lancaster-CA-Becomes-First-US-City-to-Require-Solar; http://www.pressdemocrat.com/news/2224191-181/sebastopol-council-votes-to-require.

3. The RDEIR's Analysis of Air Quality Impacts Is Deficient.

The South Coast Air Basin suffers from some of the nation's worst air quality. [13] It is designated as an extreme nonattainment area for ozone at the state and federal level. RDEIR at 4.6-11. It is also designated nonattainment for PM_{10} and $PM_{2.5}$. *Id.* Air quality in the Salton Sea Air Basin and the Mojave Air Basin is no better. Both air basins are nonattainment for ozone and PM_{10}. *Id.* at 4.6-12 and 13. Riverside County also experiences elevated theoretical inhalation cancer risks, largely due to diesel engines. *Id.* at 4.6-13. By its own admission, implementation of the proposed Plan would cause a substantial increase in air pollution. The RDEIR, however, fails to adequately analyze these significant impacts.

(a) The RDEIR's Analysis of the Project's Conflict with the Applicable Air Quality Plans Is Deficient.

The RDEIR relies on the Plan's increased air emissions to conclude that the Plan has the potential to hinder the region's compliance with the South Coast Air Quality Management District's ("SCAQMD") and the Mohave Desert Air Quality Management District's ("MDAQMD") air quality plans. RDEIR at 4.6-48. While we do not disagree with this conclusion, the RDEIR fails to provide sufficient information to verify the accuracy of the impact analysis. A legally adequate EIR "must contain sufficient detail to help ensure the integrity of the process of decision making by precluding stubborn problems or serous criticism from being swept under the rug." *Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal.App.3d 692, 733; CEQA Guidelines § 15151.

[13] *See* Press Enterprise articles on air quality, attached as Exhibit I and list of studies documenting the effects of air pollution on health, attached as Exhibit J.

The RDEIR contains tables identifying the increase in air pollutant emissions that would accompany implementation of the Plan. RDEIR at 4.6-44 – 4.6-47. Yet, the document never discloses the assumptions that were used to identify these emissions. Instead, the RDEIR states that the specific modeling assumptions are included in an appendix. This is a wholly unacceptable way of presenting decisionmakers and the public with essential information, and it renders the EIR legally inadequate. Whatever is required to be in the text of the EIR must be in the EIR itself, not buried in some appendix. *See Santa Clarita Organization for Planning the Environment v. County of Los Angeles* (2003) 106 Cal.App.4th 715, 722-23; *San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal.App.4th 713, 727. In order to fulfill its purpose as an informational document, the EIR must provide information that is accessible to the lay person. Forcing the reader to dig through numbers in a technical appendix does not meet achieve this core objective.

For example, the RDEIR does not identify the sources (stationary, mobile and area) used to calculate the Plan's increase in emissions. There are several airports within the County, including Palm Springs International Airport[14] and March Joint Air Reserve Base. *See* Circulation Element, Figure C-6 and C-56. The Ontario International Airport[15] is just over the border from Riverside County. As the proposed Plan acknowledges, air cargo is the fastest growing method of transporting goods in and out of southern California. *Id*. The March Joint Air Reserve Base is currently a joint use status land use. The Air Reserve Base will gradually reduce the military use of this facility and begin to increase the amount of goods and cargo that can be accommodated at this site. *Id*. In addition, the Plan mentions that the Base has the potential to become a passenger airport. *Id*. Although this increase in use is certainly contemplated by buildout of the proposed Plan, we can find no indication that aircraft-related emissions from these airports were included in the emission calculations for the proposed Plan. Even a search of EIR Appendix 5 (Air Quality Data) includes no reference whatsoever to aircraft or aircraft emissions.

[14] A surging tourism economy coupled with increased air service into the Coachella Valley have pushed the passenger count at Palm Springs Airport past the 1.9 million mark in 2014. *See* http://www.desertsun.com/story/news/2015/01/21/psp-travel-increases/22123263/; accessed March 27, 2015.

[15] Nearly 3.8 million passengers per year used Ontario Airport from January through November 2014. *See* http://www.scpr.org/blogs/economy/2014/12/31/17740/lax-ontario-john-wayne-airports-see-passenger-numb/; accessed March 27, 2015.

In another example, while the RDEIR asserts that it relied on data including average daily trips, vehicle-miles traveled ("VMT") and average trip lengths to calculate the Plan's mobile source emissions (RDEIR at 4.6-43), the RDEIR text fails to actually identify the assumed number of trips, VMT or average trip length. Nor does the RDEIR include any of the transportation and land use assumptions that were supposedly used to calculate the VMT or trip generation statistics. Instead, it includes statements such as:

> It can be assumed that various sizes and types of project [sic] would be developed, however. And, because of the increased density seen for the land uses and desired proximity of residential land uses to both transit and commercial centers, it can be assumed that both construction and operation of commercial and potentially industrial sources would be developed relatively close to sensitive receptors such as residences or schools. RDEIR at 4.6-45.

Vague and generic statements such as these do not come close to providing the factual basis needed for an impact analysis. A transparent analysis would disclose all of the relevant statistics used to calculate air pollutant emissions, including all air pollution sources. These statistics would then be compared with the assumptions used to calculate the emissions projections assumed in each of the applicable air quality plans. For example, how does the Plan's increase in VMT compare to the VMT projections in the applicable air quality plans? Is per capita VMT under the Plan greater or less than the per capita VMT figure used in each of the air quality plans? What would be the trip generation from the Plan's land uses and how does this figure compare to trip generation identified in the applicable air quality plans? How do each of the proposed Plan's alternatives compare with regard to number of trips, VMT and trip length? We request that answers to these questions be included in the revised RDEIR or in the Final EIR.

The problems with this impact analysis extend far beyond the RDEIR's failure to disclose the analytical assumptions. The RDEIR also fails to disclose the severity of these impacts. Air quality plans are prepared to demonstrate how the applicable air districts would meet required federal and state criteria emissions' planning milestones, including attainment of ambient air quality standards. This RDEIR must disclose whether implementation of the proposed Plan would push compliance with the air quality standards back by one year, five years, or ten years. What would be the health implications of such delays for the region's residents? Simply concluding that the Plan may conflict with the air quality plans does not allow decisionmakers to evaluate whether implementation of the proposed Project is worth a potentially extensive delay in achieving attainment of health-based air quality standards. Because the RDEIR provides no insight on this question, it is legally deficient. The revised EIR must explain the actual and specific implications associated with the region's failure to attain the state and federal standards for each of the relevant pollutants.

Yet another problem with the RDEIR's analysis is that it concludes that the Plan would result in a net change in NOx emissions of -3,800 pounds per day. RDEIR 4.6-44. The EIR comes to this startling conclusion based on "the substantial decrease in anticipated emissions from vehicles mandated by increased efficiency requirements in current federal and California law that have been implemented and will continue to affect the motor vehicle fleet between the existing year and 2040." *Id.* at 4.6-44. While we do not disagree that NOx reductions will occur as a result of these state and federal laws, this reduction cannot and should not be attributable to the Project.

As a result of the Plan, VMT will increase by 352 percent. EIR Appendices Part 1, pdf pages 1401, 1402. The number of vehicular trips will increase by 246 percent. *Id.* The average trip length will even increase by 30 percent. *Id.* NOx is a byproduct of internal combustion engine exhaust, and along with reactive organic gases ("ROG") form ozone. RDEIR at 4.6-7. Despite the massive increase in vehicular travel that will accompany the Plan, the RDEIR concludes a similarly substantial reduction in NOx emissions. This makes no sense as tailpipe emissions cannot be negative. Project-related increases in VMT will be associated with an increase in tailpipe (exhaust) emissions, no matter how small (unless all cars in 2035 are electric, in which case tailpipe emissions would be zero). While, the RDEIR certainly can disclose regionwide NOx emissions in 2040, it must also disclose the increase in NOx emissions that would result solely from the Project. Once accurately calculated, the Project's NOx emissions will almost certainly exceed the SCAQMD and MDAQMD thresholds of significance. The EIR must once again be revised to include an accurate estimate of NOx emissions. An EIR should analyze the criteria pollutant and GHG emissions that would be generated by the Project over the planning period. *This analysis must disclose the Project's total amount of emissions, with and without emission reductions achieved from state and federal regulations*. In any event, the revised EIR or the Final EIR must identify the total amount of emissions that will result from the Plan, including all mobile, stationary and area sources. If these emissions are determined to be significant, the EIR must identify mitigation measures capable of minimizing these emissions.

(b) The RDEIR Fails to Adequately Analyze or Mitigate the Plan's Potential to Expose Sensitive Receptors to a Substantial Concentration of Pollutants from Mobile Sources.

Although the RDEIR states that trucks, buses, and some smaller vehicles using freeways, major highways and railroads emit toxic air contaminants (TACs), diesel particulate matter ("DPM") and particulate matter (at 4.6-7, 10, 48, and 67), it provides no analysis of whether the Plan would expose sensitive receptors to a substantial concentration of these pollutants.[16] Instead, the document provides numerous excuses as to why it would be impossible to study the Plan's health impacts. Each of these excuses is unavailing.

First, it asserts such an analysis of health impacts is not possible because the exact location, timing, and level of future development are unforeseeable. *Id*. at 4.6-66. It further explains that "the expected future development would occur across the entirety of Riverside County over roughly 50 years' time, making exact sizes and locations similarly unknowable at this time." *Id*. at 4.6-67. The RDEIR preparers cannot evade their obligation to analyze the Plan's environmental impacts on the grounds that they are extensive. Following this convoluted reasoning, the greater the environmental harm contemplated by an agency, the lesser the obligation of conducting environmental review. The California Supreme Court has clearly rejected such an approach. As explained by the Court in *Laurel Heights Improvement Assn. of San Francisco v. Regents of the University of California* (1988) 47 Cal.3d 376, 399 (*"Laurel Heights I"*), "[w]e find no authority that exempts an agency from complying with the law, environmental or otherwise, merely because the agency's task may be difficult."

Second, the RDEIR implies such an analysis is not required because the document admits that the impacts would be significant and unavoidable. *See, e.g., Id*. at 4.6-67. Here too, the RDEIR preparers are mistaken: an agency's rote acknowledgement that impacts are "significant" does not cure its EIR's failure to analyze the issue. An agency may not, as the County attempts to do here, "travel the legally impermissible easy road to CEQA compliance . . . [by] simply labeling the effect 'significant' without accompanying analysis . . . ." *Berkeley Keep Jets Over the Bay Comm.* (2001) 91 Cal.App.4th 1344,

[16] Such an analysis is particularly important for those projects that have been approved, but not yet built such as the 16-mile six-lane Mid County Parkway and the six-lane Cajalco Road. These are just two examples of major projects proposed within the County that will expose sensitive receptors to an increase in TAC emissions.

1371. Rather, "a more detailed analysis of how adverse the impact will be is required." *Galante Vineyards v. Monterey Peninsula Water Management Dist.* (1997) 60 Cal.App.4th 1109, 1123. Whether or not the Plan's health impacts are "significant," the public and decision-makers have the right to know whether the Plan's addition of air pollution will merely cause a nuisance, or lead to catastrophic health consequences. The RDEIR's dismissive treatment of the Plan's potential to adversely impact public health is unlawful.

Third, the RDEIR asserts that regional modeling cannot accurately capture the project-level effects of pollutant concentrations because emissions from projects are typically small and localized. *Id.* at 4.6-74. The fact that project-level emissions may be relatively minor – an assertion that is unsupported by any evidence – is irrelevant. The purpose of this RDEIR is not to analyze project-level impacts; it must analyze the impacts from *this Plan*. As the RDEIR itself acknowledges, the Plan would result in a substantial increase in criteria air pollutants. *See* RDEIR at Table 4.6-G at 4.6-46. The Plan would also result in toxic air contaminant emissions, but the RDEIR makes no attempt whatsoever to quantify these emissions.

Moreover, if we take the EIR at its word—that project-level emissions tend to be relatively minor—there is no likelihood that the cumulative health effects from all of these project will ever be studied. CEQA requires that environmental impacts be specifically identified and mitigated at the earliest possible date, in order to "inform the public and responsible officials of the environmental consequences of their decisions before they are made." CEQA Guidelines § 15168(a), (c)(5)*Citizens of Goleta Valley v. Board of Supervisors* (1990) 52 Cal .3d 553, 564. Accordingly, the purpose of this EIR is to examine the environmental impacts from *this Plan*.

The RDEIR's fourth excuse for not examining the health impacts from the Plan is that there is no need for such an analysis because project level emissions typically are a low percentage of total emissions within an air basin emissions. This "drop-in-the-bucket" approach to impact analysis has been explicitly rejected by the courts. In *Kings County Farm Bureau*, the court invalidated an EIR that concluded that increased ozone impacts from the project would be insignificant because it would emit relatively minor amounts of precursor pollutants compared with the large volume already emitted by other sources in the county. 221 Cal.App.3d at 717-18. The *Kings County Farm Bureau* court aptly stated, "The relevant question to be addressed in the EIR is not the relative amount of precursors emitted by the project when compared with preexisting emissions, but whether any additional amount of precursor emissions should be considered significant in light of the serious nature of the ozone problems in this air basin." *Id.* at 718. Likewise, here, the RDEIR may not minimize the Project's health impacts of the Plan suggesting that air pollution in the region is already poor. Indeed, existing adverse conditions weigh in favor of a finding of significance. *Kings County Farm Bureau*, 221 Cal.App.3d at 718. The EIR is therefore legally inadequate.

Finally, after all of these excuses, the RDEIR presents a qualitative discussion that purports to correlate each air pollutant emissions level resulting from GPA No. 960 with potential health impacts. *Id*. at 4.6-74. Unfortunately, this analysis is entirely useless. The document simply provides a generic summary of the type of health impacts that can potentially result from exposure to criteria air pollutants and states that exposure to these pollutants has the potential to harm public health. *See Id*. at 4.6-74, 75. The RDEIR's "qualitative discussion" does not even mention toxic air contaminants, and, again, fails to analyze the impacts of *this Plan*. CEQA requires more.

Certainly the RDEIR preparers could have analyzed whether the Plan would expose sensitive receptors to mobile source emissions. Other agencies have conducted such health risk studies. *See, e.g.*, Marin County General Plan EIR Air Quality Analysis at 4.3-21, attached as Exhibit K. Using the Marin County analysis as an example, the RDEIR preparers could first identify the freeways and highways within the County that have the potential to cause a significant health risk for sensitive land uses. Second, a screening analysis of future diesel particulate matter ("DPM") exposure and associated health effects could be conducted. Such an analysis could involve estimating DPM emissions for the County's major highways and freeways using a model such as EMFAC. Modeled concentrations could then be calculated for various distances from the edge of the highways and freeways. Maximum individual cancer risks could be computed using the applicable air districts' recommended cancer risk factors. Modeled cancer risks could then be compared to the thresholds established by the air districts. Third, the RDEIR preparers could determine the locations where the proposed Plan proposes the development of new housing and evaluate whether the Plan would put new sensitive receptors closer to sources of toxic air contaminants, primarily DPM from traffic or railroads.

As part of its General Plan update process, the Humboldt County Board of Supervisors asked the public health agency to consider the health impacts of three future growth alternatives ranging from restricting development to existing urban areas to allowing continued sprawl. *See* Humboldt County General Plan Update Health Impact Assessment, attached as Exhibit U. The public health officer consulted with a non-profit organization to conduct a health impact assessment ("HIA") on the three general plan alternatives, with participation from the planning agency and a community group (Human

Impact Partners, 2008). The analysis, based upon 35 community- prioritized indicators, found that the compact development alternative would improve health outcomes related to almost all the indicators, while the sprawl alternative would harm health. The HIA process led to a strong partnership between the planning and health agencies and an increase in participation in the General Plan process on the part of community members. The planning agency used the HIA extensively in forming the policies in the Circulation element and to support infill policies in the Housing Element.

SCAG also conducted a health risk analysis for its 2012 Regional Transportation Plan/Sustainable Communities Strategy. *See* SCAG 2012-2035 DEIR Air Quality Analysis attached as Exhibit L. In addition to this health risk analysis, SCAG's evaluation included a compilation of studies demonstrating the health effects of mobile source emissions, and identified existing locations within the SCAG region that have high instances of cancer risk. Inasmuch as SCAG was able to conduct this health risk assessment for the entire region, we see no plausible reason why such an analysis cannot be conducted for Riverside County.

It is important to acknowledge that the County must examine the health effects from all sources of air pollution that are expected to be developed upon implementation of the proposed Plan. Airport activity including cargo and passenger operations at March Air Base, Palm Springs and Ontario Airports is projected to increase significantly during the proposed Plan's timeframe. Recent studies demonstrate that serious health effects from aircraft activity extend much further than previously assumed. *See* USC News, "New Concerns Raised About Air Pollution at LAX," May 30, 2014, attached as Exhibit M. This article explains that airports may be as important to air quality as a region's freeway system. The revised EIR must account for air pollution from existing and proposed airport expansion projects and include those emissions in its analysis of transportation-related health risks.

Finally, it is important to acknowledge that the RDEIR's proposed mitigation measure to reduce the Plan's impacts on sensitive land uses from freeways and major highways is inadequate. Mitigation Measure 4.6.D-N2.e calls for proposed sensitive land uses to be sited at least 500 feet from existing freeways and major urban roadways with 100,000 vehicles per day or more, and from major rural roadways with 50,000 vehicles per day or more. DEIR at 4.6-69, 70. Although buffer zones can be effective in reducing impacts from incompatible land uses, the most prudent approach is to avoid developing sensitive land uses near high-volume highways/railroads/ warehouse distributions centers in the first place.

In any event, there is no evidence that a 500-foot buffer would be sufficient to protect public health. According to the California Air Resources Board ("CARB"), increased asthma hospitalizations are associated with those living within 650 feet of heavy traffic and heavy truck volumes. CARB handbook at 8. Children, in particular, suffer from reduced lung function with traffic density, especially trucks, within 1,000 feet. *Id.* There is an increased likelihood of medical visits in children living within 550 feet of heavy traffic. *Id.* Based on scientific evidence, agencies such as the Los Angeles County Department of Public Health recommend that new schools, housing or other sensitive land uses built within 1,500 feet of a freeway should adhere to current best-practice mitigation measures to reduce exposure to air pollution which may include:

- the use of air filtration to enhance heating, ventilation and air conditioning (HVAC) systems, and the
- orientation of site buildings and placement of outdoor facilities designed for moderate physical
- activity as far from the emission source as possible. *See* County of Los Angeles Public Health, "Air Quality Recommendations for Local Jurisdictions", attached as Exhibit N.

These, and other measures, were included in a recent settlement over air quality impacts in connection with the 1.1 million square-foot Mira Loma Commerce Center in Jurupa Valley. *See* Press-Enterprise Article, attached as Exhibit O. The settlement requires the city and/or developer to provide air-filtration systems to nearby homes, monitor air quality, install solar panels and charging stations for e-vehicles, and to ban heavy trucks on a major road near Mira Loma Village. *Id.* These are feasible mitigation measures which should be included in the revised EIR.

4. The RDEIR's Analysis of and Mitigation for the General Plan's Agricultural Impacts Are Inadequate.

The Legislature has repeatedly stated that the preservation of state farmland is an important policy goal and that public agencies should use CEQA to carry out this goal. *Masonite Corp. v. Cnty. of Mendocino* (2013) 218 Cal.App.4th 230, 240 -241 ("our Legislature has repeatedly stated the preservation of agricultural land is an important public policy"). In particular, "[a]gricultural lands near urban areas that are maintained in productive agricultural use are a significant part of California's agricultural heritage.... Conserving these lands is necessary due to increasing development pressures and the effects of urbanization on farmland close to cities." Pub. Resources Code, § 10201(c).

"The Legislature has also declared that CEQA is intended to effectuate this public policy." *Masonite Corp.,* 218 Cal.App.4th at 241.

Riverside County's agricultural industry plays a vital role in the local economy and consistently ranks among the most profitable in California. RDEIR at 4.5-1. Despite the importance of this critical resource, the RDEIR does not adequately describe the Plan's impacts to agriculture and wholly dismisses the potential for measures to avoid or mitigate for its loss. Accordingly, the RDEIR fails to meet the basic requirements of CEQA.

(a) The RDEIR Fails to Adequately Describe the Current Distribution and Designation of Agricultural Land.

Every analysis of a project's environmental effects must begin with the description of the environmental conditions before the project – the baseline. *See Save Our Peninsula Committee v. Monterey County Board of Supervisors* (2001) 87 Cal.App.4th 99, 122. In considering impacts to agricultural lands, the crucial issues are how much agricultural land is under threat of development, and where the threatened land is located. Yet, the RDEIR's description of the current state of agricultural land in the County lacks crucial information. The RDEIR contains a map (Figure 4.5-1) showing the County's agricultural resources. However, this information is virtually useless without a description or depiction of how these lands relate to existing and proposed land use designations. To be adequate, the RDEIR must contain maps showing the County's agricultural resources overlaid by the County's existing and proposed land uses.

Equally troubling, the RDEIR's inventory of agricultural lands does not appear to include small farms, *i.e.,* farms of less than 40 acres, in its farmland resources inventory. Almost 79,000 acres of farmland within the County's unincorporated areas fall within lands categorized as "Urban and Built-up." RDEIR at 4.5-4. The RDEIR explains that agricultural lands within the Urban and Built-up category must exceed 40 acres in order to be mapped as farmland. RDEIR at 4.5-5. Because the RDEIR does not appear to measure or describe farms smaller than 40 acres that fall within Urban and Built-Up areas, it significantly underestimates the amount of land that is in agricultural use in the County.[17] According to recent USDA data, many farms in the County are small: out of 2,949 farms in Riverside County, 1,581 are 9 acres or less and another 955 are between

[17] The RDEIR also states that it used photo-interpretation of GIS data to determine effects of the Plan on agricultural uses. RDEIR at 4.5-25. However, it is not clear if the County used this procedure to assesses impacts on small farms throughout the County, or only in the specific areas noted in Table 4.5-E.

10 and 49 acres. *See* USDA Agricultural Census, 2012, attached as Exhibit X. As a consequence, the EIR also unlawfully ignores the Project's impact on these small farms. The RDEIR must be revised to provide a clear, complete picture of current and proposed uses for agricultural lands within the County.

(b) The RDEIR Fails to Provide Sufficient Information for Accurate Analysis and Decisionmaking.

The RDEIR's agricultural impact analysis lacks sufficient information to enable the public and decisionmakers to make an informed judgment regarding the potentially significant impacts of the Project. In particular, the section relies on conclusory statements and unstated assumptions, an approach that CEQA specifically prohibits. *See Berkeley Keep Jets,* 91 Cal.App.4th at 1371 (striking down an EIR "for failing to support its many conclusory statements by scientific or objective data"); *County of Merced*, 149 Cal.App.4th at 659 ("[D]ecision makers and general public should not be forced to . . . ferret out the fundamental baseline assumptions that are being used for purposes of the environmental analysis.").

The section addressing the conversion of Prime Farmland, Unique Farmland and Farmland of Statewide Importance is particularly uninformative. The unincorporated portion of Riverside County has almost 337,000 of designated Farmland totals (105,390 acres of Prime, 36,660 acres of Statewide Importance, 32,360 acres of Unique Farmland, and 162,410 acres of Farmland of Local Importance). RDEIR at 4.5-27. Remarkably, the RDEIR asserts that the Plan would result in the direct conversion of only 32 acres of Prime Farmland and Farmland of Statewide Importance, and concludes that this impact is less than significant. RDEIR at 4.5-27, 29. The RDEIR fails to provide any information as to how its authors arrived at this minuscule amount of lost Farmland. This number of lost acreage is particularly surprising in light of the RDEIR's statement elsewhere that "Between 2000 and 2006, Riverside County loss roughly 30% of its existing agricultural lands to conversions made in the face of increasing development pressure." RDEIR at 1.0-19. It is also surprising in light of the EIR's statement that "[t]otal build out of the updated General Plan would increase the amount of residential developed land within unincorporated Riverside County by just over 62,000 acres." RDEIR at 4.13-78. How is it that the County has lost so much agricultural land to development in the recent past and so much new development could occur under the Plan, yet this development would cause the loss of virtually no farmland? The EIR never explains.

For example, if the RDEIR assumes that land converted from agricultural to rural residential zoning will not result in the loss of farmland because farming is still allowed in rural residential zoning designations, it must explain this. Of course, any such rezoning or redesignation would result in loss of farmland because even if farming is allowed in rural residential zones, those zones are typically developed, at least partially, leading to some loss of farmland due to the construction of homes, driveways and appurtenant structures.

Notwithstanding the RDEIR's conclusion that the Plan's direct impacts to Prime Farmland, Unique Farmland and Farmland of Statewide Importance will be less than significant, the RDEIR does an about-face and concludes that the growth facilitated by the Plan will cause *indirect*, significant impacts to these resources. *Id*. at 4.5-35. However, the RDEIR's section discussing indirect impacts to Farmlands from the Plan's growth fails to provide any analysis. Instead, the document claims that it is not possible to conduct an analysis because "future development accommodated by the project in locations is not foreseeable at this time." RDEIR at 4.5-29. The RDEIR is mistaken. It is this EIR's precise purpose to analyze the loss of Farmland resulting from the growth caused by the Plan. An agency's rote acknowledgement that impacts are "significant" does not cure its EIR's failure to analyze the impact. As the court stated in *Galante Vineyards v. Monterey Peninsula Water Management Dist.*, "this acknowledgment is inadequate. 'An EIR should be prepared with a sufficient degree of analysis to provide decisionmakers with information which enables them to make a decision which intelligently takes account of environmental consequences . . . .'" (1997) 60 Cal.App.4th 1109,1123 (quoting *Santiago County Water Dist. v. County of Orange* (1981), 118 Cal.App.3d 818, 831); *see also Mira Monte Homeowners Assn. v. County of Ventura* (1985) 165 Cal.App.3d 357, 365 (an EIR is meant to protect "the right of the public to be informed in such a way that it can intelligently weigh the environmental consequences of a[] contemplated action.").

Thus, the RDEIR may not "travel the legally impermissible easy road to CEQA compliance . . . [by] simply labeling the effect 'significant' without accompanying analysis . . . ." *Berkeley Keep Jets*, 91 Cal.App.4th at 1371. Rather, "a more detailed analysis of how adverse the impact will be is required." *Galante Vineyards*, 60 Cal.App.4th at 1123. If the loss of state-designated farmlands is "significant" as a result of the Plan, the public and decisionmakers have a right to know the severity and extent of this loss. Notably, until the RDEIR identifies the acreage of lost farmland, it is not possible to identify appropriate mitigation. Even if it were not possible to identify the location where farmland would be lost, the EIR must provide some analysis of the types of areas where it would be lost. For example, would most indirect impacts to farmland occur in areas with rural residential LUDs, or high density residential LUDs? Currently, the public has no way to understand what exactly is causing the pressures on farmland that the EIR acknowledges may lead to indirect, significant impacts on them.

(c) The RDEIR Fails to Provide Sufficient Mitigation for the General Plan's Agricultural Impacts.

An EIR's central purpose is to identify a project's significant environmental effects and then evaluate ways of avoiding or minimizing them. Pub. Res. Code §§ 21002.1(a), 21061. The lead agency also must adopt any feasible mitigation measure that can substantially lessen the project's significant environmental impacts. Pub. Resources Code § 21002; CEQA Guidelines § 15002(a)(3). In doing so, the lead agency must "ensure that feasible mitigation measures will actually be implemented as a condition of development, and not merely adopted and then neglected or disregarded." *Federation of Hillside & Canyon Assns.,* 83 Cal.App.4th at 1261 (italics omitted). Furthermore, mitigation is especially crucial when an agency prepares a program EIR. An advantage of a Program EIR is that it allows the lead agency to consider broad policy alternatives and 'program wide mitigation measures' at an early time when the agency has greater flexibility to deal with basic problems or cumulative impacts." CEQA Guidelines § 15168(b)(4)).

The RDEIR violates this mandate. After admitting that the Plan will result in a significant impact on agricultural lands, it fails to identify *any* mitigation measures. Instead, the RDEIR looks to the County's past failure to mitigate agricultural impacts to claim that mitigation for current impacts is simply not possible:

> In EIR No. 441, prepared for the 2003 RCIP General Plan, it was found under "Impact 4.2.2" (Final EIR, page 4.2-32) that implementation of the General Plan would "result in the significant conversion of active agricultural land and agricultural soils to non-agricultural uses." Although the existing General Plan includes policies intended to identify and implement programs that would limit the conversion of agricultural land to non-agricultural uses, EIR No. 441 finds that these policies do not set specific requirements that would limit the conversion of agricultural lands to non-agricultural uses. Further, EIR No. 441 finds the policies do not identify the amount, extent or location of agricultural land to be conserved and that it is impossible to assess if policies would effectively reduce potentially significant impacts associated with the conversion of agricultural land to non-agricultural uses.
>
> As a result, future development accommodated by the land use and policy changes proposed by the project is similarly found to have the potential for significant and unavoidable indirect impacts to agricultural uses through

> introducing new urban uses within 300 feet of agriculturally zoned property and contributing to the demand for additional development and infrastructure that would further fuel conversion of agricultural lands to nonagricultural uses. Pursuant to EIR No. 441, no additional project-specific mitigation measures are feasible. Thus, impacts due to conflict with existing agricultural zoning or uses, including those leading to the conversion of designated Farmlands, as well as encroachment impacts, would be significant and unavoidable. RDEIR at 4.5-35.

Recognizing the County's failure to adopt feasible mitigation for the prior Plan's impact to agricultural resources, we fully expected that this RDEIR would correct this critical mistake with the current proposal. Yet, rather than amend the Plan's policies to establish specific requirements limiting the conversion of agricultural lands, the RDEIR preparers throw their hands up in defeat and adopt the same ill-conceived approach.

Between 2000 and 2006, Riverside County lost roughly 30% of its existing agricultural lands to conversions made in the face of increasing development pressure. RDEIR at 1.0-19. The County now has an opportunity to put a stop to this staggering rate of farmland conversion. Rather than use this Plan update as an opportunity, though, the County continues to ignore the problem. Contrary to the RDEIR's assertions, numerous mitigation measures are feasible. The simplest measure of all, of course, is to revise the Plan's proposed policies that will cause this massive conversion.

The vast majority of the proposed Plan's policies purporting to protect agricultural resources are vague and unenforceable. Policies such as OS 7.1, OS 7.3, LU 20.1, LU 20.4, for example, call for "encouraging" or "discouraging" certain actions. RDEIR at 4.5-34. As discussed above, General plan policies must be fully enforceable to be effective mitigation under CEQA. Pub. Resources Code § 21081.6(b); CEQA Guidelines § 15126.4(a)(3).

Policy OS 7.2, which suggests the County will employ land conservation programs, appears promising, but is impermissibly vague and unenforceable. The Policy states that the County will seek funding for farmland conservation and proposes to establish a Farmland Protection and Stewardship Committee to develop an agricultural preservation strategy. To be effective, this Policy should commit to a timeline for both the formation of the Committee and its development of the agricultural preservation strategy. The Policy should also require that the strategy include an evaluation of the feasibility of specific measures such as the following:

- Amending the County's agricultural preserve program to reduce the acreage of land required to establish an agricultural preserve since the County currently requires 100 contiguous acres. In addition the program should be revised to allow for smaller amounts of agricultural preserve lands if they are adjacent to designated wildlife habitat areas, such as the San Jacinto Wildlife Area.

- Expanding minimum parcel size on Important Farmland in the agricultural regions;

- Restricting subdivision of Important Farmland;

- Reducing the area of Important Farmland designated for nonagricultural uses;

Policy OS 7.2 should also commit to the study and implementation of an agricultural conservation easement ("ACE") program. ACE's have recently been upheld as a feasible and effective method of protecting off-site agricultural lands. In *Masonite Corp. v. Cnty. of Mendocino* (2013) 218 Cal.App.4th 230, a proposed project planned to convert 45 acres of prime farmland, which the agency properly recognized was a significant impact. The agency refused to mitigate for this impact by requiring the project proponent to purchase off-site agricultural easements or by paying an in-lieu fee for the agency to acquire the same. The agency claimed that such easements did not actually mitigate the project's impacts because they did not replace the lost farmland or lessen the amount of acreage that was converted.

The court emphatically disagreed, stating that an ACE "may appropriately mitigate for the direct loss of farmland when a project converts agricultural land to a nonagricultural use, even though an ACE does not replace the onsite resources. Our conclusion is reinforced by the CEQA Guidelines, case law on offsite mitigation for loss of biological resources, case law on ACEs, prevailing practice, and the public policy of this state." *Id*. at 238. As the court noted, "[t]here is no good reason to distinguish the use of offsite ACEs to mitigate the loss of agricultural lands from the offsite preservation of habitats for endangered species, an accepted means of mitigating impacts on biological resources." *Id*. at 238-39.

Here, because the RDEIR admits the Plan will have significant impacts on agricultural lands, it must take the next step and design appropriate mitigation. In California, agricultural easements are crucial: they can help maintain a critical mass of agricultural land and stave off some of the financial pressures to convert that land.

Because courts and other agencies have recognized the feasibility of this type of mitigation, the County must impose it as a condition on this Project if it goes forward.

Finally, it will be important that the agricultural preservation strategy developed by the Farmland Protection and Stewardship Committee include a comprehensive study of the varying roles that agricultural lands play throughout the County. For example, agricultural preservation in the western portion of the County, especially in highly sensitive locations such as the San Jacinto Wildlife Area, is highly valued because agricultural uses also protect crucial open space and important biological resources. In other locations, such as east County, it may make sense to allow some comparatively non-intensive uses (such as photovoltaic solar farms) to be developed on agricultural lands in order to preserve and protect sensitive habitats. This is the precise type of land use planning exercise that must be undertaken to ensure that valuable Farmland is not lost, biological resources are protected, and only appropriate development is allowed. We again encourage the County to expeditiously appoint the Farmland Protection and Stewardship Committee so that they can explore these critically important issues.

5. The RDEIR Fails to Adequately Evaluate the Environmental Implications from Planned Changes to the San Jacinto River.

The San Jacinto River flows westward from Lake Hemet in the San Jacinto Mountains, through Canyon Lake, and then to Lake Elsinore. Lakeview/Nuevo Area Plan ("LNAP") at 7. The River, a semi-natural (partially channelized with earthen berms) watercourse, is normally dry; it poses flood threats to developments within the floodplain only during storms of long duration. LNAP at 7 and RDEIR at 4.11-7.

The River is characterized by expansive overflow areas, including the Mystic Lake area. RDEIR at 4.11-6. These overflow areas are either vacant or in agricultural use, providing an important corridor for species migration and habitat preservation. *Id.*; LNAP at 5; Harvest Valley/Winchester Area Plan at 5. The River is also a major riparian corridor containing many native endemic species, which thrive on the habitat this river provides. Mead Valley Area Plan at 47. According to the Sierra Club, the River's floodplain provides habitat for sensitive plant species, including the San Jacinto Valley Crownscale, an endangered plant that relies on the gentle spreading of the River's flood waters and the floodplain's Alkali Playa soils.[18]

[18] http://www.fws.gov/carlsbad/SpeciesStatusList/5YR/20120817_5YR_ATCONO.pdf, accessed March 17, 2015.

The River is considered to have "a profound influence over the Planning Area's land use patterns." LNAP at 7. Recognizing the tremendous importance of the River and its adjacent lands, members of the public specifically requested that changes affecting the River be addressed in the context of one study area and not split amongst Area Plans. RDEIR at 2.0-8. We fully support this request. The River, its floodplains and riparian habitat constitute one hydrological system. By splitting the study of the River and its land uses among several Area Plans, it is not possible to ensure the integrity of the River's hydrology as a whole. Sound urban planning principles dictate that the County conduct a single, comprehensive study analyzing how changes to the River and nearby land uses will affect the flood zone, the floodplain, and sensitive habitats.

Unfortunately, the RDEIR fails to provide *any* analysis of impacts to the River and its environs, let alone a comprehensive analysis. To gain even a limited sense of the importance of this hydrological system and the County's ultimate plans for its modification and subsequent development, the reader must wade through various sections of the EIR, the proposed Plan, and numerous Area Plans.

For example, the Lakeview/Nuevo Area Plan ("LNAP")confirms that the County contemplates widespread changes to the San Jacinto River. A channelization project, sponsored by property owners, is intended to significantly reduce the River's flood threat and allow for the development of the broad valley through which the River flows. *Id*. at 7, 22.

The proposed Plan further discloses that the County intends to amend the River's flood zone from 500-years to 100-years. Whereas the prior Plan mapped a 500-year flood hazard zones, the proposed Plan identifies only a 100-year flood hazard zone. *See* General Plan, S-28 and Figure S-9. Although neither the proposed Plan nor the RDEIR acknowledges the purpose of this change in flood zone designation, it is clear that the change would open up considerably more land for development. *See* LNAP Policy 5.1 at LNAP at 24: Requiring new developments to remain outside 100-year flood plain.

Neither the proposed Plan nor the RDEIR discloses the nature or extent of the land use changes that will be facilitated by the channelization project and the change in the flood zone designation. The LNAP includes a cursory discussion of land uses near the River, but this information raises more questions than it answers. Tellingly, the document merely states that habitat lands that would serve as a corridor for wildlife movement, and that will be directly affected by the channelization project, have yet to be defined and that, "depending upon where these wildlife lands are identified, the underlying land use designations may change." LNAP at 22.

Perhaps most alarming, the County proposes to process these future land use changes via a technical amendment. *Id.* Inasmuch as technical amendments are not discretionary actions, these future land use changes would likely occur outside the public's view and forego any environmental review. Thus, rather than actually plan for this location -- taking the river, its hydrology and adjacent sensitive resources into account --, the County proposes to defer this important land use planning exercise until *after* the Plan is approved and in a manner that is all but certain to avoid public review and participation.

The County's refusal to grapple with this issue is particularly troubling as this type of land use planning and its associated environmental investigation is the very purpose of a general plan. Clearly the County had intended to conduct an in-depth analysis, as the Notice of Preparation for the Plan EIR states that the San Jacinto River area will be examined to determine if the Plan's policies continue to appropriately address potential intensification of the area in light of growth pressures and floodplain management plans. RDEIR, Volume 2: Technical Appendices, Part 1, page 13 ("If deemed appropriate, plans will be developed or modified to ensure that any future development of the area is accommodated in a coordinated manner in appropriate locations with suitable consideration given to environmental resources, flood hazards and other constraints affecting the region.")

While the County clearly "deems appropriate" some level of development within the River's valley, it recognizes that it cannot *approve* such land uses until the necessary environmental investigation is undertaken. The fact that the County intends to defer this critical land use and environmental planning exercise until after the Plan is approved makes a mockery of the General Plan process. Certainly the County could describe its grand vision for the River and its environs *now* and conduct proper environmental review. The public deserves this information, and CEQA requires it.

6. The RDEIR Fails to Adequate Analyze or Mitigate the Risks Resulting from the Introduction of Development into the County's Wildlands.

As the past several years have demonstrated, wildfires dramatically alter the environment in California, pose a tremendous risk of injury and death, and cause billions of dollars of damage to buildings and infrastructure. Within California, ten of the 20 largest wildland fires on record have occurred in the last decade alone. RDEIR at 4.13-28. Since 2000, the total annual average acres burned is nearly twice that burned in the pre-2000 period. *Id*. And the threat of wildfire is only increasing: warmer temperatures associated with climate change will increase the frequency of large wildfires by drying out vegetation and increasing the winds that throw embers.

Wildland fires are, of course, a serious and growing hazard in Riverside County. Many factors contribute to this hazard including extended droughts, insect predation which increase dead and dying vegetation, and many days of low humidity. RDEIR at 4.13-2, 3, 28. Because of dry vegetation and recurring Santa Ana winds, the fire danger for the County is considered extremely high during 25% of each year, throughout the months of August, September and October. *Id.* Additionally, CalFire and the US Forest Service are now referring to wildfire risk as a year-round issue.

The environmental destruction wrought by wildfires is exacerbated by development in the Wildland-Urban Interface ("WUI"), which unwisely places people and structures directly in the line of fire. More and more people are living in the WUI, which poses the most danger for wildfire conditions because of the complex mix of fuels (vegetation), topography (hills), accessibility (roads) and structures (homes). In some parts of the County, fire danger is worsened significantly by steep, rugged topography, which allows wildland fire to spread quickly and makes it more difficult to fight. RDEIR at 4.13-3. This mixture creates the perfect situation for a serious threat to the safety of both the public and firefighters as well as the County's natural lands. RDEIR at 4.13-2.

Because of this extreme risk, one would expect that the RDEIR would thoroughly describe the history of wildfires in the County, examine the potential for the proposed Plan to exacerbate these hazardous conditions and, identify comprehensive measures to reduce this risk. Indeed, in 2012 the Legislature emphasized the importance of analyzing the risks of wildfire to development and modified CEQA to require more stringent analysis of this issue. Pub. Res. Code § 21083.01. Unfortunately, the RDEIR does not undertake these necessary tasks or take the Legislature's direction seriously.

(a) The RDEIR Fails to Adequately Describe the Existing Wildfire Conditions in the County.

CEQA requires an EIR to include a description of the physical conditions in the vicinity of the project from both a local and a regional perspective. "Knowledge of the regional setting is critical to the assessment of environmental impacts." CEQA Guidelines at 15125(a) and (c). Here, the RDEIR omits the critical information required to understand the severity and extent of the wildfire risk that would occur upon implementation of the proposed Plan.

At a minimum, the RDEIR should have addressed the following questions pertaining to the County's recent wildfire history:

- What exactly is the County's rank in CalFire's list of "Wildfire Activity Statistics"?

- How many major wildland fires have occurred in the County within the last decade? How many civilian deaths, civilian injuries and firefighter deaths have occurred? How many structures were lost? How many acres of land were consumed? What was the financial cost of these fires?

- Was there adequate fire response for these wildland fire events? Were additional fire fighters recruited from across or outside the State? What was County's standard response time for wildland events? Was there sufficient water to fight the wildland fires?

- How many people in the County currently have homes and businesses in the County's wildland areas?

- Which locations within the wildland areas are considered to have inadequate access and evacuation options? Inadequate access (e.g. long roads with a single access point, roads over steep grades, improper road surfaces, and/or narrow roads) significantly contributes to the inability to effectively evacuate residents during a disaster and provide necessary emergency access for fire, ambulance, or law enforcement personnel.

- What percentage of the County's lands (i.e., conifer forests) that historically experienced frequent but low-intensity surface fires, are now predisposed to high-intensity, high-severity crown fires (because of the greater infrequency of fires due to greater fire suppression efforts)? Does the County have a controlled burn program? What is the status of funding for this program?

These are just a few of the questions that require answers so that the EIR preparers are able to evaluate the severity of the risk associated with the intensification of land uses within the County's wildlands. We request responses to these answers be included in the revised EIR or the FEIR.

(b) The RDEIR Fails to Conduct an Adequate Impact Analysis.

The RDEIR's analysis of wildfire risk (Impact 4.13.H) never discloses the amount of changed land uses that would be introduced into the County's wildlands. However, another section of the EIR provides this information, and it is alarming. Buildout of the proposed Plan would result in the introduction of approximately 16,230 acres of "wildland" uses (20-acre-plus lots), roughly 8,100 homes. RDEIR at 4.13-78. It would also result in roughly 35,000 additional acres of "rural" lands (i.e., homes on 5- to 20-acre lots) throughout Riverside County and another 10,200 acres of "interface" lands on lots of one to five acres in size. The "interface" total represents *a twenty-fold increase in the amount of people and property that would be at risk for WUI fires*. *Id.* Total build out of the updated General Plan would increase the amount of residential developed land within unincorporated Riverside County by just over 62,000 acres. *Id.* at Table 4.13-M at page 4.13-77.

Despite this massive increase in the number of people and the amount of property that would be put at risk for WUI fires, the RDEIR never discloses the actual hazard to people and property resulting from this encroachments into wildlands. The RDEIR fails, for example, to evaluate how specific wildland locations proposed for development would fare under wildfire conditions. Locational constraints such as topography, fuel loads, and access to water obviously vary tremendously in the County's wildlands. The RDEIR makes no attempt to identify those locations that should be restricted from development and those that could accommodate development based on these constraints. Other jurisdictions employ modeling tools that evaluate constraints to development. For example, San Diego County employs Fire Behavior Modeling which evaluates a worst-case scenario wildland fire based on site topography, fuel loads, atmospheric conditions and fire intensity. *See e.g.*, San Diego County Guidelines for Determining Significance Wildland Fire and Fire Protection at 9, attached as Exhibit Q. Had this RDEIR employed such a tool, it would have been able to identify the wildland locations at the most risk of wildland fire and compared them to development levels contemplated by the proposed Plan.

Another important consideration in evaluating the risks associated with wildland development is the adequacy of emergency access and emergency response. Here too, the RDEIR misses the mark entirely. Rather than evaluate the status of emergency access and response throughout the wildlands proposed for development, it simply concludes that any impacts from the proposed Plan would be *beneficial*. RDEIR at 4.13-89 (emphasis added). The RDEIR arrives at this absurd conclusion because it compares development levels contemplated by the proposed Plan to those allowed under the existing General Plan. *Id*. Comparing the proposed Plan's impacts to those that would occur under the existing General Plan is considered a "plan-to-plan" analysis, an approach CEQA prohibits. *CBD v. SCAQMD*, 158 Cal.App.4th at 1353. By conducting this plan-to-plan analysis, the RDEIR gives the public and decisionmakers the mistaken impression that the emergency access and emergency response would be adequate. *Id.* At 4.13-90,91. In fact, this is not the case. Allowing more than 62,000 acres of residential development in the County's wildlands is all but certain to adversely affect emergency access and response. The revised EIR must provide an analysis of this impact.

Notwithstanding this deficient impact analysis, the RDEIR asserts that compliance with existing regulations and General Plan policies would be sufficient to ensure that impacts relating to wildfire hazards and emergency response are less than significant. *Id*. at 4.13-91, 92. The RDEIR lacks any evidentiary support for this assertion. Indeed, a review of the regulations and policies identified in the RDEIR reveals that although certain measures may help to minimize the potential for wildland fires, they in no way eliminate the risk to public safety. For example, Ordinance No. 695 requires the abatement of "hazardous vegetation" and provides the County the *ability* to require development applicants to pay established fire protection mitigation fees that are to be used by the Riverside County Fire Department to construct new fire protection facilities. *Id*. at 4.13-50 (emphasis added). Even if the removal of hazardous vegetation and the construction of new fire protection facilities would somehow protect new development from conflagration—which has not been sufficiently demonstrated in the EIR—nothing can guarantee the safety of the County's residents.

Likewise, the proposed General Plan policies calling for such actions as meeting building safety codes (Policy S 5.1 b and c), the provision of defensible space (Policy S 5.1f), and mapping Fire Hazard Zones (Policy S 5-17) (RDEIR at 4.13-66 – 69), provide no evidence that they will be sufficient to protect County residents and property from wildfire hazards. The RDEIR identifies certain potentially strong Plan policies such as Policy S 5.4, calling for "limiting or prohibiting development in areas lacking water and access roads" but because they are voluntary they are entirely unenforceable. The policies should be modified to make them clear and enforceable. For example, Policy S 5.6 should be modified as follows (additions underlined; deletions indicated with strikeout): "All proposed developments must d~~D~~emonstrate ~~that the proposed development can provide fire services that meet~~ compliance with the minimum travel times identified in Riverside County Fire Department Fire Protection and EMS Strategic Master Plan." *See* RDEIR at 4.13-68.

The EIR must be revised to include mitigation measures, alternatives, and/or revised General Plan policies that are sufficient to reduce impacts relating to wildland fire hazard to less than significant levels. For example, the Added Community Centers Alternative would significantly reduce the risks related to wildfire and other hazards, yet the County erroneously dismisses this superior alternative as having more significant impacts than the proposed Plan.

In addition to the issues identified above regarding emergency access and response capability, the EIR must also analyze emergency evacuation standards and provide policies that ensure that evacuation will not be compromised in the event of fires. Certainly the County could consider mechanisms such as land use restrictions. In fact, the RDEIR states that fire hazards are addressed through various mechanisms including land use restrictions. RDEIR at 4.13-1. Such restrictions, especially in locations with inadequate emergency access, are necessary to protect residents and property but we can find no evidence that the County has even considered such an approach to mitigating wildfire impacts.

In sum, the wildfire risks associated with development in the County's wildlands warrant comprehensive scrutiny. The RDEIR's superficial treatment of this issue is a fatal flaw requiring recirculation.

7. The RDEIR's Transportation Impacts Mitigation Is Faulty.

The RDEIR analyzes the Plan's transportation impacts and proposes mitigation to lessen some of the significant transportation-related impacts of the Plan. However, it fails to adopt mitigation for all potentially significant impacts, stating that some

> roadways listed fall outside the jurisdiction of Riverside County (i.e. State of California and cities). These roadways similarly have impacts which require mitigation measures. However since these roadways are not within the jurisdiction of Riverside County, the impacts may potentially remain significant unless improved by others to standards that are higher than those modeled.

RDEIR at 4.18-91. The RDEIR may not identify potentially significant impacts and then abdicate all responsibility for imposing mitigation merely because other agencies may have jurisdiction over some of the potential mitigation measures. It is the County's General Plan that will cause impacts to other jurisdictions' roadways, so it is the County's responsibility to find ways to mitigate these impacts, even if it requires the cooperation of the other jurisdictions. Lead agencies may adopt mitigation that relies on other agencies' cooperation, but may only rely on this mitigation to reduce impacts if there is substantial evidence that the other agency will actually carry out the mitigation. For example, in *Neighbors for Smart Rail v. Exposition Metro Line* (2013) 57 Cal.4th 439, 465-66, a regional transportation agency adopted mitigation to address parking impacts caused by the expansion of transit facilities. While the agency did not have jurisdiction to institute restrictions on street parking, it nonetheless adopted mitigation under which it was "*required* to monitor parking in the potentially affected neighborhoods, to pay for a residential permit parking program where station spillover has resulted in a street parking shortage, and to assist in developing other measures where a residential permit program is inappropriate." *Id*. (emphasis in original). At the least, the County here must find that other agencies "can and should" adopt mitigation, and must adopt measures to support other agencies' efforts to carry out this mitigation. *See* Pub. Res. Code § 21081(a)(2); CEQA Guidelines § 15091(a)(2).

Additionally, the County can and must mitigate traffic impacts by taking actions over which it *does* have jurisdiction. For example, the County certainly has the authority to plan for higher-density, more compact, mixed land use patterns that reduce dependency on automobiles. More compact developments designed to be walkable and accessible to regional transit can greatly reduce vehicle miles traveled ("VMT"). The County could also increase its investment in public transit or require developers to mitigate transportation impacts by funding transit capital and operations instead of intersection or roadway improvements. Studies demonstrate that integrated smart growth programs that result in community design similar to what developed prior to 1950 can reduce vehicle ownership and travel by 20-40%, and significantly increase walking, cycling and public transit; the results are even more impressive if such programs are integrated with other policy changes such as increased investments in public transportation. *See* Land Use Impacts on Transportation, Victoria Transport Policy Institute, January 15, 2015, attached as Exhibit V. The RDEIR clearly acknowledges that land uses that are spread throughout a community increase the number and length of motor vehicle trips. RDEIR at 4.16-13. Inasmuch as the Plan will increase VMT by a staggering 352%, the County must consider opportunities to promote compact development and increase its commitment to alternative modes of transportation.

The County could also institute policies to manage travel demand, institute parking pricing in certain areas to discourage driving, create financial and bureaucratic incentives for transit-oriented developments, and more. The County's failure to even consider other types of mitigation for the Plan's impacts on other jurisdictions' roads is a fatal flaw.

8. The RDEIR Fails to Address the Ecological Disaster at the Salton Sea.

The General Plan refers to the Salton Sea as a "thriving water, recreation, and environmental resource." GPA Volume 1, pdf page 58. Unfortunately, nothing could be further from the truth. The deterioration of the Salton Sea is already wreaking havoc on the environment and greater threats are in store. This crisis should be front and center in the proposed General Plan Update and the RDEIR, but it appears to be ignored altogether.

There are numerous reasons that the lake levels are dropping, including wastewater treatment and recycling and changes in agricultural irrigation practices.[19][20] The diminishing water levels are causing severe environmental impacts. As the water recedes it exposes more ground to the air. Dust storms swirl, contaminating the air of areas such as Imperial Valley and Coachella Valley, which already experience some of the highest asthma rates in the state. *Id.* High salinity and fertilizer runoff regularly cause algae blooms which starve the lake of oxygen. This in turn results in numerous problems, including, for example, fish die-offs and its stench. One particularly egregious event occurred in 2012. Winds stirred decaying matter at the bottom of the lake and blew a rotten egg smell 150 miles across Southern California. *Id.* While the RDEIR includes a cursory discussion of air pollution levels in the Salton Sea Air Basin (at 4.6-6, 12), it ignores altogether the air quality threats that will continue to occur as a result of the proposed General Plan.

Further declines in the lake level will result in a significant habitat loss for fish, wildlife and more than 400 species of birds—many that migrate to this Pacific Flyway stop. *Id.* The RDEIR acknowledges the contribution that the Salton Sea makes to biodiversity through its marshes, mudflats and other wetland habitats (at 4.8-13), yet it never mentions the lake's current condition, the expectation of its continued decline, or the County's land use practices that may be contributing to this problem. This results in an unlawful failure to accurately describe existing conditions (Guidelines § 15125), and a failure to provide analysis of how the General Plan will impact this resource. To the

[19] *See* Water Official Hear Predictions of Looming Crisis at Salton Sea, Los Angeles Times, March 18, 2015, available at http://www.latimes.com/local/lanow/la-me-ln-salton-sea-20150318-story.html; accessed March 27, 2015..

[20] *See* Salton Sea Struggles to Survive, Orange County Register, March 5, 2015 available at http://www.ocregister.com/articles/sea-645924-lake-water.html; accessed March 27, 2015.

extent the General Plan allows continued development near the Sea, yet fails to take action to prevent the Sea's decline and potential environmental, it fails to adequately analyze the Plan's impacts, as required by CEQA.

We can find no plausible explanation for the County to not address this crisis in the draft General Plan. Certainly the County could play an important role in promoting environmentally sustainable wastewater treatment and recycling practices. It could also revise its agricultural irrigation goals, policies and programs to reduce this ongoing threat to the Salton Sea. The County could also work together with the state and neighboring counties to develop a plan for restoration. This General Plan Update is the appropriate forum for undertaking these critical actions.

D. The RDEIR's Analysis of Alternatives to the Proposed Plan Is Inadequate.

As discussed above, this General Plan will determine the shape of growth in Riverside County for decades to come. Determining which policies become a part of the Plan is likely to be one of the most important decisions the County Board of Supervisors will make. It is thus crucially important that the decisionmakers and the public have all of the available information before them.

This RDEIR, of course, is the main source of that information. And at the "core of an EIR" lies the analysis of alternatives. *Citizens of Goleta Valley v. Bd. of Supervisors*, (1990) 52 Cal.3d 553, 564. "Without meaningful analysis of alternatives in the EIR, neither the courts nor the public can fulfill their proper roles in the CEQA process . . . . [Courts will not] countenance a result that would require blind trust by the public, especially in light of CEQA's fundamental goal that the public be fully informed as to the environmental consequences of action by their public officials." *Laurel Heights I*, 47 Cal.3d at 404. An EIR therefore must analyze a reasonable range of alternatives to the proposed project. *Citizens for Quality Growth v. City of Mount Shasta* (1988) 198 Cal.App.3d 433, 443-45. A reasonable alternative is one that would feasibly attain most of the project's basic objectives while avoiding or substantially lessening the project's significant impacts. *See* Pub. Resources Code § 21100(b)(4); CEQA Guidelines § 15126.6(a).

The RDEIR does not comply with CEQA's standards for alternatives. First, it improperly characterizes an alternative in which future growth is directed toward cities as a "no-project" alternative.[21] This alternative assumes that no new development would be approved within the unincorporated areas of the County and that the incorporated cities would continue to grow pursuant to their individual general plans. RDEIR at 6.0-08, 10.

More troubling, the RDEIR appears to have crafted this city-centered alternative in a manner that would ensure its rejection. Because the alternative "posits no growth and no development" whatsoever, the County concludes that this "straw-man" option does not achieve the Project objectives *Id*. at 6.0-23, 24. Yet, the RDEIR could have included a more workable city-centered alternative in which future growth is directed to areas inside, or *immediately adjacent to*, the boundaries of the County's incorporated cities. The County's failure to analyze such an option violated CEQA.

Policies in the County's proposed (and existing) Plan indicate that such a city-centered alternative would have been feasible. For example:

- LU 2.1.e: "*Concentrate growth near or within existing urban and suburban areas to maintain the rural and open space character of Riverside County to the greatest extent possible*." RDEIR at 4.6-20;

- AQ 8.8: "*Promote land use patterns which reduce the number and length of motor vehicle trips*." *Id*. at 4.6-25;

- AQ 20.9: "*Reduce urban sprawl in order to minimize energy costs associated with infrastructure construction and transmission to distant locations, and to maximize protection of open space*." *Id*. at 4.6-32;

- AQ 23.1.a*: "Reduce vehicle miles traveled (VMT) through increased densities in urban centers and emphasis on mixed use to provide localized residential, commercial and employment opportunities in closer proximity to each other."* *Id*. at 4.6-35;

- AQ 23.1. b: "*Prevent urban sprawl in order to minimize energy costs associated with infrastructure construction and transmission to distant locations and to maximize protection of open space, particularly forests, which provide carbon sequestration potential*." *Id*.

[21] The RDEIR includes a second "no-project" alternative that assumes the proposed Plan is not adopted and that the existing General Plan remains the guiding document dictating future growth within unincorporated Riverside County. RDEIR at 1.0-15.

Importantly, a city-centered alternative would address many of the environmental impacts of the proposed Plan. For example, it would reduce the Plan's substantial increase in VMT. If housing is concentrated in denser areas, people will drive less because they will be closer to jobs and services and because good transit systems are easier to develop and maintain under such circumstances. The RDEIR itself recognizes this logic when it states:

> land uses that are spread throughout a community increase the number and length of motor vehicle trips and associated air pollutant emissions. This is due to the relatively few opportunities to walk, ride bicycles and use public transportation between such uses as homes and work or shopping. Compact communities often mix residential uses with or near commercial, business and employment uses, thereby reducing dependence on motor vehicles and reducing necessary vehicle trips. Smaller, higher density uses also produce less air emissions from natural gas on a per-unit basis.
> RDEIR at 4.6-13 and 14.

The city-centered alternative thus would reduce criteria, air toxic and GHG emissions. It would also protect the County's agricultural resources, result in more efficient infrastructure and public services, ease the demand on the region's water supplies and greatly reduce the risk of wildland fire.

Given the RDEIR's recognition of these impacts, it is baffling that the County did not include a workable alternative that focused future growth within or adjacent to incorporated cities. There is likely more than enough room in these urban areas to accommodate the growth projected by the County. Because the County failed to evaluate such an option, it violated CEQA. CEQA Guidelines § 15126.6(b); *Center for Biological Diversity v. County of San Bernardino* (2010) 185 Cal.App.4th 866, 884-85 (agency failed to demonstrate that a suggested alternative was infeasible).

Additionally, the RDEIR rejects a "community centers" alternative on confusing and apparently unsupported grounds. This alternative would create a more concentrated pattern of development and would reduce the overall size of the development footprint within unincorporated Riverside County by a million acres, while increasing overall residential density. RDEIR at 1.0-20—21. The RDEIR acknowledges that the alternative would reduce some impacts due to its more efficient use of land. However, it states that the alternative would only substantially lessen only one of the Plan's significant impacts, related to farmland, while having similar or worse impacts on air quality, growth inducement, greenhouse gas emissions and traffic. *Id.*; RDEIR at 6.0-5, 64. These counterintuitive conclusions are not supported by the record.

The EIR acknowledges that:

> increasing the density/intensity of an urban core can actually result in decreased traffic, noise and air pollution in some locations (particularly outlying areas) because compact development can create shorter commutes for shoppers, workers and others. Also, increased densities, and in particular, mixed use developments, can foster more walkable communities in which pedestrian and bicycle travel supplants vehicle trips for short distances, further reducing traffic and its attendant impacts

The EIR's conclusion that, despite the obvious benefits of denser development, the community centers alternative would result in greater impacts to, for example, GHG emissions, is based on the fact that this alternative is not actually equivalent to the Plan. Instead of providing the same number of new units, residents and jobs as the Plan, this alternative "would yield an increase of nearly 7,000 dwelling units and over 90,000 jobs, plus a population increase of roughly 12,600 people as compared to build out under the General Plan as amended per the project." RDEIR at 6.0-64. Thus, the EIR does not compare apples to apples. Instead, while creates an alternative that *should* have obvious and significant environmental benefits, it sets the option up to fail. Thus, the County concludes that as a result of the "density and intensity increases within the added Community Centers . . ., this alternative would have increased population-driven impacts due to the roughly 12,600 additional people and 90,000-plus jobs added . . . ." RDEIR at 6.0-65. It is only because of the differing baseline assumptions that the EIR finds the alternative's impacts to air quality, noise, water, and other resources would be greater than the Plan's impacts. *Id.*

In addition, the EIR is inconsistent in describing the alternative's impacts in relation to the Plan's impacts. It states in one place that the only impact significantly reduced by the alternative would be to farmland. RDEIR at 1.0-20—21. However, elsewhere it describes how, "[c]ompared to the project [] this alternative would result in a substantial reduction in the extent of biological impacts due to the million-plus acre reduction in the overall size of the development footprint." RDEIR at 6.0-66. Similarly, it describes how "this alternative would also provide a substantial reduction in cumulative wildfire risks and, hence, demands on fire protection services." *Id.* Thus, the first statement—that the only impact significantly reduced by the alternative would relate to farmland—appears to be incorrect.

Many of the EIR's other conclusions are confusing or unsupported by any evidence. For example, the EIR states that the alternative would cause VMT to increase by more than 50 % (RDEIR at 6.0-66), despite the fact that the alternative would create more transit-friendly urban cores and only calls for a 1 % increase in population and 16 % increase in jobs (as compared to the Plan) (RDEIR at 6.0-71). The RDEIR must explain these seemingly bizarre conclusions.

Likewise, the EIR is simply contradictory in places. It states that the alternative would increase VMT by more than 50 %, yet it also describes how the alternative's denser developments would "further the VMT reduction goals established by SCAG," thereby furthering the GHG reduction goals of AB 32. RDEIR at 6.0-67. These inconsistent statements highlight the County's error in creating an alternative that calls for a substantially different number of people, homes and jobs than the Plan. The EIR cannot accurately compare the alternative with the Plan because of these differences. At the least, the EIR should use different metrics to compare GHG emissions and VMT. For example, it should use a per capita measure of GHG emissions or energy usage, which would capture the benefits of the alternative instead of incorrectly portraying the alternative as less environmentally friendly than the Plan. *See* RDEIR at 6.0-68 (acknowledging that EIR would result in more efficient use of energy).

In reality, the community centers alternative presents an environmentally superior alternative to the Plan. The RDEIR concludes otherwise only by erroneously failing to compare apples to apples and by presenting a skewed and contradictory analysis. Planning for more dense development that would spare a million acres of rural County land from being developed would clearly have fewer impacts on energy, agriculture, biological resources, GHG emissions, and many other areas. The EIR is legally defective for failing to present an adequate analysis of alternatives that properly compares the alternative to the Plan and that fails to support its analysis with substantial evidence. *See* Guidelines § 15126.6(d).

IV. The General Plan Update and the Court Order in *Friends of the Northern San Jacinto Valley v. County of Riverside*.

A. The Riverside County Superior Court Previously Ordered the County to Set Aside Approvals Related to the Villages of Lakeview Project.

On March 23, 2010, the County approved a large development project called Villages of Lakeview. Sierra Club, Friends of the Northern San Jacinto Valley, the Center for Biological Diversity and the City of Riverside sued the County, challenging the County's approval on the grounds that the County failed to conduct adequate environment review of the project and that the project violated the County's General Plan. The Riverside County Superior Court ruled in favor of petitioners on nearly all claims. *See* Statement of Decision, attached as Exhibit E. Specifically, the court found that the County's environmental review failed to comply with CEQA in the following respects:

- The EIR failed to adequately evaluate GHG impacts because it compared the project's GHG emissions to an unreasonable, hypothetical situation rather than to existing conditions, as required by CEQA. It also failed to adequately evaluate possible mitigation of GHG impacts. *Id*. at 1-4.

- The Final EIR added substantial new information revealing that the project would cause a hundred million more miles of driving than previously disclosed, which would cause a huge increase in air pollution. The County unlawfully failed to recirculate the document after making this new disclosure. *Id*. at 4-5.

- The EIR did not adequately analyze the project's impacts on air quality and related health impacts. Specifically, the EIR made only general references to respiratory and pulmonary conditions and cancer health risks rather than providing adequate information and analysis as to the specific impacts on the general population versus sensitive receptors, or as to the degree of impacts and the specific effects on the public's health. *Id*. at 5-6.

- The EIR failed to conduct an adequate review of the project's impacts on regional traffic, and it ignored impacts of project-related traffic on nearby freeways. *Id*. at 6-7.

- The EIR did not adequately address concerns raised with respect to the project's inconsistency with a Habitat Conservation Plan. *Id*. at 9-11.

- The EIR failed to adequately address the project's growth-inducing impacts. *Id*. at 11.

On July 11, 2012, the court issued a peremptory writ of mandate ordering the County to set aside all approvals related to the project and stating that the County "shall refrain from approving these same *or new approvals relating to or implementing the Villages of Lakeview Project ("Project") until such time as the County fully complies with CEQA and State Planning and Zoning Law.*" Peremptory Writ of Mandate, attached as Exhibit R (emphasis added).

B. The Proposed General Plan Update Constitutes an Approval Relating to or Implementing the Villages of Lakeview Project.

The Draft Lakeview/Nuevo Area Plan encompasses the site of the previously proposed Villages of Lakeview project. When this draft Area Plan was first shown to the public along with the DEIR, it contained a Lakeview Mountains Policy Area that precisely overlapped with the previously-proposed Villages of Lakeview project, as demonstrated in Sierra Club's DEIR comment letter. As described in that prior comment letter, the policy area was intended specifically to promote the Villages of Lakeview project and as such, would constitute a "new approval[] relating to or implementing the Villages of Lakeview Project." Accordingly, the County needed to comply with the Riverside County Superior Court's Order before it may approve a General Plan Update that includes the Lakeview Mountains Policy Area or any other action that relates to or implements the Villages of Lakeview Project.

When it revised the DEIR, the County also revised the Area Plan by deleting the Lakeview Mountains Policy Area. *See* RDEIR at 3.0-16. Sierra Club agrees that this deletion is necessary and proper. As Sierra Club explained in its DEIR letter, the County's General Plan EIR does not provide the necessary CEQA review to allow the County to approve any policy area, area plan or other entitlement that relates to or implements the Villages of Lakeview Project; specifically, it does not correct the many legal deficiencies identified by the court in the Villages of Lakeview litigation. Please confirm that the County believes the General Plan Update and related EIR do not constitute an approval relating to or implementing the Villages of Lakeview Project.

C. The County Should Modify a Proposed Change to the General Plan's Certainty System.

The General Plan's Administrative Chapter describes a certainty system that allows amendment of certain Foundation Elements only during comprehensive General Plan updates or in extraordinary circumstances. It then lists certain findings that the Board must make in order to justify extraordinary amendments. Specifically, the Board must make two mandatory findings and one or more other findings. *See* General Plan at A-13, 14.

The General Plan update adds a new, optional finding: "i. All land use conversions from the Rural Community to Community Development Foundation Component within the City Sphere of Influence Area should be consistent with the policies outlined in the Land Use Element of Chapter 3." While Sierra Club does not object to this addition, it should not be added as simply one of the optional findings. The other optional findings (b – h) require a showing of necessity for the extraordinary amendment, whereas this one does not require any showing of necessity; it simply requires conformity with Land Use policies. If the County wishes to add this requirement, it should add it separately for all extraordinary amendments, and should not allow projects to use this finding *instead* of any of the findings in b – h. Doing so would significantly weaken the intent of the certainty system and need to justify extraordinary amendments.

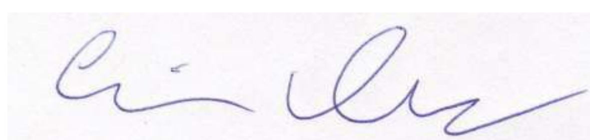
V. The RDEIR Must Be Revised and Recirculated.

CEQA requires recirculation of an EIR when significant new information is added to the document after notice and opportunity for public review was provided. Pub. Resources Code § 21092.1; CEQA Guidelines § 15088.5. *Laurel Heights Improvements Assn. v. Regents of the University of California* (1993) 6 Cal.4th 1112, 1130 .

As this letter explains, the RDEIR must be redrafted in ways that require extensive new information and analysis. This analysis will likely result in the identification of new, substantial environmental impacts or substantial increases in the severity of significant environmental impacts. Consequently, the County must again revise and recirculate the EIR for public review and comment.

Very truly yours,

SHUTE, MIHALY & WEINBERGER LLP



Rachel B. Hooper
Laurel L. Impett, AICP, Urban Planner
Erin Chalmers

cc: George Hague

List of
Exhibits

Exhibit A List of Area Plan Issues

Exhibit B California Air Resources Board, Climate Change Scoping Plan (2008)

Exhibit C	Letter from Attorney General to San Joaquin Valley Air Pollution Control District re: Final Draft Staff Report on Greenhouse Gas Emissions Under CEQA (Nov. 4, 2009)
Exhibit D	Final Statement of Reasons for Regulatory Action on the Amendments to the State CEQA Guidelines Addressing Analysis and Mitigation of Greenhouse Gas Emissions Pursuant to SB 97
Exhibit E	*Friends of the Northern San Jacinto Valley v. County of Riverside*, Statement of Decision
Exhibit F	CAPCOA, CEQA & Climate Change, January 2008
Exhibit G	Submitted with this firm's letter on the DEIR
Exhibit H	Renewable Siting Criteria for California Desert Conservation Area
Exhibit I	Press-Enterprise Articles, Air Quality in Riverside County
Exhibit J	List of studies documenting the effects of air pollution on health
Exhibit K	Marin Countywide General Plan Update EIR, Air Quality Analysis, November 2007
Exhibit L	SCAG 2012-2035 RTP/SCS Health Analysis, December 2011
Exhibit M	USC News, "New Concerns Raised About Air Pollution at LAX," May 30, 2014
Exhibit N	County of Los Angeles Public Health, Air Quality Recommendations for Local Jurisdictions
Exhibit O	Press-Enterprise Article, Jurupa Valley
Exhibit P	LEED 2009 for Neighborhood Development
Exhibit Q	San Diego County Guidelines for Determining Significance Wildland Fire and Fire Protection
Exhibit R	Peremptory Writ of Mandate, *Friends of the Northern San Joaquin Valley, et al. v. County of Riverside, et al.*
Exhibit S	Submitted with this firm's letter on the DEIR
Exhibit T	Measuring Sprawl 2014, Smart Growth America, April 2014

Exhibit U	Humboldt County General Plan Update Health Impact Assessment, March 2008
Exhibit V	Land Use Impacts on Transportation, Victoria Transport Policy Institute, January 15, 2015
Exhibit W	WRCOG Subregional Climate Action Plan, Final Draft, May 2014
Exhibit X	USDA Agricultural Census, 2012
Exhibit Y	Efficient Use of Land to Meet Sustainable Energy Needs, Rebecca R. Hernandez et. al., Nature Climate Change, March 16, 2015

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Exhibit A

Exhibit A

List of Priority Issues in Riverside County Area Plans

Desert Center Plan

- Fails to acknowledge the nearly 200,000 acre BLM designated Riverside East Solar Zone - the biggest solar project in the nation).

- Fails to include mega-solar projects planned, approved, under construction and/or operating in the Desert Center area. BLM has approved 18,000 acres of solar projects in eastern Riverside County and has applications for another 36,000 acres proposed for conversion to solar projects, for a total of 54,000 acres (more than 84 square miles) of potential industrialization. See BLM applications and authorization lists at:
http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/pa/energy/solar.Par.84447.File.dat/BLM%20Solar%20Applications%20&%20Authorizations%20April%202013..pdf

- Includes outdated features such the Eagle Mountain Landfill, despite the fact that a recent court decision makes location of a landfill in the area highly unlikely.

- Fails to include a current proposal (endorsed by FERC) for a pumped storage generating system.

- Relies on outdated aerials of Desert Center that fail to show that almost ten square miles of natural public lands around Desert Center that have already been converted to industrial solar.

- Fails to evaluate the potential biological, cultural, scenic, air quality, infrastructure, growth inducing, and other impacts resulting from these projects.

East Coachella Valley Plan

No discussion of the proposed new city in the planning stages in Shavers Valley approximately 15 miles east of Indio. This new city would be a major environmental disaster given that it would be sandwiched in between Joshua tree National Park and the Mecca Hills Wilderness.

Shavers Valley (a.k.a. Paradise Valley)
Shavers Valley is a mostly undeveloped desert bajada that sits between the southern boundary of Joshua Tree National Park ("Park") and the northern boundaries of the Mecca hills and Orocopia Wilderness areas. Located 15 miles east of Coachella, it is traversed by the I-10 Freeway and Indio at the north and Box Canyon Road at the south.

One of the main features of Shavers Valley is Pinkham Canyon, which starts about 10 miles inside the Park. I-10 traverses the Canyon. Several under-crossings along I-10 are heavily used by a wide variety of wildlife (including bighorn sheep) as they migrate back and forth between the Park and the Mecca Hills and Orocopia wilderness areas. The canyon is a major connectivity corridor that is well documented and considered vital to maintaining biological diversity. This canyon is also hydrologically connected to other drainages to the east and is subject to periodic severe flooding, frequently rendering Box Canyon Road impassable, even after a minor storm event.

The proposed development is inconsistent with the Coachella Valley Multiple Species Habitat Plan. It would destroy most dry wash woodland in the wash (6 times the amount of the allowable disturbance) and there is insufficient replacement habitat of this nature anywhere in the Plan that could be used as mitigation.

- The site is located in a Desert Tortoise and Linkage Conservation Area. Development would result in twice the amount of disturbance. Other species affected include Le Conte's thrasher (4 times the allowable disturbance) and twice the amount of disturbance allowed for corridors and linkages. Recently the Department of Fish and Wildlife released a draft report on the importance of maintaining linkages for bighorn sheep and the report states that "The long term persistence in this metapopulation fragment will likely depend on north to south movements across I-10 to maintain genetic diversity."

The above is a brief summary of the situation in Shavers Valley. Obviously there are many other facets such as water (or lack of), leap frog development issues, urban sprawl, increased traffic etc. and very limited public services in this area.

Recently GLC submitted a slightly scaled down plan through the Joint Powers Review process of a Specific Plan which only includes what they are naming "Phase 1" as part of a tiered process. This is clearly a piecemeal approach and unlawful.

Impacts to Joshua Tree National Park, Orocopia, and Mecca Hills Wilderness Areas

The urbanization of the southern boundary of the Park would be a major threat to the parks mission which is to "Preserve unimpaired for future generations". During construction, which would last for many years, the dust and noise generated by the huge earthmoving equipment would spread far beyond the site, will be seen and heard for many miles and will echo through the southern canyons of the Park. Construction would destroy and disturb much of the wildlife that inhabits the area.

As the development grows and people move in, light pollution from the area will penetrate many miles into the Park and will forever change the dark night skies that are sought after by many visitors. The increasing population will bring with it many of the ills of modern society with an increase in illegal off-road vehicle use already seen in this part of the Park. It would introduce domestic predators that would result in significant impacts to special status species.

This area of the Park is used by occasional visitors for a solitude experience in the Cottonwood Mountains, where cross country hiking can be a remarkable adventure

Palo Verde Valley

- Fails to include mega-solar projects planned, approved, under construction and/or operating in the Blythe area.

- Fails to consider alternative of using already disturbed land for public land projects. For example, large areas of fallowed agricultural lands that are no longer producing due to water transfers should be considered for renewable energy projects instead of grading pristine open desert lands.

- All of the major environmental groups unanimously advocate moving public land projects onto disturbed land, including agricultural land. (For example, joint comments on Blythe Solar). It is important that the GPU comments be consistent with the Club's position on the issue of preferentially using degraded or type converted lands in lieu of natural habitat.

- The BLM should have examined an alternative that would allow for development only within the eastern one-half of the ROW area to already degraded private lands located immediately east of the proposed project site (the "Blythe Mesa area"). Such an alternative would significantly reduce habitat loss and impacts to several species of special concern.

Lakeview/Nuevo Area Plan

- the boundary established for the plan area should be the Ramona Expressway instead of the San Jacinto River (SJR)

Page 2: Transportation means the six lane Mid County Parkway (also mentioned on page 17 as a transportation corridor and page 35 and Figure 7) . Conservation and Open Space "form distinctive edges to many or our communities" allows development too close to habitat. This idea is again mentioned on pages 37 and 38. Open Space is not just to "help define the edges of and separation between communities."

Page 3: Air Quality doesn't mention the diesel particulate matter from the goods movement industry. There is a need for an Agricultural Mitigation Bank or a program for Agricultural Easements to mitigate for lost agricultural land.

Page 5: San Jacinto River (SJR) where they mention "a channelization project." The City of LA and the Federal Government have just approved 1 billion dollars to eliminate 11 miles of channelization of the LA River and reconstruct habitat. The "property owners" mentioned in the second paragraph have been pushing for this for at least a decade so they can develop their lands. Figure 4 shows Specific Plan 183 is really hoping for this, but so are owners of lands which have no approvals.

Page 7: assumes that the channelization of the SJR is a foregone conclusion. The Plan should consider alternatives to channelization to protect the Alkali Playa (critical to endangered plants) from scouring/erosion of soils. If channelization does occur, the MSHCP requires (or recommends?) a minimum 1000-foot multi-species corridor, which includes the corridor along the SJR.

Page 7: the plan downplays the San Jacinto Wildlife Area (SJWA). It is not shown on maps and charts throughout the GPU. There are two units of the SJWA; each about 10,000 acres. One unit, referred to as the Davis Road unit, about 50 plant and animal species covered by the Riverside County MSHCP.

- The plan describes the SJWA as a Wildlife Area and not an Urban Park, but this document would lead you to believe it is there for recreational values. While it can serve the purpose of providing recreational opportunities to a limited degree, its main function should be as a Wildlife Area. The SJWA and surrounding lands are recognized during Audubon's Christmas Bird Count as being in the top 1% or 2% of all inland areas for North America for diversity of species. This includes about 25 species of raptors, which includes five species of owls. National Audubon recognizes it as an Important Birding Area (IBA).

Page 7 and 8: mention both the Lakeview and Nuevo Community as being rural, but Figure 3 shows urban uses in these areas.

Page 17 and 18: mention these communities east of the SJR, but it doesn't match Figure 3 which shows urban for much of the area. Community Centers should be in the City of Perris or further west not here.

Page 19: shows Supplementary Land Use Planning Area with Overlays over thousands of acres yet on page 8 the word overlay is crossed out. The EIR needs to show a map or figure with these overlays. Page 21 again mentions these overlays and policy areas.

Page 22: explains more on the channelization and that it will result in 500 foot wide river which is soft bottom. The Plan will allow 4 units per acre on what is now habitat.

Pages 23, 24 and 25: Outline the VOL with the Northeast Business Park and Lakeview Mountains Policy Area. The Northeast Business Park was put in place to deal with the lack of jobs by VOL that resulted in significant commuting. The Lakeview Mountains Policy Area is nothing, but the VOL. They mention that the Nuevo community "is protected by the Lakeview/Nuevo Guidelines", but in my opinion they are bringing urbanization right next door and it doesn't protect anything. Also they do not say they will protect the community of Lakeview.

Page 45: First Key biological issue is what the VOL was giving away = Lakeview Mountains.

The Reche Canyon---Badlands Area Plan

Area contains the San Jacinto Wildlife Area (SJWA) yet the SJWA is not labeled on any of the Figures.

Page 2: Conservation and Open Space: They present these issues as "virtually resolved" which is false. The Plan does not show connections/linkages between the two units of the SJWA. .... The Davis Road Unit and the Potrero Unit. Each are about 10,000 acres and the two areas are separated by Highway 79. It is critical that the two areas are connected via a safe wildlife crossing over/under Highway 79.

- The Plan includes exaggerated language such as "unprecedented commitment to their preservation" when nothing could be further from the truth.

Page 3: Air Quality: This area is heavily impacted by aircraft operations at March Air Reserve Base. Cannot assume that the diesel particulates resulting from the expansion of the air base would result in less air pollution. The increased number of trucks will offset any reduction in emissions due to improved technologies.

Page 7: SJWA/Mystic Lake: fail to mention that it is home to threatened/endangered plant and animal species. It is a cornerstone for about 50 species in the Multi-Species HCP and the endangered Stephens' Kangaroo Rat(SKR) reserve system. It is a major portion of the Audubon's Important Birding Area (IBA).

Lake Perris: Immediately adjacent to the SJWA and shares similar habitat values.

Page 15: Land Use Concepts: "Open Space areas for the preservation of publicly owned habitat" and "areas designated for Agriculture uses are located adjacent to the SJWA" gives the impression that a project like the Villages of Lakeview could not be approved. The County needs to preserve appropriate agricultural land next to publicly owned habitat.

Page 17: Overlays and Policy Areas indicated will result in land use conflicts between suburban uses (like the Villages of Lakeview) in areas that are currently agricultural areas.

Page 32 and Figure 7: Circulation: Moreno Valley to San Bernardino Corridor will have to go through Box Springs Mountain and through portions of Reche Canyon.

Figure 10: Flooding slices and dices Lake Perris Dam flood inundation into three Area Plans and doesn't do it justice. The lake level is currently lowered due to Dam weakness and because the lake is subject to subsidence.

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Exhibit B

Exhibit B




Climate Change Scoping Plan

a framework for change

DECEMBER 2008

Pursuant to AB 32
The California Global Warming Solutions Act of 2006


Prepared by
the California Air Resources Board
for the State of California

Arnold Schwarzenegger
Governor

Linda S. Adams
Secretary, California Environmental Protection Agency

Mary D. Nichols
Chairman, Air Resources Board

James N. Goldstene
Executive Officer, Air Resources Board

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APPENDICES

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EXECUTIVE SUMMARY

On September 27, 2006, Governor Schwarzenegger signed Assembly Bill 32, the Global Warming Solutions Act of 2006 (Núñez, Chapter 488, Statutes of 2006). The event marked a watershed moment in California's history. By requiring in law a reduction of greenhouse gas (GHG) emissions to 1990 levels by 2020, California set the stage for its transition to a sustainable, clean energy future. This historic step also helped put climate change on the national agenda, and has spurred action by many other states.

The California Air Resources Board (ARB or Board) is the lead agency for implementing AB 32, which set the major milestones for establishing the program. ARB met the first milestones in 2007: developing a list of discrete early actions to begin reducing greenhouse gas emissions, assembling an inventory of historic emissions, establishing greenhouse gas emission reporting requirements, and setting the 2020 emissions limit.

ARB must develop a Scoping Plan outlining the State's strategy to achieve the 2020 greenhouse gas emissions limit. This Scoping Plan, developed by ARB in coordination with the Climate Action Team (CAT), proposes a comprehensive set of actions designed to reduce overall greenhouse gas emissions in California, improve our environment, reduce our dependence on oil, diversify our energy sources, save energy, create new jobs, and enhance public health.

This "Approved Scoping Plan" was adopted by the Board at its December 11, 2008 meeting. The measures in this Scoping Plan will be developed over the next two years and be in place by 2012.

Reduction Goals

This plan calls for an ambitious but achievable reduction in California's carbon footprint. Reducing greenhouse gas emissions to 1990 levels means cutting approximately 30 percent from business-as-usual emission levels projected for 2020, or about 15 percent from today's levels. On a per-capita basis, that means reducing our annual emissions of 14 tons of carbon dioxide equivalent for every man, woman and child in California down to about 10 tons per person by 2020. This challenge also presents a magnificent opportunity to transform California's economy into one that runs on clean and sustainable technologies, so that all Californians are able to enjoy their rights in the future to clean air, clean water, and a healthy and safe environment.

Significant progress can be made toward the 2020 goal relying on existing technologies and improving the efficiency of energy use. A number of solutions are "off the shelf," and many – especially investments in energy conservation and efficiency – have proven economic benefits. Other solutions involve improving our state's infrastructure, transitioning to cleaner and more secure sources of energy, and adopting 21st century land use planning and development practices.

A Clean Energy Future

Getting to the 2020 goal is not the end of the State's effort. According to climate scientists, California and the rest of the developed world will have to cut emissions by 80 percent from today's levels to stabilize the amount of carbon dioxide in the atmosphere and prevent the most severe effects of global climate change. This long range goal is reflected in California Executive Order S-3-05 that requires an 80 percent reduction of greenhouse gases from 1990 levels by 2050.

Reducing our greenhouse gas emissions by 80 percent will require California to develop new technologies that dramatically reduce dependence on fossil fuels, and shift into a landscape of new ideas, clean energy, and green technology. The measures and approaches in this plan are designed to accelerate this necessary transition, promote the rapid development of a cleaner, low carbon economy, create vibrant livable communities, and improve the ways we travel and move goods throughout the state. This transition will require close coordination of California's climate change and energy policies, and represents a concerted and deliberate shift away from fossil fuels toward a more secure and sustainable future. This is the firm commitment that California is making to the world, to its children and to future generations.

Making the transition to a clean energy future brings with it great opportunities. With these opportunities, however, also come challenges. As the State moves ahead with the development and implementation of policies to spur this transition, it will be necessary to ensure that they are crafted to not just cut greenhouse gas emissions and move toward cleaner energy sources, but also to ensure that the economic and employment benefits that will accompany the transition are realized in California. This means that particular attention must be paid to fostering an economic environment that promotes and rewards California-based investment and development of new technologies and that adequate resources are devoted to building and maintaining a California-based workforce equipped to help make the transition.

A Public Process

Addressing climate change presents California with a challenge of unprecedented scale and scope. Success will require the support of Californians up and down the state. At every step of the way, we have endeavored to engage the public in the development of this plan and our efforts to turn the tide in the fight against global warming.

In preparing the Draft Scoping Plan, ARB and CAT subgroups held dozens of workshops, workgroups, and meetings on specific technical issues and policy measures. Since the release of the draft plan in late June, we have continued our extensive outreach with workshops and webcasts throughout the state. Hundreds of Californians showed up to share their thoughts about the draft plan, and gave us their suggestions for improving it. We've received thousands of postcards, form letters, emails, and over 1,000 unique comments posted to our website or sent by mail. All told, more than 42,000 people commented on the draft Plan.

ARB catalogued and publicly posted all the comments we received. In many instances, we engaged experts and staff at our partner agencies for additional evaluation of comments and suggestions.

This plan reflects the input of Californians at every level. Our partners at other State agencies, in the legislature, and at the local government level have provided key input. We've met with members of community groups to address environmental justice issues, with representatives of California's labor force to ensure that good jobs accompany our transition to a clean energy future, and with representatives of California's small businesses to ensure that this vital part of our state's economic engine flourishes under this plan. We've heeded the advice of public health and environmental experts throughout the state to design the plan so that it provides valuable co-benefits in addition to cutting greenhouse gases. We've also worked with representatives from many of California's leading businesses and industries to craft a plan that works in tandem with the State's efforts to continue strong economic growth.

In short, we've heard from virtually every sector of California's society and economy, reflecting the fact that the plan will touch the life of almost every Californian in some way.

Scoping Plan Recommendations

The recommendations in this plan were shaped by input and advice from ARB's partners on the Climate Action Team, as well as the Environmental Justice Advisory Committee (EJAC), the Economic and Technology Advancement Advisory Committee (ETAAC), and the Market Advisory Committee (MAC). Like the Draft Scoping Plan, the strength of this plan lies in the comprehensive array of emission reduction approaches and tools that it recommends.

Key elements of California's recommendations for reducing its greenhouse gas emissions to 1990 levels by 2020 include:

- **Expanding and strengthening existing energy efficiency programs as well as building and appliance standards;**
- **Achieving a statewide renewables energy mix of 33 percent;**
- **Developing a California cap-and-trade program that links with other Western Climate Initiative partner programs to create a regional market system;**
- **Establishing targets for transportation-related greenhouse gas emissions for regions throughout California, and pursuing policies and incentives to achieve those targets;**

- **Adopting and implementing measures pursuant to existing State laws and policies, including California's clean car standards, goods movement measures, and the Low Carbon Fuel Standard; and**
- **Creating targeted fees, including a public goods charge on water use, fees on high global warming potential gases, and a fee to fund the administrative costs of the State's long term commitment to AB 32 implementation.**

After Board approval of this plan, the measures in it will be developed and adopted through the normal rulemaking process, with public input.

Key Changes

This plan is built upon the same comprehensive approach to achieving reductions as the draft plan. However, as a result of the extensive public comment we received, this plan includes a number of general and measure-specific changes. The key changes and additions follow.

Additional Reports and Supplements

1. Economic and Public Health Evaluations: This plan incorporates an evaluation of the economic and public health benefits of the recommended measures. These analyses follow the same methodology used to evaluate the Draft Scoping Plan.[1]

2. CEQA Evaluation: This plan includes an evaluation of the potential environmental impacts of the Scoping Plan under the California Environmental Quality Act (CEQA).[2]

Programmatic Changes

1. Margin of Safety for Uncapped Sectors: The plan provides a 'margin of safety,' that is, additional reductions beyond those in the draft plan to account for measures in uncapped sectors that do not, or may not, achieve the estimated reduction of greenhouse gas emissions in this plan. Along with the certainty provided by the cap, this will ensure that the 2020 target is met.

2. Focus on Labor: The plan includes a discussion of issues directly related to California's labor interests and working families, including workforce development and career technical education. This additional element reflects ARB's existing activities and expanded efforts by State agencies, such as the Employment Development Department, to ensure that California will have a green technology workforce to address the challenges and opportunities presented by the transition to a clean energy future.

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[1] Staff will provide an update to the Board to respond to comments received on these analyses.

[2] This evaluation is contained in Appendix J.

3. Long Term Trajectory: The plan includes an assessment of how well the recommended measures put California on the long-term reduction trajectory needed to do our part to stabilize the global climate.

4. Carbon Sequestration: The plan describes California's role in the West Coast Regional Carbon Sequestration Partnership (WESTCARB), a public-private collaboration to characterize regional carbon capture and sequestration opportunities. In addition, the plan expresses support for near-term development of sequestration technology. This plan also acknowledges the important role of terrestrial sequestration in our forests, rangelands, wetlands, and other land resources.

5. Cap-and-Trade Program: The plan provides additional detail on the proposed cap-and-trade program including a discussion regarding auction of allowances, a discussion of the proposed role for offsets, the role of voluntary renewable power purchases, and additional detail on the mechanisms to be developed to encourage voluntary early action.

6. Implementation: The plan provides additional detail on implementation, tracking and enforcement of the recommended actions, including the important role of local air districts.

Changes to Specific Measures and Programs

1. Regional Targets: ARB re-evaluated the potential benefits from regional targets for transportation-related greenhouse gases in consultation with regional planning organizations and researchers at U.C. Berkeley. Based on this information, ARB increased the anticipated reduction of greenhouse gas emissions for Regional Transportation-Related Greenhouse Gas Targets from 2 to 5 million metric tons of CO_2 equivalent ($MMTCO_2E$).

2. Local Government Targets: In recognition of the critical role local governments will play in the successful implementation of AB 32, ARB added a section describing this role. In addition, ARB recommended a greenhouse gas reduction goal for local governments of 15 percent below today's levels by 2020 to ensure that their municipal and community-wide emissions match the State's reduction target.

3. Additional Industrial Source Measures: ARB added four additional measures to address emissions from industrial sources. These proposed measures would regulate fugitive emissions from oil and gas recovery and transmission activities, reduce refinery flaring, and require control of methane leaks at refineries. We

anticipate that these measures will provide 1.5 $MMTCO_2E$ of greenhouse gas reductions.

4. Recycling and Waste Re-Assessment: In consultation with the California Integrated Waste Management Board, ARB re-assessed potential measures in the Recycling and Waste sector. As a result of this review, ARB increased the anticipated reduction of greenhouse gas emissions from the Recycling and Waste Sector from 1 to 10 $MMTCO_2E$, incorporating measures to move toward high recycling and zero-waste.[3]

5. Green Building Sector: This plan includes additional technical evaluations demonstrating that green building systems have the potential to reduce approximately 26 $MMTCO_2E$ of greenhouse gases. These tools will be helpful in reducing the carbon footprint for new and existing buildings. However, most of these greenhouse gas emissions reductions will already be counted in the Electricity, Commercial/Residential Energy, Water or Waste sectors and are not separately counted toward the AB 32 goal in this plan.

6. High Global Warming Potential (GWP) Mitigation Fee: Currently many of the chemicals with very high Global Warming Potential (GWP)—typically older refrigerants and constituents of some foam insulation products—are relatively inexpensive to purchase. ARB includes in this plan a Mitigation Fee measure to better reflect their impact on the climate. The fee is anticipated to promote the development of alternatives to these chemicals, and improve recycling and removal of these substances when older units containing them are dismantled.

7. Modified Vehicle Reductions: Based on current regulatory development, ARB modified the expected emissions reduction of greenhouse gases from the Heavy-Duty Vehicle Greenhouse Gas Emission Reduction (Aerodynamic Efficiency) measure and the Tire Inflation measure. The former measure is now expected to achieve 0.9 $MMTCO_2E$ while the latter is now expected to achieve 0.4 $MMTCO_2E$.

8. Discounting Low Carbon Fuel Standard Reductions: ARB modified the expected emission reductions from the Low Carbon Fuel Standard to reflect overlap in claimed benefits with California's clean car law (the Pavley greenhouse gas vehicle standards). This has the result of discounting expected reduction of greenhouse gas emissions from the Low Carbon Fuel Standard by approximately 10 percent.

[3] Research to help quantify these greenhouse gas emissions reductions is continuing, so only 1 $MMTCO_2E$ of these reductions are currently counted toward the AB 32 goal in this plan. Additional tons will be considered part of the safety margin.

A Balanced and Comprehensive Approach

Meeting the goals of AB 32 will require a coordinated set of strategies to reduce emissions throughout the economy. These strategies will fit within the comprehensive tracking, reporting, and enforcement framework that is already being developed and implemented. By 2020, a hard and declining cap will cover 85 percent of California's greenhouse gas emissions, helping to ensure that we meet our reduction targets on time.

AB 32 lays out a number of important factors that have helped to guide the development of this plan and will continue to be considered as regulations are developed over the next few years. Some of the key criteria that have and will be further considered are: cost-effectiveness; overall societal benefits like energy diversification and public health improvements; minimization of leakage; and impacts on specific sectors like small business and disproportionately impacted communities. The comprehensive approach in the plan reflects a balance among these and other important factors and will help to ensure that California meets its greenhouse gas reduction targets in a way that promotes and rewards innovation, is consistent with and helps to foster economic growth, and delivers improvements to the environment and public health.

Many of the measures in this plan complement and reinforce one another. For instance, the Low Carbon Fuel Standard, which reduces the carbon intensity of transportation fuels sold in California, will work in tandem with technology-forcing regulations designed to reduce greenhouse gas emissions from cars and trucks. Improvements in land use and the ways we grow and build our communities will further reduce emissions from the transportation sector.

Many of the measures also build on highly successful long-standing practices in California—such as energy efficiency and the use of renewable energy resources—that can be accelerated and expanded. Increasing the amount of energy we get from renewable energy sources, including placing solar arrays and solar water heaters on houses throughout California, will be supported by an increase in building standards for energy efficiency. Other measures address the transport and treatment of water throughout the state, reduce greenhouse gas emissions that come from ships in California's ports, and promote changes to agricultural and forestry practices. There are also measures designed to safely reduce or recover a range of very potent greenhouse gases – refrigerants and other industrial gases – that contribute to global warming at a level many times greater per ton emitted than carbon dioxide.

Many of the measures in this plan are designed to take advantage of the economic and innovation-related benefits that market-based compliance strategies can provide. Particularly in light of current economic uncertainty, it is important to ensure that California's climate policies be designed to promote and take advantage of economic opportunities while also cutting greenhouse gas emissions. For instance, the cap-and-trade program creates an opportunity for firms to seek out cost-effective emission reduction strategies and provides an incentive for technological innovation. California's clean car standards, which require manufacturers to meet annual average levels of greenhouse gas emissions for all cars they sell in California, also offer flexibility to help ensure compliance. Under California's clean car standards, manufacturers who exceed compliance standards are permitted to bank credits for future use or sell them to other manufacturers. These types of compliance options will be key in ensuring that we are able to meet our reduction targets in a cost-effective manner.

Working with the Western Climate Initiative

California is working closely with six other states and four Canadian provinces in the Western Climate Initiative (WCI) to design a regional greenhouse gas emissions reduction program that includes a cap-and-trade approach. California's participation in WCI creates an opportunity to provide substantially greater reductions in greenhouse gas emissions from throughout the region than could be achieved by California alone. The larger scope of the program also expands the market for clean technologies and helps avoid leakage, that is, the shifting of emissions from sources within California to sources outside the state.

The WCI partners released the recommended design for a regional cap-and-trade program in September 2008.[4] ARB embraces the WCI effort, and will continue to work with WCI partners. The creation of a robust regional trading system can complement the other policies and measures included in this plan, and provide the means to achieve the reduction of greenhouse gas emissions needed from a wide range of sectors as cost-effectively as possible.

California's Economy, Environment, and Public Health

The approaches in this plan are designed to maximize the benefits that can accompany the transition to a clean energy economy. California has a long and successful track record of implementing environmental policies that also deliver economic benefits. This plan continues in that tradition.

AB 32: Evaluating the Economic Effects

The economic analysis of this plan indicates that implementation of the recommended strategies to address global warming will create jobs and save individual households money.[5] The analysis also indicates that measures in the plan will position California to move toward a more secure, sustainable future where we invest heavily in energy efficiency and clean technologies. The economic analysis indicates that implementation of that forward-looking approach also creates more jobs and saves individual households more money than if California stood by and pursued an unacceptable course of doing nothing at all to address our unbridled reliance on fossil fuels.

Specifically, analysis of the Scoping Plan indicates that projected economic benefits in 2020 compared to the business-as-usual scenario include:

- Increased economic production of $33 billion

[4] Details of the WCI recommendation are provided in Appendix D.

[5] See Appendix G.

- Increased overall gross state product of $7 billion
- Increased overall personal income by $16 billion
- Increased per capita income of $200
- Increased jobs by more than 100,000

Furthermore, the results of the economic analysis may underestimate the economic benefits of the plan since the models that were used do not account for savings that result from the flexibility provided under market-based programs.

AB 32: The Environmental and Public Health Costs of Inaction

A key factor that was not weighed in the overall economic analysis is the potential cost of doing nothing. When these costs are taken into account, the benefits associated with implementing a comprehensive plan to cut greenhouse gas emissions become even clearer. As a state, California is particularly vulnerable to the costs associated with unmitigated climate change.

A summary report from the California Climate Change Center notes that a warming California climate would generate more smoggy days by contributing to ozone formation while also fostering more large brush and forest fires. Continuing increases in global greenhouse gas emissions at business-as-usual rates would result, by late in the century, in California losing 90 percent of the Sierra snow pack, sea level rising by more than 20 inches, and a three to four times increase in heat wave days. These impacts will translate into real costs for California, including flood damage and flood control costs that could amount to several billion dollars in many regions such as the Central Valley, where urbanization and limited river channel capacity already exacerbate existing flood risks.[6] Water supply costs due to scarcity and increased operating costs would increase as much as $689 million per year by 2050.[7] ARB analysis shows that due to snow pack loss, California's snow sports sector would be reduced by $1.4 billion (2006 dollars) annually by 2050 and shed 14,500 jobs; many other sectors of California's economy would suffer as well.

Failing to address climate change also carries with it the risk of substantial public health costs, primarily as a result of rising temperatures. Sustained triple-digit heat waves increase the health risk for several segments of the population, especially the elderly. But higher average temperatures will also increase the interactions of smog-causing chemicals with sunlight and the atmosphere to produce higher volumes of toxic byproducts than would otherwise occur. In the 2006 report to the Governor

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[6] A Summary Report from: California Climate Change Center. *Our Changing Climate: Assessing the Risks to California.* Document No. CEC-500-2006-077. July 2006. http://www.energy.ca.gov/2006publications/CEC-500-2006-077/CEC-500-2006-077.PDF (accessed October 12, 2008)

[7] A Report from: California Climate Change Center. *Climate Warming and Water Supply Management in California*. Document No. CEC-500-2005-195-SF. March 2006. pp.13-14 http://www.energy.ca.gov/2005publications/CEC-500-2005-195/CEC-500-2005-195-SF.PDF (accessed October 12, 2008).

from the California Climate Center, it was reported that global increases in temperature will lead to increased concentrations and emissions of harmful pollutants in California.[8] Some cities in California are disproportionately susceptible to temperature increases since they already have elevated pollution levels and are subject to the heat-island effect that reduces nighttime cooling, allowing heat to build up and magnify the creation of additional harmful pollution. Low-income communities are disproportionately impacted by climate change, lacking the resources to avoid or adapt to these impacts. For example, low-income residents are less likely to have access to air conditioning to prevent heat stroke and death in heat waves. For California, then, taking action with other regions and nations to help mitigate the impacts of climate change will help slow temperature rise. This in turn will likely result in fewer premature deaths from respiratory and heat-related causes, and many thousands fewer hospital visits and days of illness.

California cannot avert the impacts of global climate change by acting alone. We can, however, take a national and international leadership role in this effort by demonstrating that taking firm and reasoned steps to address global warming can actually help spur economic growth.

AB 32: Providing Savings for Households and Businesses

This plan builds upon California's thirty-year track record of pioneering energy efficiency programs. Many of the measures in the plan will deliver significant gains in energy efficiency throughout the economy. These gains, even after increases in per unit energy costs are taken into account, will help deliver annual savings of between $400 and $500 on average by 2020 for households, including low-income households.

Businesses, both large and small, will benefit too. By 2020, the efficiency measures in the plan will decrease overall energy expenditures for businesses even after taking into account projected rises in per unit energy costs. Since small businesses spend a greater proportional share of revenue on energy-related costs, they are likely to benefit the most. Furthermore, businesses throughout the state will benefit from the overall economic growth that is projected to accompany implementation of AB 32 between now and 2020.

Similar savings are projected in the transportation sector. By reducing greenhouse gas pollution from more efficient and alternatively-fueled cars and trucks under California's Clean Car law (the Pavley greenhouse gas standards), consumers save on operating costs through reduced fuel use. Although cars will be marginally more expensive, owners will be paid back with savings over the lifetime of the car, and the average new car buyer will have an extra $30 each month for other expenditures. Current estimates indicate that consumer savings in 2020 for California's existing

[8] A Report from: California Climate Change Center. *Scenarios of Climate Change in California: An Overview*. Document No. CEC-500-2005-186-SF. February 2006. http://www.energy.ca.gov/2005publications/CEC-500-2005-186/CEC-500-2005-186-SF.PDF (accessed October 12, 2008)

clean car standards will be over $12 billion. These savings give Californians the ability to invest their dollars in other sectors of the state's economy.

AB 32: Driving Investment and Job Growth

Addressing climate change also provides a strong incentive for investment in California. Our leadership in environmental and energy efficiency policy has already helped attract a large and growing share of the nation's venture capital investment in green technologies. Since AB 32 was signed into law, venture capital investment in California has skyrocketed. In the second quarter of 2008 alone, California dominated world investment in clean technology venture capital, receiving $800 million of the global total of $2 billion.[9]

These investments in building a new clean tech sector also translate directly into job growth. A study by U.C. Berkeley's Energy and Resources Group and Goldman School of Public Policy found that investments in green technologies produce jobs at a higher rate than investments in comparable conventional technologies.[10] And the National Venture Capital Association estimates that each $100 million in venture capital funding helps create 2,700 jobs, $500 million in annual revenues for two decades and many indirect jobs.[11]

AB 32: Improving Public Health

The public health analysis conducted for this Plan indicates that cutting greenhouse gases will also provide a wide range of additional public health and environmental benefits. By 2020, the economic value alone of the additional air-quality related benefits is projected to be on the order of $4.4 billion. Our analysis indicates that implementing the Scoping Plan will result in a reduction of 15 tons per day of combustion-generated soot (PM 2.5) and 61 tons per day of oxides of nitrogen (precursors to smog). These reductions in harmful air pollution would provide the following estimated health benefits in 2020, above and beyond those projected to be achieved as a result of California's other existing public health protection and improvement efforts:

- An estimated 780 premature deaths statewide will be avoided
- Almost 12,000 incidences of asthma and lower respiratory symptoms will be avoided

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[9] Press Release from Cleantech Network LLC, *Cleantech Venture Investment Reaches Record of $2 Billion in 2008*. July 08, 2008. http://cleantech.com/about/pressreleases/011008.cfm (accessed October 12, 2008)

[10] Report of the Renewable and Appropriate Energy Laboratory. *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* Energy and Resources Group/Goldman School of Public Policy at University of California, Berkeley. April 13, 2004. http://rael.berkeley.edu/old-site/renewables.jobs.2006.pdf (accessed October 12, 2008)

[11] Report prepared for the National Venture Capital Association. *Venture Impact 2004: Venture Capital Benefits to the U.S. Economy*. Prepared by: Global Insight. June 2004. http://www.globalinsight.com/publicDownload/genericContent/07-20-04_fullstudy.pdf (accessed October 12, 2008)

- 77,000 work loss days will be avoided

In addition to the quantified health benefits, our analysis also indicates that implementation of the measures in the plan will deliver a range of other public health benefits. These include health benefits associated with local and regional transportation-related greenhouse gas targets that will facilitate greater use of alternative modes of transportation such as walking and bicycling. These types of moderate physical activities reduce many serious health risks including coronary heart disease, diabetes, hypertension and obesity.[12] Furthermore, as specific measures are developed, ARB and public health experts will work together to ensure that they are designed with an eye toward capturing a broad range of public health co-benefits.

The results of both the economic and public health analyses are clear: guiding California toward a clean energy future with reduced dependence on fossil fuels will grow our economy, improve public health, protect the environment and create a more secure future built on clean and sustainable technologies.

State Leadership

California is committed to once again lead and support a pioneering effort to protect the environment and improve public health while maintaining a vibrant economy. Every agency, department and division will bring climate change considerations into its policies, planning and analysis, building and expanding current efforts to green its fleet and buildings, and managing its water, natural resources, and infrastructure to reduce greenhouse gas emissions.

In all these efforts, California is exercising a leadership role in global action to address climate change. It is also exemplifying the essential role states play as the laboratories of innovation for the nation. As California has done in the past in addressing emissions that caused smog, the State will continue to develop innovative programs that benefit public health and improve our environment and quality of life.

Moving Beyond 2020

AB 32 requires a return to 1990 emission levels by 2020. The Scoping Plan is designed to achieve that goal. However, 2020 is by no means the end of California's journey to a clean energy future. In fact, that is when many of the strategies laid out in this plan will just be kicking into high gear.

Take, for example, the regional transportation-related greenhouse gas emissions targets. In order to achieve the deep cuts in greenhouse gas emissions we will need beyond 2020 it will be necessary to significantly change California's current land use and transportation planning policies. Although these changes will take time, getting started now will help put California

[12] Appendix H contains a reference list of studies documenting the public health benefits of alternative transportation.

on course to cut statewide greenhouse gas emissions by 80 percent in 2050 as called for by Governor Schwarzenegger.

Similarly, measures like the cap-and-trade program, energy efficiency programs, the California clean car standards, and the renewables portfolio standard will all play central roles in helping California meet its 2020 reduction requirements. Yet, these strategies will also figure prominently in California's efforts beyond 2020. Some of these measures, like energy efficiency programs and the renewables portfolio standard, have already delivered greenhouse gas emissions reduction benefits that will expand over time. Others, like the cap-and-trade program, will put in place a foundation on which to build well into the future. All of these measures, and many others in the plan, will ensure that California meets its 2020 target and is positioned to continue its international role as leader in the fight against global warming to 2050 and beyond.

A Shared Challenge

Californians are already responding to the challenge of reducing greenhouse gas emissions. Over 120 California cities and counties have signed on to the U.S. Conference of Mayors Climate Protection Agreement[13] and many have established offices of climate change and are developing comprehensive plans to reduce their carbon footprint. Well over 300 companies, municipalities, organizations and corporations are members of the California Climate Action Registry, reporting their greenhouse gas emissions on an annual basis. Many other businesses and corporations are making climate change part of their fiscal and strategic planning. ARB encourages these initial efforts and has set in place a policy to support and encourage other voluntary early reductions.

Successful implementation of AB 32 will depend on a growing commitment by a majority of companies to include climate change as an integral part of their planning and operations. Individuals and households throughout the state will also have to take steps to consider climate change at home, at work and in their recreational activities. To support this effort, this plan includes a comprehensive statewide outreach program to provide businesses and individuals with the widest range of information so they can make informed decisions about reducing their carbon footprints.

Californians will not have to wait for decades to see the benefits of a low carbon economy. New homes can achieve a near zero-carbon footprint with better building techniques and existing technologies, such as solar arrays and solar water heaters. Many older homes can be retrofitted to use far less energy than at present. A new generation of vehicles, including plug-in hybrids, is poised to appear in dealers' showrooms, and the development of the infrastructure to support hydrogen fuel cell cars continues. Cities and new developments will be more walkable, public transport will improve, and high-speed rail will give travelers a new clean transportation option.

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[13] Mayors Climate Protection Center. *List of Participating Mayors.* http://www.usmayors.org/climateprotection/list.asp (accessed October 12, 2008)

That world is just around the corner. What lies beyond is even more exciting. Where will California be in 2050? By harnessing the ingenuity and creativity of our society and sparking the imagination of the next generation of Californians, California will make the transition to a clean-energy, low-carbon society and become a healthier, cleaner and more sustainable place to live. This plan charts a course toward that future.

ARB invites comment and input from the broadest array of the public and stakeholders as we move forward over the next two years to develop the individual measures, and develop the policies that will move us toward sustainable clean energy and away from fossil fuels. Your participation will help craft the mechanisms and measures to make this plan a reality. This is California's plan and together, we need to make the necessary changes to address the greatest environmental challenge we face. As Governor Schwarzenegger stated when he signed AB 32 into law two years ago, "We owe our children and we owe our grandchildren. We simply must do everything in our power to fight global warming before it is too late."

I. INTRODUCTION: A Framework for Change

California strengthened its commitment to address climate change when Governor Schwarzenegger signed Assembly Bill 32 (AB 32), the Global Warming Solutions Act of 2006 (Núñez, Chapter 488, Statutes of 2006). This groundbreaking legislation represents a turning point for California and makes it clear that a business-as-usual approach toward greenhouse gas emissions is no longer acceptable. In light of the need for strong and immediate action to counter the growing threat of global warming, AB 32 sets forth an aggressive timetable for achieving results.

AB 32 embodies the idea that California can continue to grow and flourish while reducing its greenhouse gas emissions and continuing its long-standing efforts to achieve healthy air, and protect and enhance public health. Achieving these goals will involve every sector of the state's $1.7 trillion economy and touch the life of every Californian.

As the lead agency for implementing AB 32, the California Air Resources Board (ARB or the Board) released a Draft Scoping Plan on June 26, 2008, which laid out a comprehensive statewide plan to reduce California's greenhouse gas emissions to 1990 levels by 2020. This draft plan set forth a comprehensive reduction strategy that combines market-based regulatory approaches, other regulations, voluntary measures, fees, policies, and programs that will significantly reduce emissions of greenhouse gases and help make our state cleaner, more efficient and more secure.

Based upon the numerous comments received on the draft, as well as additional staff analysis, ARB released a *Proposed* Scoping Plan on October 15, 2008. At its November 20 and 21, 2008 meeting, the Board heard staff presentations on the Proposed Scoping Plan and directed staff to make a number of modifications. This *Approved* Scoping Plan incorporates these modifications, as well as corrections from the November 14, 2008 errata sheet, but otherwise reflects the same measures of the Proposed Scoping Plan.

The Board approved this Scoping Plan at its December 11, 2008 meeting, providing specific direction for the State's greenhouse gas emissions reduction program. The recommended measures will be developed into regulations over the next two years, to go into effect by January 1, 2012. As specific measures in the plan are developed, we will update and adjust our regulatory proposals as necessary to ensure that they reflect any new information, additional analyses, new technologies or other factors that emerge during the process.

ARB has conducted a transparent, wide-ranging public process to develop the Scoping Plan, including numerous meetings, workshops, and seminars with stakeholders. Substantial input on the development of the Scoping Plan came from formal advisory committees, meetings with industrial and business groups, non-profit organizations and members of the public, as well as written comments on the Draft Scoping Plan. ARB will continue its outreach activities to seek ongoing public input and will encourage early and continued involvement in the implementation of the plan from all Californians.

A. Summary of Changes from the Draft Scoping Plan

ARB released the June Draft Scoping Plan and requested public comment and input, while continuing to analyze the measures and their impact on California. Since the Draft Scoping Plan release, ARB received almost 1,000 unique written comments as well as hundreds of verbal comments at workshops and in meetings. Taking into account that some written comments were submitted by multiple individuals, all told more than 42,000 people have commented on the draft plan. ARB has also completed detailed economic and public health evaluations of its recommendations.

The key changes between the Draft Scoping Plan and the Scoping Plan are summarized below. The Scoping Plan includes the following modifications:

1. General

- Incorporates economic and public health analyses of the Scoping Plan. These analyses show that the recommendations in the Scoping Plan will have a net positive impact on both the economy and public health. These analyses follow the same methodology used to evaluate the Draft Scoping Plan.
- Provides a "margin of safety" by recommending additional greenhouse gas emissions reduction strategies to account for measures in uncapped sectors that do not achieve the greenhouse gas emissions reductions estimated in the Scoping Plan. Along with the certainty provided by the cap, this will ensure that the 2020 target is met.
- Expands the discussion of workforce development, education, and labor to more fully reflect existing activities and the role of other state agencies in ensuring an adequate green technology workforce.
- Assesses how well the recommended measures put California on the long-term reduction trajectory needed to do our part to stabilize the global climate.
- Describes California's role in the West Coast Regional Carbon Sequestration Partnership (WESTCARB), a public-private collaboration to characterize regional carbon capture and sequestration opportunities, and expresses support for near-term advancement of the technology and monitoring of its development. Acknowledges the important role of terrestrial sequestration.
- Provides greater detail on the mechanisms to be developed to encourage voluntary early action.
- Provides additional detail on implementation, tracking and enforcement of the recommended actions, including the important role of local air districts.

- Evaluates the potential environmental impacts of the Scoping Plan under the California Environmental Quality Act (CEQA). This evaluation is contained in Appendix J.

2. Proposed Measures

- Provides greater detail on the proposed cap-and-trade program including more detail on the allocation and auction of allowances, and clarification of the proposed role of offsets.
- Re-evaluates the potential benefits from regional targets for transportation-related greenhouse gases in consultation with regional planning organizations and researchers at U.C. Berkeley. Based on this information, ARB increased the anticipated greenhouse gas emissions reductions for Regional Transportation-Related Greenhouse Gas Targets from 2 to 5 million metric tons of CO_2 equivalent ($MMTCO_2E$).
- In recognition of the importance of local governments in the successful implementation of AB 32, adds a section describing this role and recommends a greenhouse gas emissions reduction target for local government municipal and community-wide emissions of a 15 percent reduction from current levels by 2020 to parallel the State's target.
- Adds four measures to address emissions from industrial sources. These proposed measures would regulate fugitive emissions from oil and gas recovery and gas transmission activities, reduce refinery flaring, and remove the methane exemption for refineries. These proposed measures are anticipated to provide 1.5 $MMTCO_2E$ of greenhouse gas reductions in 2020.
- In consultation with the California Integrated Waste Management Board, re-assesses potential measures in the Recycling and Waste sector. As a result of this assessment, ARB increased the reduction of greenhouse gas emissions that can ultimately be anticipated from the Recycling and Waste Sector from 1 to 10 $MMTCO_2E$, recommending measures to move toward high recycling and zero-waste. Research to help quantify these greenhouse gas emissions is continuing, so only 1 $MMTCO_2E$ of these reductions is currently counted towards the AB 32 goal in this plan.
- Estimates the potential reduction of greenhouse gas emissions from the Green Building sector. Green building systems have the potential to reduce approximately 26 $MMTCO_2E$ of greenhouse gas emissions. Since most of these emissions reductions are counted in the Electricity, Commercial/Residential Energy, Water or Waste sectors, emission reductions in the Green Building sector are not separately counted toward the AB 32 goal.
- Adds a High Global Warming Potential (GWP) Mitigation Fee measure to ensure that the climate impact of these gases is reflected in their price to encourage reduced use and end-of-life losses, as well as the development of alternatives.
- Reduces the expected greenhouse gas emissions reduction from the Heavy-Duty Vehicle Greenhouse Gas Emissions Reduction (Aerodynamic Efficiency) measure and the Tire Inflation measure based on ongoing regulatory

development. The Heavy-Duty Vehicle Greenhouse Gas Emissions Reduction (Aerodynamic Efficiency) measure is now expected to achieve 0.9 $MMTCO_2E$ and the Tire Inflation measure is now expected to achieve 0.4 $MMTCO_2E$.

- Modifies the expected reduction of greenhouse gas emissions from the Low Carbon Fuel Standard to account for potential overlap of benefits with the Pavley greenhouse gas vehicle standards. ARB discounted the expected emission reductions from the Low Carbon Fuel Standard by 10 percent.
- After further evaluation, moves the Heavy-Duty Truck Efficiency measure to the Goods Movement measure. ARB expects that market dynamics will provide an inducement to improve heavy-duty truck efficiency, and reductions in greenhouse gases in the future. ARB would consider pursuing direct requirements to reduce greenhouse gases if truck efficiency does not improve in the future.

B. Background

1. Climate Change Policy in California

California first addressed climate change in 1988 with the passage of AB 4420 (Sher, Chapter 1506, Statutes of 1988). This bill directed the California Energy Commission (CEC) to study global warming impacts to the state and develop an inventory of greenhouse gas emissions sources. In 2000, SB 1771 (Sher, Chapter 1018, Statutes of 2000) established the California Climate Action Registry to allow companies, cities and government agencies to voluntarily record their greenhouse gas emissions in anticipation of a possible program that would allow them to be credited for early reductions.

In 2001, the United Nations' Intergovernmental Panel on Climate Change (IPCC) reported that "there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities." The following year, AB 1493 (Pavley, Chapter 200, Statutes of 2002) was signed into law, requiring ARB to develop regulations to reduce greenhouse gas emissions from passenger vehicles, light-duty trucks and non-commercial vehicles sold in California.

Recognizing the value of regional partners in addressing climate change, the governors of California, Washington, and Oregon created the West Coast Global Warming Initiative in 2003 with provisions for the states to work together on climate change-related programs.

Two years later Governor Schwarzenegger signed Executive Order S-3-05, calling for the State to reduce greenhouse gas emissions to 1990 levels by 2020 and to reduce greenhouse gas emissions to 80 percent below 1990 levels by 2050. The 2020 goal was established to be an aggressive, but achievable, mid-term target, and the 2050 greenhouse gas emissions reduction goal represents the level scientists believe is necessary to reach levels that will stabilize climate.

In 2006, SB 1368 (Perata, Chapter 598, Statutes of 2006) created greenhouse gas performance standards for new long-term financial investments in base-load electricity generation serving California customers. This law is designed to help spur the transition toward cleaner energy in California by placing restrictions on the ability of utilities to build new carbon-intensive plants or enter into new contracts with high carbon sources of electricity. Expiration of existing utility long-term contracts with coal plants will reduce greenhouse gas emissions when such generation is replaced by lower greenhouse gas-emitting resources. These reductions will reduce the need for utilities to submit allowances to comply with the cap-and-trade program.

2. Assembly Bill 32: The Global Warming Solutions Act

In 2006, the Legislature passed and Governor Schwarzenegger signed AB 32, the Global Warming Solutions Act of 2006, which set the 2020 greenhouse gas emissions reduction goal into law. It directed ARB to begin developing discrete early actions to reduce greenhouse gases while also preparing a Scoping Plan to identify how best to reach the 2020 limit. The reduction measures to meet the 2020 target are to become operative by 2012.

AB 32 includes a number of specific requirements for ARB:

- *Identify the statewide level of greenhouse gas emissions in 1990 to serve as the emissions limit to be achieved by 2020 (Health and Safety Code (HSC) §38550).* In December 2007, the Board approved the 2020 emission limit of 427 million metric tons of carbon dioxide equivalent ($MMTCO_2E$) of greenhouse gases.
- *Adopt a regulation requiring the mandatory reporting of greenhouse gas emissions (HSC §38530).* In December 2007, the Board adopted a regulation requiring the largest industrial sources to report and verify their greenhouse gas emissions. The reporting regulation serves as a solid foundation to determine greenhouse gas emissions and track future changes in emission levels.
- *Identify and adopt regulations for Discrete Early Actions that could be enforceable on or before January 1, 2010 (HSC §38560.5).* The Board identified nine Discrete Early Action measures including potential regulations affecting landfills, motor vehicle fuels, refrigerants in cars, port operations and other sources in 2007. The Board has already approved two Discrete Early Action measures (ship electrification at ports and reduction of high GWP gases in consumer products). Regulatory development for the remaining measures is ongoing.
- *Ensure early voluntary reductions receive appropriate credit in the implementation of AB 32 (HSC §38562(b)(3)).* In February 2008, the Board approved a policy statement encouraging voluntary early actions and establishing a procedure for project proponents to submit quantification methods to be evaluated by ARB. ARB, along with California's local air districts and the California Climate Action Registry, is working to implement this program. Voluntary programs are discussed further in Chapter II and in Chapter IV.

- *Convene an Environmental Justice Advisory Committee (EJAC) to advise the Board in developing the Scoping Plan and any other pertinent matter in implementing AB 32 (HSC §38591).* The EJAC has met 12 times since early 2007, providing comments on the proposed Early Action measures and the development of the Scoping Plan, and submitted its comments and recommendations on the draft Scoping Plan in October 2008. ARB will continue to work with The EJAC as AB 32 is implemented.
- *Appoint an Economic and Technology Advancement Advisory Committee (ETAAC) to provide recommendations for technologies, research and greenhouse gas emission reduction measures (HSC §38591).* After a year-long public process, The ETAAC submitted a report of their recommendations to the Board in February 2008. The ETAAC also reviewed and provided comments on the Draft Scoping Plan.

3. Climate Action Team

In addition to establishing greenhouse gas emissions reduction targets for California, Executive Order S-3-05 established the Climate Action Team (CAT) for State agencies in 2005. Chaired by the Secretary of the California Environmental Protection Agency (CalEPA), the CAT has helped to direct State efforts on the reduction of greenhouse gas emissions and engage key State agencies including ARB. The Health and Human Services Agency, represented by the Department of Public Health, is the newest member of the CAT. Based on numerous public meetings and the review of thousands of submitted comments, the CAT released its first report in March 2006, identifying key carbon reduction recommendations for the Governor and Legislature.

Climate Action Team
California Environmental Protection Agency
Business, Transportation, and Housing Agency
Health and Human Services Agency
Resources Agency
State and Consumer Services Agency
Governor's Office of Planning and Research
Air Resources Board
California Energy Commission
California Public Utilities Commission
Department of Food and Agriculture
Department of Forestry and Fire Protection
Department of General Services
Department of Parks and Recreation
Department of Transportation
Department of Water Resources
Integrated Waste Management Board
State Water Resources Control Board

In April 2007, the CAT released a second report, "Proposed Early Actions to Mitigate Climate Change in California," which details numerous strategies that should be initiated prior to the 2012 deadline for other climate action regulations and efforts.

AB 32 recognizes the essential role of the CAT in coordinating overall climate policy. AB 32 does not affect the existing authority of other state agencies, and in addition to

ARB, many state agencies will be responsible for implementing the measures and strategies in this plan. The CAT is central to the success of AB 32, which requires an unprecedented level of cooperation and coordination across State government. The CAT provides the leadership for these efforts and helps ARB work closely with our state partners on the development and implementation of the strategies in the Scoping Plan.

There are currently 12 subgroups within the CAT – nine that address specific economic sectors, and three that were formed to analyze broad issues related to implementing a multi-sector approach to greenhouse gas emissions reduction efforts. The CAT sector-based subgroups include: Agriculture, Cement, Energy, Forest, Green Buildings, Land Use, Recycling and Waste Management, State Fleet, and Water-Energy. The members of these subgroups are drawn from departments that work with or regulate industries in the sector. ARB participated in each of the subgroups. All of the subgroups held public meetings and solicited public input, and many had multiple public workshops.

In March 2008, the subgroups collectively submitted more than 100 greenhouse gas emissions reduction measures to ARB for consideration in the Draft Scoping Plan. Many of those recommendations are reflected in this plan, and a number of them focus on reducing greenhouse gas emissions from energy production and use.

Through the Energy Subgroup the California Energy Commission (CEC) and the California Public Utilities Commission (CPUC) are conducting a joint proceeding to provide recommendations on how best to address electricity and natural gas in the implementation of AB 32, including evaluation of how the Electricity sector might best participate in a cap-and-trade program. The two Commissions forwarded interim recommendations to ARB in March 2008 that supported inclusion of the Electricity sector in a multi-sector cap-and-trade program, and measures to increase the penetration of energy efficiency programs in both buildings and appliances and to increase renewable energy sources. The two Commissions have developed a second proposed decision that was released in September 2008. This proposed decision provides more detailed recommendations that relate to the electricity and natural gas sectors. Because implementation of the Scoping Plan will require careful coordination with the State's energy policy, ARB will continue working closely with the two Commissions on this important area during the implementation of the recommendations in the Scoping Plan.

There are also three subgroups which are not sector-specific. The Economic Subgroup reviewed cost information associated with potential measures that were included in the 2006 CAT report with updates reflected in the report, "Updated Macroeconomic Analysis of Climate Strategies," in October 2007. This report provided an update of the macroeconomic analysis presented in the March 2006 CAT report to Governor Schwarzenegger and the Legislature. The Research Subgroup coordinates climate change research and identifies opportunities for collaboration, and is presently working on a report to the Governor. The State Operations Subgroup has been created to work with State agencies to create a statewide plan to reduce State government's greenhouse gas emissions by a minimum of 30 percent by 2020.

In the first quarter of 2009, the Climate Action Team will release a report on its activities outside of its involvement in the development of the Scoping Plan. The CAT report will focus on several cross-cutting topics with which members of the CAT have been involved since the publication of the 2006 CAT report. The topics to be covered include research on the physical and consequent economic impacts of climate change as well as climate change research coordination efforts among the CAT members. There will also be an update on the important climate change adaptation efforts led by the Resources Agency and a discussion of cross-cutting issues related to environmental justice concerns. The CAT report will be released in draft form and will be available for public review in December 2008.

4. Development of the Greenhouse Gas Emission Reduction Strategy

In developing the Scoping Plan, ARB considered the State's existing climate change policy initiatives and the Early Action measures identified by the Board. Several advisory groups were formed to assist ARB in developing the Scoping Plan, including the Environmental Justice Advisory Committee (EJAC), the Economic and Technology Advancement Committee (ETAAC), and the Market Advisory Committee (MAC).

The Environmental Justice Advisory Committee (HSC §38591(a) et seq) advises ARB on development of the Scoping Plan and any other pertinent matter in implementing AB 32. The Board appoints its members, based on nominations received from environmental justice organizations and community groups.

The Economic and Technology Advancement Advisory Committee (HSC §38591(d)) includes members who are appointed by the Board based on expertise in fields of business, technology research and development, climate change, and economics. The ETAAC advises ARB on activities that will facilitate investment in, and implementation of, technological research and development opportunities, funding opportunities, partnership development, technology transfer opportunities, and related areas that lead to reductions of greenhouse gas emissions.

Members of the Market Advisory Committee (created under Executive Order S-20-06) were appointed by the Secretary of CalEPA based on their expertise in economics and climate change. The MAC advised ARB on the design of a cap-and-trade program for reducing greenhouse gas emissions.

Along with input from the advisory groups, ARB received submittals to a public solicitation for ideas, and numerous comments during public workshops, workgroup meetings, community meetings, and meetings with stakeholder groups. ARB held numerous workshops on the Draft Scoping Plan and convened workgroup meetings focused on program design and economic analysis. ARB and other involved State agencies also held sector-specific technical workshops to look in greater detail at potential emissions reduction measures.

ARB also looked outward to examine programs at the regional, national and international levels. ARB met with and learned from experts from the European Union, the United Kingdom, Japan, Australia, the United Nations, the Regional Greenhouse Gas Initiative, the RECLAIM program, and the U.S. Environmental Protection Agency (U.S. EPA).

After the release of the Draft Scoping Plan, ARB conducted workshops and community meetings around the state to solicit public input. The Environmental Justice Advisory Committee and the Economic and Technology Advancement Advisory Committee held meetings to review and provide additional comments on the Draft Scoping Plan. In addition, ARB held meetings with numerous stakeholder groups to discuss specific greenhouse gas emissions reduction measures.

As described before, ARB has reviewed and considered both the written comments and the verbal comments received at the public workshops and meetings with stakeholders. This input, along with additional analysis, has ultimately shaped this Scoping Plan.

5. Implementation of the Scoping Plan

The foundation of the Scoping Plan's strategy is a set of measures that will cut greenhouse gas emissions by nearly 30 percent by the year 2020 as compared to business as usual and put California on a course for much deeper reductions in the long term. In addition to pursuing the reduction of greenhouse gas emissions, other strategies to mitigate climate change, such as carbon capture and storage (underground geologic storage of carbon dioxide), should also be further explored. And, as greenhouse gas reduction measures are implemented, we will continually evaluate how these measures can be optimized to also help deliver a broad range of public health benefits.

Most of the measures in this Scoping Plan will be implemented through the full rulemaking processes at ARB or other agencies. These processes will provide opportunity for public input as the measures are developed and analyzed in more detail. This additional analysis and public input will likely provide greater certainty about the estimates of costs and expected greenhouse gas emission reductions, as well as the design details that are described in this Scoping Plan. With the exception of Discrete Early Actions, which will be in place by January 1, 2010, other regulations are expected to be adopted by January 1, 2011 and take effect at the beginning of 2012.

Some of the measures in the plan may deliver more emission reductions than we expect; others less. It is also very likely that we will figure out new and better ways to cut greenhouse gas emissions as we move forward. New technologies will no doubt be developed, and new ideas and strategies will emerge. The Scoping Plan puts

California squarely on the path to a clean energy future but it also recognizes that adjustments will probably need to occur along the way and that as additional tools become available they will augment, and in some cases perhaps even replace, existing approaches.

California will not be implementing the measures in this Plan in a vacuum. Significant new action on climate policy is likely at the federal level and California and its partners in the Western Climate Initiative are working together to create a regional effort for achieving significant reductions of greenhouse gas emissions throughout the western United States and Canada. California is also developing a state Climate Adaptation Strategy to reduce California's vulnerability to known and projected climate change impacts.

ARB and other State agencies will continue to monitor, lead and participate in these broader activities. ARB will adjust the measures described here as necessary to ensure that California's program is designed to facilitate the development of integrated and cost-effective regional, national, and international greenhouse gas emissions reduction programs. (HSC §38564)

6. Climate Change in California

The impacts of climate change on California and its residents are occurring now. Of greater concern are the expected future impacts to the state's environment, public health and economy, justifying the need to sharply cut greenhouse gas emissions.

In the Findings and Declarations for AB 32, the Legislature found that:

> "The potential adverse impacts of global warming include the exacerbation of air quality problems, a reduction in quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to the marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other health-related problems."

The Legislature further found that global warming would cause detrimental effects to some of the state's largest industries, including agriculture, winemaking, tourism, skiing, commercial and recreational fishing, forestry, and the adequacy of electrical power.

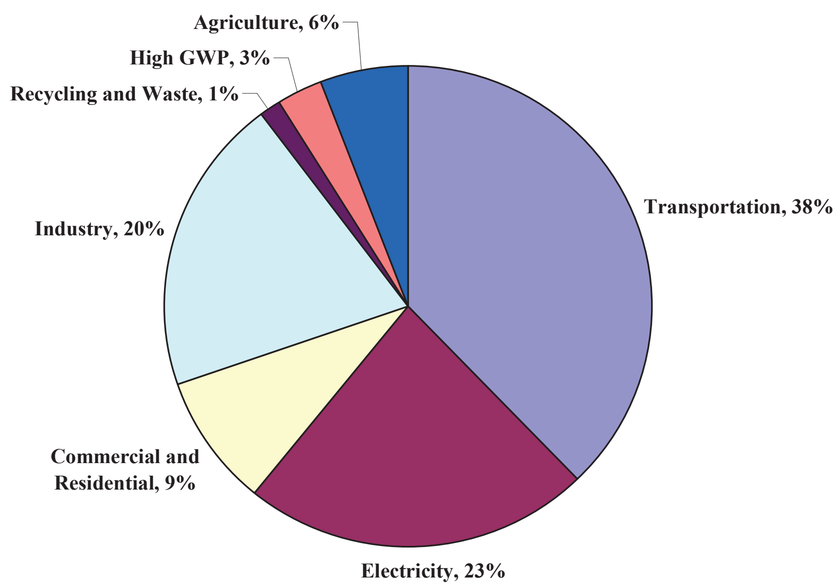
The impacts of global warming are already being felt in California. The Sierra snowpack, an important source of water supply for the state, has shrunk 10 percent in the last 100 years. It is expected to continue to decrease by as much as 25 percent by 2050. World-wide changes are causing sea levels to rise – about 8 inches of increase has been recorded at the Golden Gate Bridge over the past 100 years – threatening low coastal areas with inundation and serious damage from storms.

C. California's Greenhouse Gas Emissions and the 2020 Target

California is the fifteenth largest emitter of greenhouse gases on the planet, representing about two percent of the worldwide emissions. Although carbon dioxide is the largest contributor to climate change, AB 32 also references five other greenhouse gases: methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). Many other gases contribute to climate change and would also be addressed by measures in this Scoping Plan.

Figure 1 and Table 1 show 2002 to 2004 average emissions and estimates for projected emissions in 2020 without any greenhouse gas reduction measures (business-as-usual case). The 2020 business-as-usual forecast does not take any credit for reductions from measures included in this Plan, including the Pavley greenhouse gas emissions standards for vehicles, full implementation of the Renewables Portfolio Standard beyond current levels of renewable energy, or the solar measures. Additional information about the assumptions in the 2020 forecast is provided in Appendix F.

Figure 1: California's Greenhouse Gas Emissions (2002-2004 Average)[14]



As seen in Figure 1, the Transportation sector – largely the cars and trucks that move goods and people – is the largest contributor with 38 percent of the state's total greenhouse gas emissions. Table 1 shows that if we take no action, greenhouse gas emissions in the

[14] Air Resources Board. Greenhouse Gas Inventory. http://www.arb.ca.gov/cc/inventory/inventory.htm (accessed October 12, 2008)

Transportation sector are expected to grow by approximately 25 percent by 2020 (an increase of 46 $MMTCO_2E$).

The Electricity and Commercial/Residential Energy sector is the next largest contributor with over 30 percent of the statewide greenhouse gas emissions. Although electricity imported into California accounts for only about a quarter of our electricity, imports contribute more than half of the greenhouse gas emissions from electricity because much of the imported electricity is generated at coal-fired power plants. AB 32 specifically requires ARB to address emissions from electricity sources both inside and outside of the state.

California's Industrial sector includes refineries, cement plants, oil and gas production, food processors, and other large industrial sources. This sector contributes almost 20 percent of California's greenhouse gas emissions, but the sector's emissions are not projected to grow significantly in the future. The sector termed recycling and waste management is a unique system, encompassing not just emissions from waste facilities but also the emissions associated with the production, distribution and disposal of products throughout the economy.

Although high global warming potential (GWP) gases are a small contributor to historic greenhouse gas emissions, levels of these gases are projected to increase sharply over the next several decades, making them a significant source by 2020.

The Forest sector is unique in that forests both emit greenhouse gases and uptake carbon dioxide (CO_2). While the current inventory shows forests as a sink of 4.7 $MMTCO_2E$, carbon sequestration has declined since 1990. For this reason, the 2020 projection assumes no net emissions from forests.

The agricultural greenhouse gas emissions shown are largely methane emissions from livestock, both from the animals and their waste. Emissions of greenhouse gases from fertilizer application are also important contributors from the Agricultural sector. ARB has begun a research program to better understand the variables affecting these emissions. Opportunities to sequester CO_2 in the Agricultural sector may also exist; however, additional research is needed to identify and quantify potential sequestration benefits.

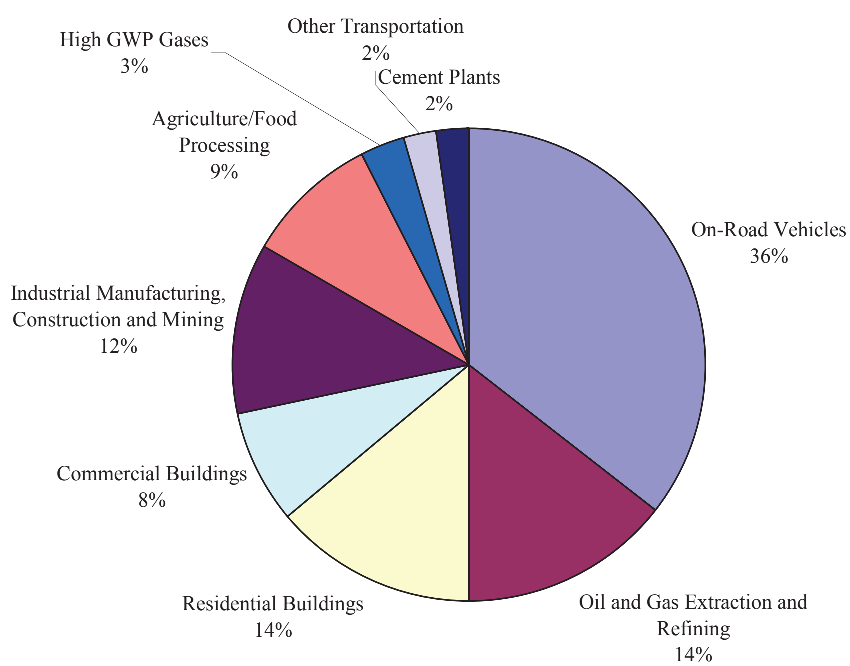
In December 2007, ARB approved a greenhouse gas emissions target for 2020 equivalent to the state's calculated greenhouse gas emissions level in 1990. ARB developed the 2020 target after extensive technical work and a series of stakeholder meetings. The 2020 target of 427 $MMTCO_2E$ requires the reduction of 169 $MMTCO_2E$, or approximately 30 percent, from the state's projected 2020 emissions of 596 $MMTCO_2E$ (business-as-usual) and the reduction of 42 $MMTCO_2E$, or almost 10 percent, from 2002-2004 average emissions.

Table 1: 2002-2004 Average Emissions and 2020 Projected Emissions (Business-as-Usual)[15] (MMTCO$_2$E)

Sector	2002-2004 Average Emissions	Projected 2020 Emissions [BAU]
Transportation	179.3	225.4
Electricity	109.0	139.2
Commercial and Residential	41.0	46.7
Industry	95.9	100.5
Recycling and Waste	5.6	7.7
High GWP	14.8	46.9
Agriculture	27.7	29.8
Forest Net Emissions	-4.7	0.0
Emissions Total	**469**	**596**

Figure 2 presents California's historic greenhouse gas emissions in a different way – based not on the source of the emissions, but on the end use. This chart highlights the importance of addressing on-road transportation sources of greenhouse gas emissions, as well as the significant contribution from the heating, cooling, and lighting of buildings.

Figure 2: California's Greenhouse Gas Emissions – A Demand-Side View –



[15] Ibid.

The data shown in this section provide two ways to look at California's greenhouse gas profile – emissions-based and end use (demand side)-based. While it is possible to illustrate the inventory many different ways, no chart or graph can fully display how diverse economic sectors fit together. California's economy is a web of activity where seemingly independent sectors and subsectors operate interdependently and often synergistically. For example, reductions in water use reduce the need to pump water, directly lowering electricity use and associated greenhouse gas emissions. Similarly, reducing the generation of waste reduces the need to transport the waste to landfills – lowering transportation emissions and, possibly, landfill methane emissions. Increased recycling or re-use reduces the carbon emissions embedded in products – it takes less energy to make a soda can made from recycled aluminum than from virgin feedstock.

The measures included in this Scoping Plan are identified discretely, but many impact each other, and changes in one measure can directly overlap and have a ripple effect on the efficacy and success of other measures. The measures and policies outlined in this Plan reflect these interconnections, and highlight the need for all agencies to work collaboratively to implement the Scoping Plan.

II. RECOMMENDED ACTIONS

Achieving the goals of AB 32 in a cost-effective manner will require a wide range of approaches. Every part of California's economy needs to play a role in reducing greenhouse gas emissions. ARB's comprehensive greenhouse gas emissions inventory lists emission sources ranging from the largest refineries and power plants to small industrial processes and farm livestock. The recommended measures were developed to reduce greenhouse gas emissions from key sources and activities while improving public health, promoting a cleaner environment, preserving our natural resources, and ensuring that the impacts of the reductions are equitable and do not disproportionately impact low-income and minority communities. These measures also put the state on a path to meet the long-term 2050 goal of reducing California's greenhouse gas emissions to 80 percent below 1990 levels. This trajectory is consistent with the reductions that are needed globally to help stabilize the climate. While the scale of this effort is considerable, our experience with cultural and technological changes makes California well-equipped to handle this challenge.

ARB evaluated a comprehensive array of approaches and tools to achieve these emission reductions. Reducing greenhouse gas emissions from the wide variety of sources can best be accomplished though a cap-and-trade program along with a mix of complementary strategies that combine market-based regulatory approaches, other regulations, voluntary measures, fees, policies, and programs. ARB will monitor implementation of these measures to ensure that the State meets the 2020 limit on greenhouse gas emissions.

An overall limit on greenhouse gas emissions from most of the California economy – the "capped sectors" – will be established by the cap-and-trade program. (The basic elements of the cap-and-trade program are described later in this chapter.) Within the capped sectors, some of the reductions will be accomplished through direct regulations such as improved building efficiency standards and vehicle efficiency measures. Whatever additional reductions are needed to bring emissions within the cap are accomplished through price incentives posed by emissions allowance prices. Together, direct regulation and price incentives assure that emissions are brought down cost-effectively to the level of the overall cap. ARB also recommends specific measures for the remainder of the economy – the "uncapped sectors."

Key elements of California's recommendations for reducing its greenhouse gas emissions to 1990 levels by 2020 include:

- **Expanding and strengthening existing energy efficiency programs as well as building and appliance standards;**
- **Achieving a statewide renewables energy mix of 33 percent;**
- **Developing a California cap-and-trade program that links with other Western Climate Initiative partner programs to create a regional market system;**
- **Establishing targets for transportation-related greenhouse gas emissions for regions throughout California and pursuing policies and incentives to achieve those targets;**
- **Adopting and implementing measures pursuant to existing State laws and policies, including California's clean car standards, goods movement measures, and the Low Carbon Fuel Standard; and**
- **Creating targeted fees, including a public goods charge on water use, fees on high global warming potential gases, and a fee to fund the administrative costs of the State's long-term commitment to AB 32 implementation.**

The recommended greenhouse gas emissions reduction measures are listed in Table 2 and are summarized in Section C below. The total reduction for the recommended measures slightly exceeds the 169 $MMTCO_2E$ of reductions estimated in the Draft Scoping Plan. This is the net effect of adding several measures and adjusting the emission reduction estimates for some other measures. The 2020 emissions cap in the cap-and-trade program is preserved at the same level as in the Draft Scoping Plan (365 $MMTCO_2E$).

The measures listed in Table 2 lead to emissions reductions from sources within the capped sectors (146.7 $MMTOCO_2E$) and from sources or sectors not covered by cap-and-trade (27.3 $MMTCO_2E$). As mentioned, within the capped sectors the reductions derive both from direct regulation and from the incentives posed by allowance prices. Further discussion of how the cap-and-trade program and the complementary measures work together to achieve the overall target is provided below.

Table 2 also lists several other recommended measures which will contribute toward achieving the 2020 statewide goal, but whose reductions are not (for various reasons including the potential for double counting) additive with the other measures. Those measures and the basis for not including their reductions are further discussed in Section C.

Table 2: Recommended Greenhouse Gas Reduction Measures

Recommended Reduction Measures	Reductions Counted Towards 2020 Target ($MMTCO_2E$)	
ESTIMATED REDUCTIONS RESULTING FROM THE COMBINATION OF CAP-AND-TRADE PROGRAM AND COMPLEMENTARY MEASURES		**146.7**
California Light-Duty Vehicle Greenhouse Gas Standards • Implement Pavley standards • Develop Pavley II light-duty vehicle standards	31.7	
Energy Efficiency • Building/appliance efficiency, new programs, etc. • Increase CHP generation by 30,000 GWh • Solar Water Heating (AB 1470 goal)	26.3	
Renewables Portfolio Standard (33% by 2020)	21.3	
Low Carbon Fuel Standard	15	
Regional Transportation-Related GHG Targets[16]	5	
Vehicle Efficiency Measures	4.5	
Goods Movement • Ship Electrification at Ports • System-Wide Efficiency Improvements	3.7	
Million Solar Roofs	2.1	
Medium/Heavy Duty Vehicles • Heavy-Duty Vehicle Greenhouse Gas Emission Reduction (Aerodynamic Efficiency) • Medium- and Heavy-Duty Vehicle Hybridization	1.4	
High Speed Rail	1.0	
Industrial Measures (for sources covered under cap-and-trade program) • Refinery Measures • Energy Efficiency & Co-Benefits Audits	0.3	
Additional Reductions Necessary to Achieve the Cap	34.4	
ESTIMATED REDUCTIONS FROM UNCAPPED SOURCES/SECTORS		**27.3**
High Global Warming Potential Gas Measures	20.2	
Sustainable Forests	5.0	
Industrial Measures (for sources not covered under cap and trade program) • Oil and Gas Extraction and Transmission	1.1	
Recycling and Waste (landfill methane capture)	1.0	
TOTAL REDUCTIONS COUNTED TOWARDS 2020 TARGET		**174**

Other Recommended Measures	Estimated 2020 Reductions ($MMTCO_2E$)
State Government Operations	1-2
Local Government Operations	TBD
Green Buildings	26
Recycling and Waste • Mandatory Commercial Recycling • Other measures	9
Water Sector Measures	4.8
Methane Capture at Large Dairies	1.0

[16] This number represents an estimate of what may be achieved from local land use changes. It is not the SB 375 regional target. ARB will establish regional targets for each Metropolitan Planning Organization (MPO) region following the input of the Regional Targets Advisory Committee and a public consultation process with MPOs and other stakeholders per SB 375.

The development of a California cap-and-trade program that links with other Western Climate Initiative partner programs to create a regional market system is a central feature of the overall recommendation. This program will lead to prices on greenhouse gas emissions, prices that will spur reductions in greenhouse gas emissions throughout the California economy, through application of existing technologies and through the creation of new technological and organizational options. The rationale for combining a cap-and-trade program with complementary measures was outlined by the Market Advisory Committee, which noted the following in its recommendations to the ARB:

> Before setting out the key design elements of a cap-and-trade program it is important to explain how the proposed emissions trading approach relates to other policy measures. The following considerations seem especially relevant:
>
> - The emissions trading program puts a cap on the total emissions generated by facilities covered under the system. Because a certain number of emissions allowances are put in circulation in each compliance period, this approach provides a measure of certainty about the total quantity of emissions that will be released from entities covered under the program.
> - The market price of emissions allowances yields an enduring price signal for GHG emissions across the economy. This price signal provides incentives for the market to find new ways to reduce emissions.
> - By itself, a cap-and-trade program alone will not deliver the most efficient mitigation outcome for the state. There is a strong economic and public policy basis for other policies that can accompany an emissions trading system.[17]

The Economic and Technology Advancement Advisory Committee (ETAAC) also addressed the benefits associated with a combined policy of cap and trade and complementary measures.

> A declining cap can send the right price signals to shape the behavior of consumers when purchasing products and services. It would also shape business decisions on what products to manufacture and how to manufacture them. Establishing a price for carbon and other GHG emissions can efficiently tilt decision-making toward cleaner alternatives. This cap and trade approach (complemented by technology-forcing performance standards) avoids the danger of having government or other centralized decision-makers choose specific technologies, thereby limiting the flexibility to allow other options to emerge on a level playing field.

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[17] Recommendations of the Market Advisory Committee to the California Air Resources Board. *Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California*. June 30, 2007. p. 19. http://www.climatechange.ca.gov/publications/market_advisory_committee/2007-06-29_MAC_FINAL_REPORT.PDF (accessed October 12, 2008)

> If markets were perfect, such a cap and trade system would bring enough new technologies into the market and stimulate the necessary industrial RD&D to solve the climate change challenge in a cost effective manner. As the Market Advisory Committee notes, however, placing a price on GHG emissions addresses only one of many market failures that impede solutions to climate change. Additional market barriers and co-benefits would not be addressed if a cap and trade system were the only state policy employed to implement AB 32. Complementary policies will be needed to spur innovation, overcome traditional market barriers (e.g., lack of information available to energy consumers, different incentives for landlords and tenants to conserve energy, different costs of investment financing between individuals, corporations and the state government, etc.) and address distributional impacts from possible higher prices for goods and services in a carbon-constrained world.[18]

The Environmental Justice Advisory Committee (EJAC) also supports an approach that includes a price on carbon along with complementary measures. Although the EJAC recommends that the carbon price be established through a carbon fee rather than through a cap-and-trade program, they recognize the importance of mutually supportive policies:

> California should establish a three-pronged approach for addressing greenhouse gases: (1) adopting standards and regulations; (2) providing incentives; and (3) putting a price on carbon via a carbon fee. The three pieces support one another and no single prong can work without equally robust support from the others.[19]

In keeping with the rationale outlined above, ARB finds that it is critically important to include complementary measures directed at emission sources that are included in the cap-and-trade program. These measures are designed to achieve cost-effective emissions reductions while accelerating the necessary transition to the low-carbon economy required to meet the 2050 target:

- The already adopted Light-Duty Vehicle Greenhouse Gas Standards are designed to accelerate the introduction of low-greenhouse gas emitting vehicles, reduce emissions and save consumers money at the pump.
- The Low Carbon Fuel Standard (LCFS) is a flexible performance standard designed to accelerate the availability and diversity of low-carbon fuels by taking into consideration the full life-cycle of greenhouse gas emissions. The LCFS will reduce emissions and make our economy more resilient to future petroleum price volatility.
- The Regional Transportation-Related Greenhouse Gas Targets provide incentives for channeling investment into integrated development patterns and transportation

[18] Recommendations of the Economic and Technical Advancement Advisory Committee (ETAAC), Final Report. *Technologies and Policies to Consider for Reducing Greenhouse Gas Emissions in California*. February 14, 2008. pp. 1-4 http://www.arb.ca.gov/cc/etaac/ETAACFinalReport2-11-08.pdf (accessed October 12, 2008)

[19] Recommendations and Comments of the Environmental Justice Advisory Committee on the Implementation of the Global Warming Solutions Act of 2006 (AB32) on the Draft Scoping Plan. October 2008. p. 10. http://www.arb.ca.gov/cc/ejac/ejac_comments_final.pdf (accessed October 12, 2008)

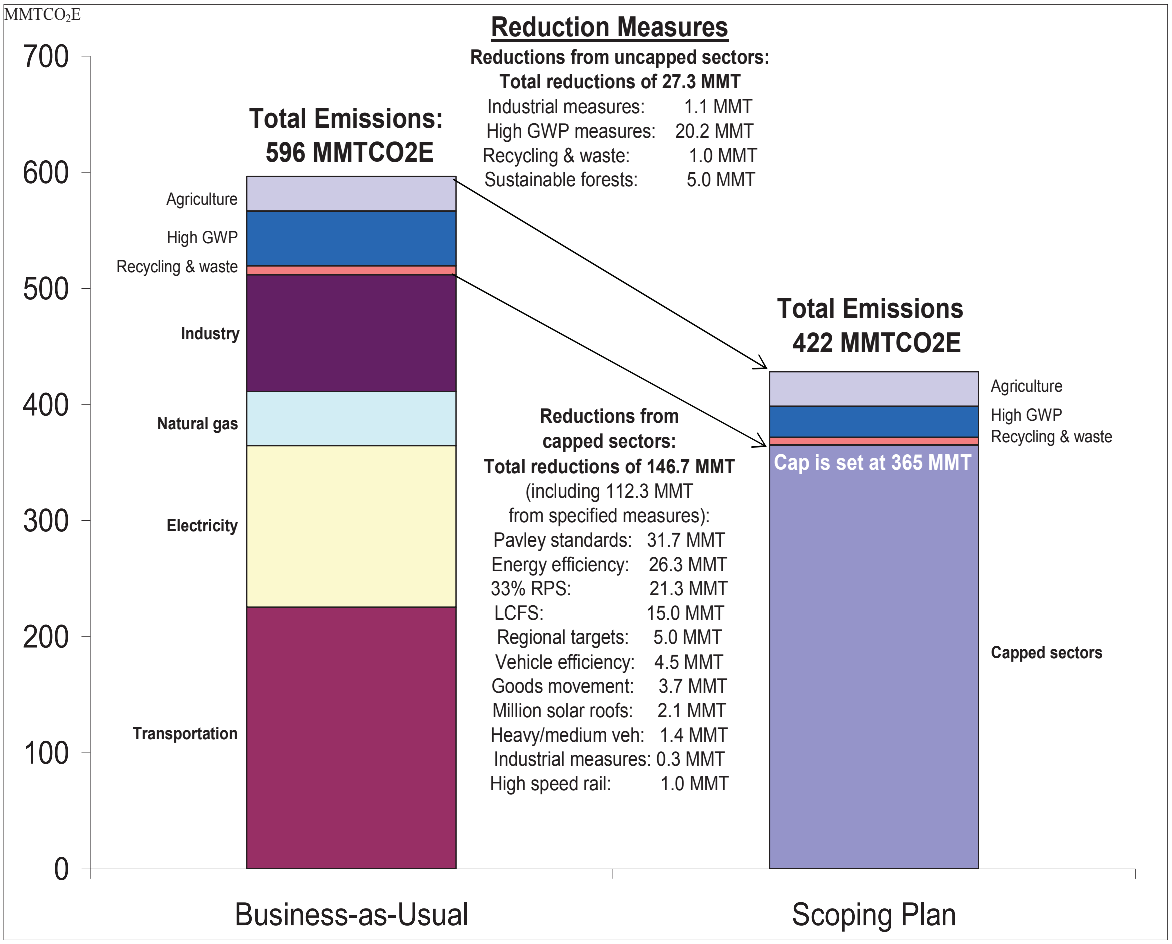
infrastructure, through improved planning. Improved planning and the resulting development are essential for meeting the 2050 emissions target.

- In the Energy sector, measures will provide better information and overcome institutional barriers that slow the adoption of cost-effective energy efficiency technologies. Enhanced energy efficiency programs will provide incentives for customers to purchase and install more efficient products and processes, and building and appliance standards will ensure that manufacturers and builders bring improved products to market.
- The Renewables Portfolio Standard (RPS) promotes multiple objectives, including diversifying the electricity supply. Increasing the RPS to 33 percent is designed to accelerate the transformation of the Electricity sector, including investment in the transmission infrastructure and system changes to allow integration of large quantities of intermittent wind and solar generation.
- The Million Solar Roofs Initiative uses incentives to transform the rooftop solar market by driving down costs over time.
- The Goods Movement program is primarily intended to achieve criteria and toxic air pollutant reductions but will provide important greenhouse gas benefits as well.
- Similar to the light duty vehicle greenhouse gas standards, the heavy duty and medium duty vehicle measures and the additional light duty vehicle efficiency measures aim to achieve cost-effective reductions of GHG emissions and save fuel.

Each of these complementary measures helps to position the California economy for the future by reducing the greenhouse gas intensity of products, processes, and activities. When combined with the absolute and declining emissions limit of the cap-and-trade program, these policies ensure that we cost-effectively achieve our greenhouse gas emissions goals and set ourselves on a path towards a clean low carbon future.

Figure 3 illustrates how the recommended emission reduction measures together put California on a path toward achieving the 2020 goal. The left hand column in Figure 3 shows total projected business as usual emissions in 2020, by sector (596 $MMTCO_2E$). The right hand column shows 2020 emissions after applying the Scoping Plan recommended reduction measures (422 $MMTCO_2E$). The measures that accomplish the needed reductions are listed in between the columns. As Figure 3 shows, there are a total of 27.3 $MMTCO_2E$ in reductions from uncapped sectors, and 146.7 $MMTCO_2E$ in reductions from capped sectors.

Figure 3: California Greenhouse Gas Emissions in 2020 and Recommended Reduction Measures



The recommended cap-and-trade program provides covered sources with the flexibility to pursue low cost reductions. It is important to recognize, however, that other recommended measures also provide compliance flexibility. As is often the case with ARB regulations, many of the measures establish performance standards and allow regulated entities to determine how best to achieve the required emission level. This approach rewards innovation and allows facilities to take advantage of the best way to meet the overarching environmental objective.

Table 3 lists the proposed measures that include compliance flexibility or market mechanisms. This flexibility ranges from the potential for tradable renewable energy credits in the Renewables Portfolio Standard to the incentives to encourage emission reductions in electricity and natural gas efficiency programs to the averaging, banking and trading mechanisms in the Pavley and Low Carbon Fuel Standard programs to a multi-sector cap-and-trade program.

Table 3: Measures With Flexible Market Compliance Features

Measure	Estimated Reductions
Additional Reductions from Capped Sectors	34.4
California Light-Duty Vehicle Greenhouse Gas Standards (Pavley I & II)	31.7
Renewables Portfolio Standard	21.3
Electricity Efficiency	15.2
Low Carbon Fuel Standard	15.0
Mitigation Fee on High GWP Gases	5.0
Natural Gas Efficiency	4.3
Goods Movement Systemwide Efficiency	3.5
Medium/Heavy Duty Vehicle Hybridization	0.5
Total	**130.9**

The recommended mix of measures builds on a strong foundation of previous action in California to address climate change and broader environmental issues. The program recommended here relies on implementing existing laws and regulations that were adopted to reduce greenhouse gas emissions and other policy goals; strengthening and expanding existing programs; implementing the discrete early actions adopted by the Board in 2007; and new measures developed during the Scoping Plan process itself.

The mix of measures recommended in this Plan provides a comprehensive approach to reduce emissions to achieve the 2020 target, and to initiate the transformations required to achieve the 2050 target. The cap-and-trade program and complementary measures will cover about 85 percent of greenhouse gas emissions throughout California's economy. ARB recognizes that due to several factors, including information discovered during regulatory development, technology maturity, and implementation challenges, actual reductions from individual measures aimed at achieving the 2020 target may be higher or lower than current estimates. The inclusion of many of these emissions within the cap-and-trade program, along with a margin of safety in the uncapped sectors, will help ensure that the 2020 target is met. The combination of approaches provides certainty that the overall program will meet the target despite some degree of uncertainty in the estimates for any individual measure. Additionally, by internalizing the cost of CO_2E emissions throughout the economy, the cap-and-trade program supports the complementary measures and provides further incentives for innovation and continuing emissions reductions from energy producers and consumers setting us on a path toward our 2050 goals.

Some emissions sources are not currently suitable for inclusion in the cap-and-trade program due to challenges associated with precise measurement, tracking or sector structure. For these emissions sources, ARB is including measures designed to focus on waste management, agriculture, forestry, and certain emissions of high GWP gases, a rapidly growing component of California's greenhouse gas emissions inventory.

California's economy is expected to continue to experience robust growth through 2020. Economic modeling, including evaluation of the effects on low-income Californians, shows that the measures included within this Scoping Plan can be implemented with a net positive effect on California's long-term economic growth. The evaluation of related public health and environmental benefits of the various measures also shows that implementation will result in not only reduced greenhouse gas emissions and improved public health, but also in a beneficial effect on California's environment. The results of these evaluations are presented in Chapter III.

AB 32 includes specific criteria that ARB must consider before adopting regulations for market-based compliance mechanisms to implement a greenhouse gas reduction program, and directs the Board, to the extent feasible, to design market-based compliance mechanisms to prevent any increase in the emissions of toxic air contaminants or criteria air pollutants. In the development of regulations that contain market mechanisms, ARB will consider the economic, environmental and public health effects, and the evaluation of potential localized impacts. These results will be used to institute appropriate economic, environmental and public health safeguards.

ARB has also designed the recommendation to ensure that reductions will come from throughout the California economy. Transportation accounts for the largest share of California's greenhouse gas emissions. Accordingly, a large share of the reduction of greenhouse gas emissions from the recommended measures comes from this sector. Measures include the inclusion of transportation fuels in the cap-and-trade program, the Low Carbon Fuel Standard to reduce the carbon intensity of transportation fuels, enforcement of regulations that reduce greenhouse gas emissions from vehicles, and policies to reduce transportation emissions by changes in future land use patterns and community design as well as improvements in public transportation.

In the Energy sector, the recommended measures increase the amount of electricity from renewable energy sources, and improve the energy efficiency of industries, homes and buildings. The inclusion of these sectors and the Industrial sector in the cap-and-trade program provides further assurance that significant cost-effective reductions will be achieved from the sectors that contribute the greatest emissions. Additional energy production from renewable resources may also rely on measures suggested in the Agriculture, Water, and the Recycling and Waste Management Sectors.

Other sectors are also called upon to cut emissions. The cap-and-trade program covers industrial sources and natural gas use. The recommended measures would require industrial processes to examine how to lower their greenhouse gas emissions and be more energy efficient, and would require goods movement operations through California's ports to be more energy efficient. Other measures address waste management, agricultural and forestry practices, as well as the transport and treatment of water throughout the state. Finally, the recommended measures address ways to reduce or eliminate the emissions of high global warming potential gases that, on a per-ton basis, contribute to global warming at a level many times greater than carbon dioxide.

As the Scoping Plan is implemented, ARB and other agencies will coordinate with the Green Chemistry Initiative, particularly in the Green Building and Recycling/Waste sectors. Green Chemistry is a fundamentally new approach to environmental protection that emphasizes environmental protection at the design stage of product and manufacturing processes, rather than focusing on end-of-pipe or end-of-life activities, or a single environmental medium, such as air, water or soil. This new approach will reduce the use of harmful chemicals, generate less waste, use less energy, and, accordingly, will contribute toward California's greenhouse gas reduction goals.

A. The Role of State Government: Setting an Example

For many years California State government has successfully incorporated environmental principles in managing its resources and running its business. The Governor has directed State agencies to sharply reduce their building-related energy use and encouraged our State-run pensions to invest in energy efficient and clean technologies.[20] The State also has been active in procuring low-emission, alternative fuel vehicles in its large fleet.

While State government has already accomplished much to reduce its greenhouse gas emissions, it can and must do more. State agencies must lead by example by continuing to reduce their greenhouse gas emissions. Therefore, California State government has established a target of reducing its greenhouse gas emissions by a *minimum* of 30 percent below its estimated business-as-usual emissions by 2020 – approximately a 15 percent reduction from current levels.

As an owner-operator of key infrastructure, State government has the ability to ensure that the most advanced, cost-effective environmental performance requirements are used in the design, construction, and operation of State facilities. As a purchaser with significant market power, State government has the ability to demand that the products and services it procures contribute positively toward California's targets to reduce greenhouse gas emissions, such as through the efforts of Environmentally Preferable Purchasing. As an investor of more than $400 billion,[21] State government has the ability to prioritize low-carbon investments. With more than 350,000 employees, State government is uniquely situated to adopt and implement policies that give State workers the ability to decrease their individual carbon impact, including encouraging siting facilities within communities to enhance balance in jobs and housing, encouraging carpooling, biking, walking, telecommuting, the use of public transit, and the use of alternative work schedules.

[20]Governor Schwarzenegger signed Executive Order Executive Order S-20-04 on December 14, 2004. This Order contains a number of directives, including a set of aggressive goals for reducing state building energy use and requested the California Public Employees Retirement System (CalPERS) and the California State Teachers Retirement System (CalSTRS) to target resource-efficient buildings for real estate investments and commit funds toward clean, efficient and sustainable technologies.

[21] CalPERS and CalSTRS are the two largest pension systems in the nation with investments in excess of $400 billion as of August 2008.

Myriad opportunities exist for California State government to operate more efficiently. These opportunities will not only reduce greenhouse gas emissions but also will produce savings for California taxpayers. Initiatives now underway that will contribute to the State government reduction target include the Governor's Green Building Initiative and the Department of General Services' efforts to increase the number of fuel-efficient vehicles in the State fleet.

Major efforts to expand renewable energy use and divest from coal-fired power plants are currently underway. Together with energy conservation and efficiency strategies on water projects, roadways, parks, and bridges, these efforts all play major roles in reducing the State's greenhouse gas emissions. State agencies should review their travel practices and make greater use of teleconferencing and videoconferencing to reduce the need for business travel, particularly air travel.

State agencies are now examining their policies and operations to determine how they can reduce their greenhouse gas emissions. These findings will be instrumental as each cabinet-level agency registers with the California Climate Action Registry (CCAR) to record and report their individual carbon footprints. The Climate Action Team has created a new State Government Operations sub-group that will work closely with the agencies to review the results of their evaluations and the CCAR reports to determine how best to achieve the maximum reductions possible.

State agencies must take the lead in driving this low-carbon economy by reducing their own emissions, and also by serving as a catalyst for local government and private sector activity. New "Best Practices" implemented by State agencies can be transferred to other entities within California, the nation, and internationally. By increasing cooperation and coordination across organizational boundaries, State government will maximize the experience and contributions of each agency involved to achieve the 30 percent reduction of greenhouse gas emissions while growing the economy and protecting the environment.

State government's impact on emissions goes far beyond its own buildings, vehicles, projects, and employees. State government casts a sizable "carbon shadow"– that is, the climate change impact of legislative, executive, and financial actions of State agencies that affect Californians now and in the future. For example, the California Energy Commission (CEC) recently initiated a proceeding to consider how to align its permitting process with the State's greenhouse gas and renewable energy policy goals. ARB intends to work closely with the CEC during this proceeding. New power plants, both fossil-fuel fired and renewable generation, will be a critical part of the state's electricity mix in coming decades. The investments that are made in this new infrastructure in the next several years will become part of the backbone of the state's electricity supply for decades to come. This timely investigation will be a critical element of California's ability to meet the AB 32 emissions reduction target for 2020, the ambitious target set by the Governor for 2050, and also the specific goal of achieving 33 percent renewables in the state's electricity mix. The Governor's Office of Planning and Research and the Resources Agency are developing proposed amendments to the California Environmental Quality Act (CEQA) Guidelines to provide guidance on how to address greenhouse gases in CEQA documents. As required by SB 97 (Chapter 185, Statutes of 2007), the amended CEQA guidelines will be adopted by January 1, 2010.

In addition, agencies such as the California Labor and Workforce Development Agency, the Business, Transportation and Housing Agency and the newly created Green Collar Jobs Council (AB 3018, Chapter 312, Statutes of 2008) are dedicated to economic development, training, safety, labor relations, and employment development throughout the State. ARB will coordinate with the Council and also with other State agencies to address workforce needs and facilitate a smooth transition to California's emerging low-carbon economy that maximizes economic development and employment opportunities in California.

The State expends funds to provide services to California residents – from preserving our natural resources to building and maintaining infrastructure like roads, bridges and dams. California residents should reap all of the benefits of these projects, including any associated quantifiable and marketable reductions in greenhouse gas emissions. Because of this, California should retain ownership of these greenhouse gas emissions reductions and use them to promote the goals of AB 32 and other goals of the state.

California State government can also lead through example by aligning its efforts to reduce greenhouse gas emissions with efforts to protect and improve public health. As a new member of the Climate Action Team, the Department of Public Health will help ensure that measures to combat global warming also incorporate public health protection and improvement strategies. As discussed below, these and many other State leadership efforts can be built upon at the local level as well.

B. The Role of Local Government: Essential Partners

Local governments are essential partners in achieving California's goals to reduce greenhouse gas emissions. They have broad influence and, in some cases, exclusive authority over activities that contribute to significant direct and indirect greenhouse gas emissions through their planning and permitting processes, local ordinances, outreach and education efforts, and municipal operations. Many of the proposed measures to reduce greenhouse gas emissions rely on local government actions.

Over 120 California cities have already signed on to the U.S. Conference of Mayors Climate Protection Agreement. In addition, over 30 California cities and counties have committed to developing and implementing Climate Action Plans. Many local governments and related organizations have already begun educating Californians on the benefits of energy efficiency measures, public transportation, solar homes, and recycling. These communities have not only demonstrated courageous leadership in taking initiative to reduce greenhouse gas emissions, they are also reaping important co-benefits, including local economic benefits, more sustainable communities, and improved quality of life.

Land use planning and urban growth decisions are also areas where successful implementation of the Scoping Plan relies on local government. Local governments have primary authority to plan, zone, approve, and permit how and where land is developed to accommodate population growth and the changing needs of their jurisdictions. Decisions on how land is used will have large impacts on the greenhouse gas emissions that will result from the transportation, housing, industry, forestry, water, agriculture, electricity, and natural gas sectors.

To provide local governments guidance on how to inventory and report greenhouse gas emissions from government buildings, facilities, vehicles, wastewater and potable water treatment facilities, landfill and composting facilities, and other government operations, ARB recently adopted the Local Government Operations Protocol. ARB encourages local governments to use this protocol to track their progress in achieving reductions from municipal operations. ARB is also developing an additional protocol for community emissions. This protocol will go beyond just municipal operations and include emissions from the community as a whole, including residential and commercial activity. These local protocols will play a key role in ensuring that strategies that are developed and implemented at the local level, like urban forestry and greening projects, water and energy efficiency projects, and others, can be appropriately quantified and credited toward California's efforts to reduce greenhouse gas emissions.

In addition to tracking emissions using these protocols, ARB encourages local governments to adopt a reduction goal for municipal operations emissions and move toward establishing similar goals for community emissions that parallel the State commitment to reduce greenhouse gas emissions by approximately 15 percent from current levels by 2020. To consolidate climate action resources and aid local governments in their emission reduction efforts, the ARB is developing various tools and guidance for use by local governments, including the next generation of best practices, case studies, a calculator to help calculate local greenhouse gas emissions, and other decision support tools.

The recent passage of SB 375 (Steinberg, Chapter 728, Statutes of 2008) creates a process whereby local governments and other stakeholders work together within their region to achieve reduction of greenhouse gas emissions through integrated development patterns, improved transportation planning, and other transportation measures and policies. The implementation of regional transportation-related greenhouse gas emissions targets and SB 375 are discussed in more detail in Section C.

C. Emissions Reduction Measures

The Scoping Plan will build on California's successful history of balancing effective regulations with economic progress. Several types of measures have been recommended. The plan includes a California cap-and-trade program that will be integrated with a broader regional market to maximize cost-effective opportunities to achieve GHG emissions reductions. The plan also includes transformational measures that are designed to help pave the path toward California's clean energy future. For example, the Low Carbon Fuel

Standard (LCFS) is a performance standard with flexible compliance mechanisms that will incent the development of a diverse set of clean, low-carbon transportation fuel options. Similarly, the plan recognizes the importance of local and regional government leadership in ensuring that California's land use and transportation planning processes are designed to be consistent with efforts to achieve a clean energy future and to protect and enhance public health and safety.

The Scoping Plan also contains a number of targeted measures that are designed to overcome existing barriers to action such as lack of information, lack of coordination, or other regulatory and institutional factors. Energy efficiency is a classic example where cost-effective action often is not taken due to lack of complete information, relatively high initial costs, and mismatches between who pays for and who benefits from efficiency investments. These problems often mean that efficiency measures are not taken that would save money in the long term for small businesses, home owners and renters. While California has a long history of success in implementing regulations and programs to encourage energy efficiency, innovative methods to overcome these economic and information barriers are needed to provide the benefits of increased efficiency to more Californians and to meet our greenhouse gas emissions reduction goals.

Several of the recommended measures complement each other. For example, the LCFS will provide clean transportation fuel options. The Pavley performance standards help deploy vehicles that can use many of the low-carbon fuels, including advanced biofuels, electricity and hydrogen. The combined operation of both programs will make it more likely that more efficient, less polluting vehicles will use the cleanest possible fuels. In addition, both of these programs will benefit from ARB's zero-emission vehicle program, which focuses on deployment of plug-in battery-electric and fuel cell vehicles. All of these strategies are expandable beyond 2020, and are needed as vital components to reach the State's 2050 goal.

The cap-and-trade program creates an emissions limit or "cap" on the sectors responsible for the vast majority of California's greenhouse gas emissions and provides capped sources significant flexibility in how they collectively achieve the reductions necessary to meet the cap. The other measures in these capped sectors provide a clear path toward achieving reductions required by the cap, while simultaneously addressing market barriers and creating the low-carbon energy options needed to achieve our long term climate goals. In the design of the cap-and-trade program, ARB will also evaluate possible ways to include features that complement the other measures, such as consideration of allowance set-asides that could be used to help achieve or exceed the aggressive energy efficiency goals included in this Plan.

Both required measures and other cost-effective actions by capped sectors will contribute toward achievement of the cap. For example, increasing energy efficiency will reduce electricity demand, thereby reducing the need for utilities to submit allowances to comply with the cap-and-trade program. In this way, energy efficiency contributes to real reductions toward the cap. Expiration of existing utility long-term contracts with coal plants will reduce GHG emissions when such generation is replaced by renewable generation, coal with carbon sequestration, or natural gas generation, which emits less CO_2 per megawatt-hour.

Additionally, measures and other actions that result in reductions in energy demand ‘downstream’ of capped sectors will help achieve the cap. For example, the Pavley vehicle standards, building efficiency standards, and land use planning that contributes to reduced transportation fuel demand will all reduce emissions by reducing the demand for upstream energy production. These downstream entities will further benefit from these reductions by avoiding any costs that would be passed through from a cap-and-trade system.

Discrete Early Actions

In September 2007, ARB approved a list of nine Discrete Early Actions to reduce greenhouse gas emissions and is currently in the process of developing regulations and programs based on these measures. Regulations implementing the Discrete Early Action measures must be adopted and in effect by January 1, 2010 (HSC §38560.5 (b)). All the Discrete Early Actions are included in the recommended measures and are shown below in Table 4.

Table 4: Anticipated Board Consideration Dates for Discrete Early Actions

Discrete Early Action	Anticipated Board Consideration
Green Ports – Ship Electrification at Ports	December 2007 – Adopted
Reduction of High GWP Gases in Consumer Products	June 2008 – Adopted
SmartWay – Heavy-Duty Vehicle Greenhouse Gas Emission Reduction (Aerodynamic Efficiency)	December 2008
Reduction of Perfluorocarbons from Semiconductor Manufacturing	February 2009
Improved Landfill Gas Capture	January 2009
Reduction of HFC-134a from Do-It-Yourself Motor Vehicle Servicing	January 2009
SF_6 Reductions from the Non-Electric Sector	January 2009
Tire Inflation Program	March 2009
Low Carbon Fuel Standard	March 2009

The following sections describe the recommended measures in this Scoping Plan. Additional information about these measures is provided in Appendix C.

1. California Cap-and-Trade Program Linked to Western Climate Initiative Partner Jurisdictions

Implement a broad-based California cap-and-trade program to provide a firm limit on emissions. Link the California cap–and-trade program with other Western Climate Initiative Partner programs to create a regional market system to achieve greater environmental and economic benefits for California. Ensure California's program meets all applicable AB 32 requirements for market-based mechanisms.

California is working closely with other states and provinces in the Western Climate Initiative (WCI) to design a regional cap-and-trade program that can deliver reductions of greenhouse gas emissions throughout the region. ARB will develop a cap-and-trade program for California that will link with the programs in the other WCI Partner jurisdictions to create a regional cap-and-trade program. The WCI Partner jurisdictions released the program design document on September 23, 2008 (see Appendix D). ARB will continue to work with the WCI Partner jurisdictions to develop and implement the cap-and-trade program. ARB will also design the California program to meet the requirements of AB 32, including the need to consider any potential localized impacts and ensure that reductions are enforceable by the Board.

Based on the requirements of AB 32, regulations to implement the cap-and-trade program need to be developed by January 1, 2011, with the program beginning in 2012. This rule development schedule will be coordinated with the WCI timeline for developing a regional cap-and-trade program. Preliminary plans for this rulemaking are described later in this section.

A cap-and-trade program sets the total amount of greenhouse gas emissions allowable for facilities under the cap and allows covered sources, including producers and consumers of energy, to determine the least expensive strategies to comply. The emissions allowed under the cap will be denominated in metric tons of CO_2E. The currency will be in the form of allowances which the State will issue based upon the total emissions allowed under the cap during any specific compliance period. Emission allowances can be banked for future use, encouraging early reductions and reducing market volatility. The ability to trade allows facilities to adjust to changing conditions and take advantage of reduction opportunities when those opportunities are less expensive than buying additional emissions allowances.

Provisions could be made to allow a limited use of surplus reductions of greenhouse gas emissions that occur outside of the cap. These additional reductions are known as offsets and are discussed further below. In order to be used to meet a source's compliance obligation, offsets will be subject to stringent criteria and verification procedures to ensure their enforceability and consistency with AB 32 requirements.

Appendix C describes the fundamentals of a cap-and-trade program and program design elements. Appendix D contains the WCI Design Recommendations and related background documents.

California Cap-and-Trade Program

By providing a firm cap on 85 percent of the state's greenhouse gas emissions, the cap-and-trade regulatory program is an essential component of the overall plan to meet the 2020 target and provides a robust mechanism to achieve the additional reductions needed by 2050. To meet the emissions reduction target under AB 32, the limit on emissions allowed under the cap, plus emissions from uncapped sources, must be no greater than the 2020 emissions goal.

By setting a limit on the quantity of greenhouse gases emitted, a well-designed cap-and-trade program will complement other measures for entities within covered sectors. Additionally, starting a cap-and-trade program now will set us on a course to achieve further emissions cuts well beyond 2020 and ensure that California is primed to take advantage of opportunities for linking with other programs, including future federal and international efforts.

The proposed cap-and-trade measure phases in the following sectors:

Starting in the first compliance period (2012):

- In-state electrical generating facilities that emit over 25,000 metric tons CO_2E per year,[22] including imports not covered by a WCI Partner jurisdiction.
- Large industrial facilities that emit over 25,000 metric tons CO_2E per year, including high global warming potential gases.

Starting in the second compliance period (2015):

- Upstream treatment of industrial fuel combustion at facilities with emissions at or below 25,000 metric tons CO_2E per year, and all commercial and residential fuel combustion regulated where the fuel enters into commerce
- Transportation fuel combustion regulated where the fuel enters into commerce.

For some energy-intensive industrial sources such as cement, stringent requirements in California, either through inclusion in a cap-and-trade program or through source-specific regulation, have the potential to create a disadvantage for California facilities relative to out-of-state competitors unless those locations have similar requirements (e.g., through the WCI). If production shifts outside of California in order to operate without being subject to these requirements, emissions could remain unchanged or even increase. This is referred to as "leakage." AB 32 requires ARB to design measures to minimize leakage. Minimizing leakage will be a key consideration when developing the cap-and-trade regulation and the other AB 32 program measures.[23]

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[22] Allowances will not be required for combustion emissions from carbon-neutral projects.

[23] The cement industry is an example of a sector that may be susceptible to this type of leakage, and the Draft Scoping Plan included consideration of a measure to institute an intensity standard at concrete batch plants that would consider this type of life-cycle emissions. ARB will evaluate whether this type of intensity standard could be incorporated into the cap-and-trade program or instituted as a complementary measure during the cap-and-trade rulemaking.

As shown in Table 5, the preliminary estimate of the cap on greenhouse gas emissions for sectors covered by the cap-and-trade program is 365 $MMTCO_2E$ in 2020, which covers about 85 percent of California's total greenhouse gas emissions.[24] Greenhouse gas emissions from most of the sectors covered by a cap-and-trade program will also be governed by other measures, including performance standards, efficiency programs, and direct regulations. These other measures will provide real reductions which will contribute reductions toward the cap.

In addition, ARB will work closely with the CPUC, CEC, and The California Independent System Operator to ensure that the cap-and-trade program works within the context of the State's energy policy and enables the reliable provision of electricity.

Table 5: Sector Responsibilities Under Cap-and-Trade Program
($MMTCO_2E$ in 2020)

Sector	Projected 2020 Business-as-Usual Emissions		Preliminary 2020 Emissions Limit under Cap-and-Trade Program
	By Sector	Total	
Transportation	225	512	365
Electricity	139		
Commercial and Residential	47		
Industry	101		

Linkage with the Western Climate Initiative Partner Jurisdictions

The WCI was formed in 2007. Members are California, Arizona, New Mexico, Oregon, Washington, Utah, and Montana, and the Canadian provinces of British Columbia, Manitoba, Ontario, and Quebec. The WCI Partner jurisdictions, including California, have adopted goals to reduce greenhouse gas emissions that, in total, reduce regional emissions to 15 percent below 2005 levels by 2020. This regional goal is approximately equal to California's goal of returning to 1990 levels by 2020. A cap-and-trade program is one element of the effort by the WCI Partner jurisdictions to identify, evaluate, and implement ways to reduce greenhouse gas emissions and achieve related co-benefits.

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[24] The actual cap for the program will be established as part of the rulemaking process. The preliminary cap of 365 $MMTCO_2E$ in 2020 assumes that all of California's electricity imports would be covered under a California cap. Because a significant portion of California's imported electricity is from power plants located in other WCI Partner Jurisdictions, emissions from those sources could be included in the cap of the states within which the power plants are located. In establishing the California cap, ARB will need to consider the degree to which emissions from these sources are addressed as part of the WCI regional market.

The WCI Partner jurisdictions released their recommendation for the design of a regional cap-and-trade program in September 2008. This design document and the background paper that accompanied it are presented in Appendix D. These recommendations were developed collaboratively by the WCI Partner jurisdictions, including California, with a goal of achieving regional targets to reduce greenhouse gas emissions equitably and effectively. The WCI Partner jurisdictions' recommendations are generally consistent with the recommendations provided in June 2007 by the California Market Advisory Committee,[25] the recommendations provided to ARB by the California Public Utilities Commission and the California Energy Commission in March 2008,[26] and the proposed opinion released by the two Commissions in September 2008.[27]

Participating in a regional system has several advantages for California. The reduction of greenhouse gas emissions that can be achieved collectively by the WCI Partner jurisdictions are approximately double what can be achieved through a California-only program. The broad scope of a WCI-wide market will provide additional opportunities for reduction of emissions, therefore providing greater market liquidity and more stable carbon prices within the program. The regional system also significantly reduces the potential for leakage, which is a shift in economic and emissions activity out of California that could hurt the state's economy without reducing global greenhouse gas emissions. Harmonizing the approach and timing of California's requirements for reducing greenhouse gas emissions with other states and provinces in the region can encourage retention of local businesses in the state. Further, by creating a cost-effective regional market system, California and the other WCI Partner jurisdictions will continue to demonstrate leadership in preparation for future federal and international climate action.

To achieve the individual WCI Partner jurisdiction goals and the regional goal, each WCI Partner jurisdiction will have an allowance budget based on its goal that declines to 2020. For example, California's allowance budget will be based on the level of emissions needed to achieve the AB 32 target for 2020, as described above. Once California links with the other WCI Partner jurisdictions, allowances could be

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[25] Recommendations of the Market Advisory Committee to the California Air Resources Board. *Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California*. June 30, 2007. p. 19. http://www.climatechange.ca.gov/publications/market_advisory_committee/2007-06-29_MAC_FINAL_REPORT.PDF (accessed October 12, 2008) Cal/EPA The Market Advisory Committee (MAC) consisted of a consortium of economists, policy makers, academics, government representatives, and environmental advocates who came together through the auspices of CalEPA, pursuant to Executive Order S-20-06 from Governor Schwarzenegger.

[26] Joint Agency Decision of the CEC and the CPUC. *Final Adopted Interim Decision on Basic Greenhouse Gas Regulatory Framework for Electricity and Natural Gas Sectors*, March 13, 2008. Document number CEC-100-2008-002-F. http://www.energy.ca.gov/2008publications/CEC-100-2008-002/CEC-100-2008-002-F.PDF (accessed October 12, 2008)

[27] Joint Agency proposed final opinion of the CEC and the CPUC. *Proposed Final Opinion on Greenhouse Gas Regulatory Strategies*. Published September 12, 2008 and to be considered for adoption on October 16, 2008 by the CEC and the CPUC. Document Number CEC-100-2008-007-D http://www.energy.ca.gov/ghg_emissions/index.html (accessed October 12, 2008)

traded across state and provincial boundaries. As a result of trading, emissions in a state may vary from its allowance budget, although total regional emissions will not exceed the regional cap.

The overall number of allowances issued in a given year by the WCI Partner jurisdictions will set a limit on emissions from sectors covered by the program for the region. Details of distribution of allowances will be established by each partner within the general guidelines set forth in the WCI program design framework. The WCI Partner jurisdictions have agreed to consider standardizing allowance distribution across specific sectors if necessary to address competitiveness issues. In addition, the WCI Partner jurisdictions have agreed to phase in regionally coordinated auctions of allowances, with a minimum percentage of allowances auctioned in each period starting with 10 percent in the first compliance period and increasing to 25 percent in 2020. WCI partners aspire to reach higher auction percentages over time, possibly to 100 percent. Under the program design, each WCI Partner jurisdiction, including California, can auction a greater portion of its allowance budget in any compliance period. The distribution of California's allowances will be determined during the cap-and-trade rulemaking process, as discussed below.

The WCI Partner jurisdictions are also proposing the use of an allowance reserve price for the first 5 percent of the auctioned allowances in the regional cap. A reserve price will help to ensure that the cap is set at a level that will motivate real emissions reductions and may provide an opportunity for the regional cap-and-trade program to provide reductions that exceed the regional target.

A regional coordinated cap-and-trade program with strong reporting and enforcement rules will provide a high degree of certainty that emissions will not exceed targeted levels and that leakage will not occur.

Federal Action

A cap-and-trade program is expected to be a significant element in any future federal action taken to reduce greenhouse gas emissions. ARB's efforts to design a broad cap-and-trade system that works in concert with sector- or source-related measures and meets the requirements of AB 32 can serve as a model for a federal program. An effective, enforceable regional cap-and-trade program can promote the type of federal legislation needed to meet the pressing challenge of climate change. In the event that California businesses, organizations, or individuals hold regional allowances when a federal system is implemented, California will work to ensure that those allowances continue to have value, either in a continuing regional program or within the federal program.

Cap-and-Trade Rulemaking

To implement the cap-and-trade program, ARB will embark on regulatory development that includes extensive and broad-based public participation. Major program design elements will include setting an emissions cap in conjunction with the

WCI Partner jurisdictions, determining the method of distributing both allowances and revenues raised through auctions, and establishing the rules for the use of offsets. ARB will continue to work with all affected stakeholders, State and local agencies, and our WCI partners to create a robust regional market system.

After adoption of the Scoping Plan, ARB will establish a formal structure to elicit ongoing participation in the rulemaking process from a wide range of affected stakeholders. While the process will be open to involvement by all interested parties, ARB anticipates creation of a series of focused working groups that include participation by representatives of the regulated community, environmental and community advocates and other public interest groups, prominent academics with expertise in cap-and-trade issues and new technology development, local air pollution control districts, stakeholders in the WCI, and other State agencies with existing authority for regulating capped sectors.

This process will integrate economic and administrative design considerations and include consideration of environmental and public health issues. ARB will convene a series of technical workshops to examine mechanisms to address the concerns related to the cap-and-trade program raised by the Environmental Justice Advisory Committee and other stakeholders. The first workshop will explore cap-and-trade program design options that could provide incentives to maximize additional environmental and economic benefits, and to analyze the proposed program to prevent increases in emissions of toxic air contaminants or criteria pollutants through the design and architecture of the program itself. Similar technical workshops will focus on issues related to offsets and the WCI proposal.

Allowances and Revenues

Emission allowances represent a significant economic value whether they are freely allocated or sold through auction. Section E includes a preliminary discussion of some of the options that have been suggested for use of allowance value or revenues. ARB will evaluate the possible uses of allowances or revenues as part of the rulemaking process. One approach would be to dedicate a portion of the allowances for such purposes as rewarding early actions to reduce emissions, providing incentives for local governments and others to promote energy efficiency, better land use planning, and other reduction strategies, and targeting projects to reduce emissions in low-income or disadvantaged communities. This type of dedicated use of allowances is typically referred to as an allowance 'set-aside.'

The California Public Utilities Commission and the California Energy Commission addressed the question of allocation and auction of allowances in their joint proceeding on implementation of AB 32 for the Electricity and Natural Gas sectors. They have recently released a proposed opinion that recommends to ARB a transition to 100 percent auction for the Electricity sector by 2016.[28] The CPUC and CEC included in their draft opinion the recommendation that all auction revenues be used for purposes related to AB 32, and all revenue from allowances allocated to the Electricity sector and received by retail providers would be used for the benefit of the Electricity sector to support investments in renewable energy, efficiency, new energy technology, infrastructure, customer bill relief, and other similar programs.

The Market Advisory Committee also recommended the eventual transition to full auction within the cap-and-trade program, noting that a system in which California ultimately auctions all of its emission allowances is consistent with fundamental objectives of cost-effectiveness, fairness and simplicity.[29] ARB agrees that the transition to a 100 percent auction, with auction revenue going to further the policy objectives of California's climate change program, is a worthwhile goal. ARB expects that California will auction significantly more than the WCI minimum levels and will transition to 100 percent auction. However a broad set of factors must be considered in evaluating the potential timing of a transition to a full auction including competiveness, potential for emissions leakage, the effect on regulated vs. unregulated industrial sectors, the overall impact on consumers, and the strategic use of auction revenues.

Allowance allocation and revenue use decisions can greatly affect the equity of a cap-and-trade system. Addressing both these issues will be a major part of the rulemaking process. ARB will seek input from a broad range of experts in an open public process regarding the options for allocation and revenue use under consideration by ARB and the WCI Partner jurisdictions. This process will evaluate various mechanisms ARB is considering for allowance distribution and potential uses of allowance value, including the recommendations offered by CPUC and CEC. Issues to be considered will include the appropriate timing and structure of a transition to full auction of allowances, the potential need to harmonize the allocation process regionally for certain sectors subject to inter-state competition, and equity across the various sectors here in California.

Offsets

Individual projects can be developed to achieve the reduction of emissions from activities not otherwise regulated, covered under an emissions cap, or resulting from government incentives. These projects can generate "offsets," i.e., verifiable reductions of emissions whose ownership can be transferred to others. The cap-and-trade rulemaking will establish appropriate rules for use of offsets. As required by

[28] Op. Cit. The proposed opinion has not yet been voted on by either the CPUC or the CEC. The Commissions are expected to vote on this proposed opinion before the December Board meeting when the Proposed Scoping Plan will be considered for approval.

[29] Recommendations of the Market Advisory Committee to the California Air Resources Board. *Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California*. June 30, 2007. p. 55. http://www.climatechange.ca.gov/publications/market_advisory_committee/2007-06-29_MAC_FINAL_REPORT.PDF (accessed October 12, 2008)

AB 32, any reduction of greenhouse gas emissions used for compliance purposes must be real, permanent, quantifiable, verifiable, enforceable, and additional (HSC §38562(d)(1) and (2)). Offsets used to meet regulatory requirements must be quantified according to Board-adopted methodologies, and ARB must adopt a regulation to verify and enforce the reductions (HSC §38571). The criteria developed will ensure that the reductions are quantified accurately and are not double-counted within the system.

Offsets can provide regulated entities a source of low-cost emissions reductions. Reductions from compliance offset projects must be quantified using rigorous measurement and enforcement protocols that provide a basis to determine whether the reductions are also additional, i.e., beyond what would have happened in the absence of the offset project. Establishing that reductions are additional is one of the major challenges in establishing the validity of particular offset projects. Once a project can quantify emissions using an approved methodology, the reductions of emissions must be verified to ensure that reductions actually occurred.

While some offsets provide benefits, allowing unlimited offsets would reduce the amount of reductions of greenhouse gas emissions occurring within the sectors covered by the cap-and-trade program. This could reduce the local economic, environmental and public health co-benefits and delay the transition to low-carbon energy systems within the capped sectors that will be necessary to meet our long term climate goals. The limit on the use of offsets and allowances from other systems within the WCI Partner jurisdiction program design assures that a majority of the emissions reductions required from 2012 to 2020 occur at entities and facilities covered by the cap and trade program. Consequently, the use of offsets and allowances from other systems are limited to no more than 49 percent of the required reduction of emissions. This quantitative limit will help provide balance between the need to achieve meaningful emissions reductions from capped sources with the need to provide sources within capped sectors the opportunity for low-cost reduction opportunities that offsets can provide. The WCI offset program may incorporate flexibility to use offsets and non-WCI allowances across the three compliance periods, which each WCI Partner jurisdiction could use at its discretion. ARB will apply the limit on offsets that is within its jurisdiction, such that the allowable offsets in each compliance period is less than half of the emissions reductions expected from capped sectors in that compliance period. Each WCI Partner jurisdiction may choose to adopt a more stringent limit on the use of offsets and non-WCI allowances.

Offsets can also encourage the spread of clean, low carbon technologies outside California. High quality offset projects located outside the state can help lower the compliance costs for regulated entities in California, while reducing greenhouse gas emissions in areas that would otherwise lack the resources needed to do so. International projects may also have significant environmental, economic and social benefits. Projects in the Mexican border region may be of particular interest, considering the opportunity to realize considerable co-benefits on both sides of the border. The Governor has recently signed a Memorandum of Understanding with the six Mexican border states that calls for cooperation on the development of project protocols for Mexican greenhouse gas emissions reduction projects.[30] Additionally, defining project types related to imported commodities (such as cement) would enable California to provide incentives to reduce emissions associated with products that are imported into the state for our consumption.

California is committed to working at the international level to reduce greenhouse gas emissions globally and finding ways to support the adoption of low-carbon technologies and sustainable development in the developing world. ARB will work with WCI Partner jurisdictions and within the rulemaking process to establish an offsets program without geographic restrictions that includes sufficiently stringent criteria for creating offset credits to ensure the overall environmental integrity of the program.

One concept being evaluated for accepting offsets from the developing world is to limit offsets to those jurisdictions that demonstrate performance in reducing emissions and/or achieving greenhouse gas intensity targets in certain carbon intensive sectors (e.g., cement), or in reducing emissions or enhancing sequestration through eligible forest carbon activities in accordance with appropriate national or sub-national accounting frameworks. This could be achieved through an agreement to work jointly to develop minimum performance standards or sectoral benchmarks, backed by appropriate monitoring and accounting frameworks. Such agreements would encourage early action in developing countries toward binding commitments, and could also reduce concerns about competitiveness and risks associated with carbon leakage.

2. California Light-Duty Vehicle Greenhouse Gas Standards

Implement adopted Pavley standards and planned second phase of the program. Align zero-emission vehicle, alternative and renewable fuel and vehicle technology programs with long-term climate change goals.

Passenger vehicles are responsible for almost 30 percent of California's greenhouse gas emissions. To address these emissions, ARB is proposing a comprehensive three-prong strategy – reducing greenhouse gas emissions from vehicles, reducing the carbon content of the fuel these vehicles burn, and reducing the miles these vehicles travel. Transportation fuels and regional transportation-related greenhouse gas targets are discussed later in the recommendations.

There are a number of efforts intended to reduce greenhouse gas emissions from California's passenger vehicles, including the Pavley greenhouse gas vehicle

[30] Memorandum of Understanding on Environmental Cooperation between the California Environmental Protection Agency, the California Department of Food and Agriculture and the California Resources Agency of the State of California, United States of America and the Ministry of Environment and Natural Resources of the United Mexican States. February 13, 2008. http://gov.ca.gov/pdf/press/021308_MOU_English.pdf (accessed October 12, 2008)

standards to achieve near-term emission reductions, the zero-emission vehicle (ZEV) program to transform the future vehicle fleet, and the Alternative and Renewable Fuel and Vehicle Technology Program created by AB 118 (Núñez, Chapter 750, Statutes of 2007).

Pavley Greenhouse Gas Vehicle Standards

AB 1493 (Pavley, Chapter 200, Statutes of 2002) directed ARB to adopt vehicle standards that lowered greenhouse gas emissions to the maximum extent technologically feasible, beginning with the 2009 model year. ARB adopted regulations in 2004 and applied to the U.S. Environmental Protection Agency (U.S. EPA) for a waiver under the federal Clean Air Act to implement the regulation. The Pavley regulations incorporate both performance standards and market-based compliance mechanisms. To obtain additional reductions from the light duty fleet, ARB plans to adopt a second, more stringent, phase of the Pavley regulations. Table 6 summarizes the estimated reduction of emissions for the Pavley regulations. In addition to delivering greenhouse gas emissions reductions, the standards will save money for Californians who purchase vehicles that comply with the Pavley standards – an estimated average of $30 each month in avoided fuel costs.

To date, 13 other states have adopted California's existing greenhouse gas standards for vehicles. Under federal law, California is the only state allowed to adopt its own vehicle standards (though other states are permitted to adopt California's more rigorous standards), but California cannot implement the regulations until U.S. EPA grants an administrative waiver. In December 2007, U.S. EPA denied California's waiver request to implement the Pavley regulations. California and others are challenging that denial in Federal court. The regulations have also been challenged by the automakers in federal courts, although to date, those challenges have been unsuccessful.

ARB is evaluating the use of feebates as a measure to achieve additional reductions from the mobile source sector, either as a backstop to the Pavley regulation if the regulation cannot be implemented, or as a supplement to Pavley if the waiver is approved and the regulation takes effect. AB 32 specifically states that if the Pavley regulations do not remain in effect, ARB shall implement alternative regulations to control mobile sources to achieve equivalent or greater reductions of greenhouse gas emissions (HSC §38590). ARB is currently evaluating the use of a feebate program as the mechanism to secure these reductions. A feebate regulation would combine a rebate program for low-emitting vehicles with a fee program for high-emitting vehicles. This program would be designed in a way to generate equivalent or greater cumulative reductions of greenhouse gas emissions compared to what would have been achieved under the Pavley regulations. ARB would also evaluate the potential to expand the program to include additional vehicle classes not currently included in the Pavley program for further greenhouse gas benefits.

If the U.S. EPA grants California's request for a waiver to proceed with implementation of the Pavley regulations, we will analyze the potential for pursuing a feebate program that could complement the Pavley regulations and achieve additional reductions of greenhouse gas emissions.

Zero-Emission Vehicle Program

The Zero Emission Vehicle (ZEV) program will play an important role in helping California meet its 2020 and 2050 greenhouse gas emissions reduction requirements. Through 2012, the program requires placement of hundreds of ZEVs (including hydrogen fuel cell and battery electric vehicles) and thousands of near-zero emission vehicles (plug-in hybrids, conventional hybrids, compressed natural gas vehicles). In the mid-term (2012-2015), the program will require placement of increasing numbers of ZEVs and near-zero emission vehicles in California. In 2009, the Board will consider a proposal that is currently being developed to ensure that the ZEV program is optimally designed to help the State meet its 2020 target and put us on the path to meeting our 2050 target of an 80 percent reduction in greenhouse gas emissions.

It is important to note that while the use of both battery-powered electric vehicles and plug-in hybrids (which can be plugged in to recharge batteries) is not expected to increase electricity demand in the near term, over the longer term these technologies could result in meaningful new electricity demand. However, the expected increased electricity demand is likely to be met by off peak vehicle battery charging (i.e., overnight) to provide a means of load leveling and other possible benefits.[31]

Air Quality Improvement Program/Alternative and Renewable Fuel and Vehicle Technology Program

Under AB 118 (Núñez, Chapter 750, Statutes of 2007), ARB is administering the Air Quality Improvement Program, which provides approximately $50 million per year for grants to fund clean vehicle/equipment projects and research on the air quality impacts of alternative fuels and advanced technology vehicles.

AB 118 also created the Alternative and Renewable Fuel and Vehicle Technology Program and authorized CEC to spend up to $120 million per year for over seven years (from 2008-2015) to develop, demonstrate, and deploy innovative technologies to transform California's fuel and vehicle types. This program creates the opportunities for investment in technologies and fuels that will help meet the Low Carbon Fuel Standard, the AB 1007 (Pavley, Chapter 371, Statutes of 2005) goal of increasing alternative fuels, the AB 32 goal of reducing greenhouse gas emissions to 1990 levels by 2020, and the State's overall goal of reducing greenhouse gas emissions 80 percent below 1990 levels by 2050. CEC and ARB are coordinating closely in the implementation of AB 118. In the long-term, programs to reduce greenhouse gas emissions from cars would reduce highway funds because less fuel would be sold, reducing tax revenue. In coordination with other State agencies, ARB

[31] There is also a potential for battery-electric and hybrid vehicles (both plug-in and traditional hybrid-electric) to be used in the future to provide electricity back into the electricity grid during times of especially high demand (peak periods).

will continue to evaluate the potential impacts of these shifts and identify potential solutions.

Table 6: California Light-Duty Vehicle Greenhouse Gas Standards Recommendation
(MMTCO$_2$E in 2020)

Measure No.	Measure Description	Reductions
T-1	Pavley I and II – Light-Duty Vehicle Greenhouse Gas Standards	31.7
	Total	**31.7**

3. Energy Efficiency

Maximize energy efficiency building and appliance standards, and pursue additional efficiency efforts including new technologies, and new policy and implementation mechanisms. Pursue comparable investment in energy efficiency from all retail providers of electricity in California (including both investor-owned and publicly-owned utilities).

Energy-efficiency measures for both electricity and natural gas can reduce greenhouse gas emissions significantly. In 2003, the CPUC and CEC adopted an Energy Action Plan that prioritized resources for meeting California's future energy needs, with energy efficiency being first in the "loading order," or highest priority. Since then, this policy goal has been codified into statute through legislation that requires electric utilities to meet their resource needs first with energy efficiency.[32]

This measure would set new targets for statewide annual energy demand reductions of 32,000 gigawatt hours and 800 million therms from business as usual[33] – enough to power more than 5 million homes, or replace the need to build about ten new large power plants (500 megawatts each). These targets represent a higher goal than existing efficiency targets established by CPUC for the investor-owned utilities due to the inclusion of innovative strategies above traditional utility programs. Achieving the State's energy efficiency targets will require coordinated efforts from the State, the federal government, energy companies and customers. ARB will work with CEC and CPUC to facilitate these partnerships. A number of these measures also have the potential to deliver significant economic benefits to California consumers, including low-income households and small businesses. California's energy efficiency programs for buildings and appliances have generated more than $50 billion in

[32] SB 1037 (Kehoe, Chapter 366, Statutes of 2005) and AB 2021 (Levine, Chapter 734, Statutes of 2006) directed electricity corporations subject to CPUC's authority and publicly-owned electricity utilities to first meet their unmet resource needs through all available energy efficiency and demand response resources that are cost effective, reliable and feasible.

[33] The savings targeted here are additional to savings currently assumed to be incorporated in CEC's 2007 demand forecasts. However, CEC has initiated a public process to better determine the quantity of energy savings from standards, utility programs, and market effects that are embedded in the baseline demand forecast.

savings over the past three decades. Tables 7 and 8 summarize the reduction of greenhouse gas emissions.

Efficiency

Achieving the energy efficiency target will require redoubled efforts to target industrial, agricultural, commercial, and residential end-use sectors, comprised of both innovative new initiatives that have been embraced by CEC's energy policy reports and CPUC's long-term strategic plan, and improvements to California's traditional approaches of improved building standards and utility programs.

High-efficiency distributed generation applications like fuel cell technologies can also play an important role in helping the State meet its requirements for reduction of greenhouse gas emissions. Key energy efficiency strategies, grouped by type, include:

Cross-cutting Strategy for Buildings
- "Zero Net Energy" buildings[34]

Codes and Standards Strategies
- More stringent building codes and appliance efficiency standards
- Broader standards for new types of appliances and for water efficiency
- Improved compliance and enforcement of existing standards
- Voluntary efficiency and green building targets beyond mandatory codes

Strategies for Existing Buildings
- Voluntary and mandatory whole-building retrofits for existing buildings
- Innovative financing to overcome first-cost and split incentives for energy efficiency, on-site, renewables, and high efficiency distributed generation

Existing and Improved Utility Programs
- More aggressive utility programs to achieve long-term savings

Other Needed Strategies
- Water system and water use efficiency and conservation measures
- Local government programs that lead by example and tap into local authority over planning, development, and code compliance
- Additional industrial and agricultural efficiency initiatives
- Providing real time energy information technologies to help consumers conserve and optimize energy performance

With the support of key State agencies, utilities, local governments and others, the CPUC has recently adopted the *California Long Term Energy Efficiency Strategic*

[34] Zero net energy refers to building energy use over the course of a typical year. When the building is producing more electricity than it needs, it exports its surplus to the grid. When the building requires more electricity than is being produced on-site, it draws from the grid. Generally, when constructing a ZNE building, energy efficiency measures can result in up to 70% savings relative to existing building practices, which then allows for renewables to meet the remaining load.

Plan.[35] Released September 2008, this Plan sets forth a set of strategies toward maximizing the achievement of cost-effective energy efficiency in California's Electricity and Natural Gas sectors between 2009 and 2020, and beyond. Its recommendations are the result of a year-long collaboration by energy experts, utilities, businesses, consumer groups, and governmental organizations in California, throughout the west, nationally and internationally.

For many of the above goals and others, the Strategic Plan discusses practical implementation strategies, detailing necessary partnerships among the state, its utilities, the private sector, and other market players and timelines for near-term, mid-term and long-term success. While the Strategic Plan is the most current and innovative summary of energy efficiency strategies needed to meet State goals, additional planning and new strategies will likely be needed, both to achieve the 2020 emissions reduction goals and to set the State on a trajectory toward 2050.

Other innovative approaches could also be used to motivate private investment in efficiency improvements. One example that will be evaluated during the development of the cap-and-trade program is the creation of a mechanism to make allowances available within the program to provide incentives for local governments, third party providers, or others to pursue projects to reduce greenhouse gas emissions, including the bundling of energy efficiency improvements for small businesses or in targeted communities.

Solar Water Heating

Solar water heating systems offer a potential for natural gas savings in California. A solar water heating system offsets the use of natural gas by using the sun to heat water, typically reducing the need for conventional water heating by about two-thirds. Successful implementation of the zero net energy target for new buildings will require significant growth in California's solar water heating system manufacturing and installation industry. The State has initiated a program to move toward a self sustaining solar water heater industry. The Solar Hot Water and Efficiency Act of 2007 (SHWEA) authorized a ten year, $250-million incentive program for solar water heaters with a goal of promoting the installation of 200,000 systems in California by 2017.[36]

Combined Heat and Power

Combined heat and power (CHP), also referred to as cogeneration, produces electricity and useful thermal energy in an integrated system. The widespread development of efficient CHP systems would help displace the need to develop new, or expand existing, power plants. This measure sets a target of an additional

[35] California Public Utilities Commission. *California Long Term Energy Efficiency Strategic Plan.* September 2008. http://www.californiaenergyefficiency.com/docs/EEStrategicPlan.pdf (accessed October 12, 2008).

[36] Established under Assembly Bill 1470 (Huffman, Chapter 536, Statues of 2007).

4,000 MW of installed CHP capacity by 2020, enough to displace approximately 30,000 GWh of demand from other power generation sources.[37]

California has supported CHP for many years, but market and other barriers continue to keep CHP from reaching its full market potential. Increasing the deployment of efficient CHP will require a multi-pronged approach that includes addressing significant barriers and instituting incentives or mandates where appropriate. These approaches could include such options as utility-provided incentive payments, the creation of a CHP portfolio standard, transmission and distribution support payments, or the use of feed-in tariffs.

Table 7: Energy Efficiency Recommendation - Electricity
($MMTCO_2E$ in 2020)

Measure No.	Measure Description	Reductions
E-1	Energy Efficiency (32,000 GWh of Reduced Demand) • Increased Utility Energy Efficiency Programs • More Stringent Building & Appliance Standards • Additional Efficiency and Conservation Programs	15.2
E-2	Increase Combined Heat and Power Use by 30,000 GWh	6.7
	Total	**21.9**

Table 8: Energy Efficiency Recommendation - Commercial and Residential
($MMTCO_2E$ in 2020)

Measure No.	Measure Description	Reductions
CR-1	Energy Efficiency (800 Million Therms Reduced Consumption) • Utility Energy Efficiency Programs • Building and Appliance Standards • Additional Efficiency and Conservation Programs	4.3
CR-2	Solar Water Heating (AB 1470 goal)	0.1
	Total	**4.4**

4. Renewables Portfolio Standard

Achieve 33 percent renewable energy mix statewide.

CEC estimates that about 12 percent of California's retail electric load is currently met with renewable resources. Renewable energy includes (but is not limited to) wind, solar, geothermal, small hydroelectric, biomass, anaerobic digestion, and landfill gas. California's current Renewables Portfolio Standard (RPS) is intended to

[37] Accounting for avoided transmission line losses of seven percent, this amount of CHP would actually displace 32,000 GWh from the grid.

increase that share to 20 percent by 2010. Increased use of renewables will decrease California's reliance on fossil fuels, thus reducing emissions of greenhouse gases from the Electricity sector. Based on Governor Schwarzenegger's call for a statewide 33 percent RPS, the Plan anticipates that California will have 33 percent of its electricity provided by renewable resources by 2020, and includes the reduction of greenhouse gas emissions based on this level.

Senate Bill 107 (Simitian, Chapter 464, Statutes of 2006) obligates the investor-owned utilities (IOUs) to increase the share of renewables in their electricity portfolios to 20 percent by 2010. Meanwhile, the publicly-owned utilities (POUs) are encouraged but not required to meet the same RPS. The governing boards of the state's three largest POUs, the Los Angeles Department of Water and Power (LADWP), the Sacramento Municipal Utility District (SMUD), and the Imperial Irrigation District (IID), have adopted policies to achieve 20 percent renewables by 2010 or 2011. LADWP and IID have established targets of 35 and 30 percent, respectively, by 2020.

In 2005, CEC and CPUC committed in the Energy Action Plan II to "evaluate and develop implementation paths for achieving renewable resource goals beyond 2010, including 33 percent renewables by 2020, in light of cost-benefit and risk analysis, for all load serving entities." The proposed opinion in the CPUC/CEC joint proceeding lends strong support for obtaining 33 percent of California's electricity from renewables, and states the two Commissions' belief that this target is achievable if the State commits to significant investments in transmission infrastructure and key program augmentation. As with the energy efficiency target, achieving the 33 percent goal will require broad-based participation from many parties and the removal of barriers. CEC, CPUC, California Independent System Operator (CAISO), and ARB are working with California utilities and other stakeholders to formally establish and meet this goal.

A key prerequisite to reaching a target of 33 percent renewables will be to provide sufficient electric transmission lines to renewable resource zones and system changes to allow integration of large quantities of intermittent wind and solar generation. The Renewable Energy Transmission Initiative (RETI) is a broad collaborative of State agencies, utilities, the environmental community, and renewable generation developers that are working cooperatively to identify and prioritize renewable generation zones and associated transmission projects. Although biomass, geothermal, and small-scale hydroelectric generation can provide steady baseload power, other renewable generation is intermittent (wind) or varies over time (solar). Therefore, integration of intermittent generation into the electricity system will require grid improvements so that fluctuations in power availability can be accommodated. Improved communications technology, automated demand response, electric sub-station improvements and other modern technologies must be implemented both to facilitate intermittent renewables, and to improve grid reliability.

Another key action that may help to achieve the renewable energy goals is to reduce the complexity and cost faced by small renewable developers in contracting with utilities to supply renewable generation. This is particularly important for projects offering below 20 megawatts of generation capacity. One such option may be a feed-in tariff for all RPS-eligible renewable energy facilities up to 20 megawatts in size. This mechanism was recommended in CEC's 2007 Integrated Energy Policy Report. Such a tariff, set at an appropriate level, could benefit small-scale facilities by allowing them to be brought into the electricity grid more rapidly.

For the purposes of calculating the reduction of greenhouse gas emissions in this Scoping Plan, ARB is counting emissions avoided by increasing the percentage of renewables in California's electricity mix from the current level of 12 percent to the 33 percent goal, as shown in Table 9.

Table 9: Renewables Portfolio Standard Recommendation
($MMTCO_2E$ in 2020)

Measure No.	Measure Description	Reductions
E-3	Achieve a 33% renewables mix by 2020	21.3
	Total	**21.3**

5. Low Carbon Fuel Standard

Develop and adopt the Low Carbon Fuel Standard.

Because transportation is the largest single source of greenhouse gas emissions in California, the State is taking an integrated approach to reducing emissions from this sector. Beyond including vehicle efficiency improvements and lowering vehicle miles traveled, the State is proposing to reduce the carbon intensity of transportation fuels consumed in California.

To reduce the carbon intensity of transportation fuels, ARB is developing a Low Carbon Fuel Standard (LCFS), which would reduce the carbon intensity of California's transportation fuels by at least ten percent by 2020 as called for by Governor Schwarzenegger in Executive Order S-01-07.

LCFS will incorporate compliance mechanisms that provide flexibility to fuel providers in how they meet the requirements to reduce greenhouse gas emissions. The LCFS will examine the full fuel cycle impacts of transportation fuels and ARB will work to design the regulation in a way that most effectively addresses the issues raised by the Environmental Justice Advisory Committee and other stakeholders. ARB identified the LCFS as a Discrete Early Action item, and is developing a regulation for Board consideration in March 2009. A 10 percent reduction in the intensity of transportation fuels is expected to equate to a reduction of 16.5 $MMTCO_2E$ in 2020. However, in order to account for possible overlap of benefits between LCFS and the Pavley greenhouse gas standards, ARB has discounted the contribution of LCFS to 15 $MMTCO_2E$.

Table 10: Low Carbon Fuel Standard Recommendation
($MMTCO_2E$ in 2020)

Measure No.	Measure Description	Reductions
T-2	Low Carbon Fuel Standard (Discrete Early Action)	15
	Total	**15**

6. Regional Transportation-Related Greenhouse Gas Targets

Develop regional greenhouse gas emissions reduction targets for passenger vehicles.

Establishment of Regional Targets

On September 30, 2008, Governor Arnold Schwarzenegger signed Senate Bill 375 (Steinberg) which establishes mechanisms for the development of regional targets for reducing passenger vehicle greenhouse gas emissions. Through the SB 375 process, regions will work to integrate development patterns and the transportation network in a way that achieves the reduction of greenhouse gas emissions while meeting housing needs and other regional planning objectives. This new law reflects the importance of achieving significant additional reductions of greenhouse gas emissions from changed land use patterns and improved transportation to help achieve the goals of AB 32.

SB 375 requires ARB to develop, in consultation with metropolitan planning organizations (MPOs), passenger vehicle greenhouse gas emissions reduction targets for 2020 and 2035 by September 30, 2010. It sets forth a collaborative process to establish these targets, including the appointment by ARB of a Regional Targets Advisory Committee to recommend factors to be considered and methodologies for setting greenhouse gas emissions reduction targets. SB 375 also provides incentives – relief from certain California Environmental Quality Act (CEQA) requirements for development projects that are consistent with regional plans that achieve the targets.

Reaching the Targets

Transportation planning is done on a regional level in major urban areas, through the Metropolitan Planning Organizations. These MPOs are required by the federal government to prepare regional transportation plans (RTPs) in order to receive federal transportation dollars. These plans must reflect the land uses called out in city and county general plans. Regional planning efforts provide an opportunity for community residents to help select future growth scenarios that lead to more sustainable and energy efficient communities. Such plans should be developed through an extensive public process to provide for local accountability.

SB 375 requires MPOs to prepare a sustainable communities strategy to reach the regional target provided by ARB. MPOs would use the sustainable communities strategy for the land use pattern underlying the region's transportation plan. If the strategy does not meet the target, the MPO must document the impediments and show how the target could be met with an alternative planning strategy. The CEQA relief would be provided to those projects that are consistent with either the sustainable communities strategy or alternative planning strategy, whichever meets the target.

Many regions in California have conducted comprehensive scenario planning, called Blueprint planning, that engages a broad set of stakeholders at the local level on the impacts of land use and transportation choices. The State has allocated resources to initiate or augment existing Blueprint efforts of MPOs. These efforts focus on fostering efficient land use patterns that not only reduce vehicle travel but also accommodate an adequate supply of housing, reduce impacts on valuable habitat and productive farmland, increase resource use efficiency, and promote a prosperous regional economy. Blueprint planning can play an important role in the SB 375 process by helping inform target-setting efforts and building strong sustainable communities strategies.

Local governments will play a significant role in the regional planning process to reach passenger vehicle greenhouse gas emissions reduction targets. Local governments have the ability to directly influence both the siting and design of new residential and commercial developments in a way that reduces greenhouse gases associated with vehicle travel, as well as energy, water, and waste. A partnership of local and regional agencies is needed to create a sustainable vision for the future that accommodates population growth in a carbon efficient way while meeting housing needs and other planning goals. Integration of the sustainable communities strategies or alternative planning strategies with local general plans will be key to the achievement of these goals. State, regional, and local agencies must work together to prioritize and create the supporting policies, programs, incentives, guidance, and funding to assist local actions to help ensure regional targets are met.

Enhanced public transit service combined with incentives for land use development that provides a better market for public transit will play an important role in helping to reach regional targets.

SB 375 maintains regions' flexibility in the development of sustainable communities strategies. There are many different ways regions can plan and work toward reducing the growth in vehicle travel. Increasing low-carbon travel choices (public transit, carpooling, walking and biking) combined with land use patterns and infrastructure that support these low-carbon modes of travel, can decrease average vehicle trip lengths by bringing more people closer to more destinations. The need for integrated strategies is supported by the current transportation and land use modeling literature.

Supporting measures that should be considered in both the regional target-setting and sustainable communities strategy processes include the following:

- Congestion pricing strategies can provide a method of efficiently managing traffic demand while raising funds for needed transit, biking and pedestrian infrastructure investment. Regional and local agencies, however, do not have the authority to pursue these strategies on their own, as federal approval and State authorization must be provided for regional implementation of most pricing measures.

- Indirect source rules for new development have already been implemented by some local air districts and proposed by others for purposes of criteria pollution reduction. Regions should evaluate the need for measures that would ensure the mitigation of high carbon footprint development outside of the sustainable communities strategies or alternative planning strategies that meet the targets established under SB 375.

- Programs to reduce vehicle trips while preserving personal mobility, such as employee transit incentives, telework programs, car sharing, parking policies, public education programs and other strategies that enhance and complement land use and transit strategies can be implemented and coordinated by regional and local agencies and stakeholder groups.

Another way to encourage greenhouse gas reductions from vehicle travel is through pay as you drive insurance (PAYD), a structure in which drivers realize a direct financial benefit from driving less. The California Insurance Commissioner recently announced support for PAYD and has proposed regulations to permit PAYD on a voluntary basis.

Separate emissions reduction estimates for these strategies are not quantified here. As regional targets are developed in the SB 375 process, ARB will work with regions to quantify the benefits in the context of the targets.

Estimating the Benefits of Regional Targets

The ARB estimate of the statewide benefit of regional transportation-related greenhouse gas emissions reduction targets is based on analysis of research results quantifying the effects of land use and transportation strategies. The emissions reduction number in Table 11 is not the statewide metric for regional targets that must be developed as SB 375 is implemented. The emissions target will ultimately be determined during the SB 375 process.

The possible impacts of land use and transportation policies have been well documented. Most recently, a 2008 U.C. Berkeley study[38] reviewed over 20

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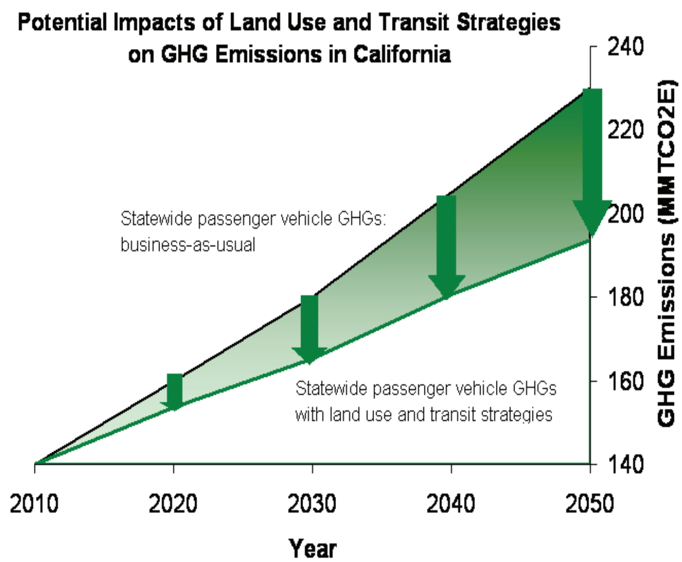
[38] Rodier, Caroline. U.C. Berkeley, Transportation Sustainability Research Center, "A Review of the International Modeling Literature: Transit, Land Use, and Auto Pricing Strategies to Reduce Vehicle Miles Traveled and Greenhouse Gas Emissions," August 2008. http://www.arb.ca.gov/planning/tsaq/docs/rodier_8-1-08_trb_paper.pdf (accessed October 12, 2008)

modeling studies from California (including the State's four largest MPOs), other states and Europe. The study found a range of 0.4 to 7.7 percent reduction in vehicle miles traveled (VMT) resulting from a combination of land use and enhanced transit policies compared to a business-as-usual case over a 10-year horizon, with benefits doubling by 2030, as shown in Figure 4. With the inclusion of additional measures such as pricing policies, the reduction of greenhouse gas emissions can be greater. These strategies will be considered during the target-setting process. Sophisticated land use and transportation models can best assess these effects. As part of the development of regional targets, technical tools will need to be refined to ensure sound quantification techniques are available.

Figure 4



The potential benefits of this measure that can be realized by 2020 (as shown in Table 11) were estimated after first accounting for the benefits of the vehicle technology and efficiency measures in the plan. It was calculated based on the U.C. Berkeley study's median value of 4 percent per capita VMT reduction over a 10-year time horizon. This value should not be interpreted as the final estimate of the benefits of this measure. The current academic literature supports this realistic statewide estimate of potential benefits, but the ultimate benefit will be determined as an outcome of SB 375 implementation on a regional level. The incentives for sustainable planning in SB 375 can set California on a new path. ARB's establishment of regional targets in 2010, combined with the Regional Targets Advisory Committee process, required by the legislation, provides a clear mechanism for maximizing the benefits of this measure.

Additional Benefits of Regional Targets and Land Use Strategies

Land use and transportation measures that help reduce vehicle travel will also provide multiple benefits beyond greenhouse gas reductions. Quality of life will be improved by increasing access to a variety of mobility options such as transit, biking, and walking, and will provide a diversity of housing options focused on proximity to jobs, recreation, and services. Other important state and community goals that could be met through better integrated land use and transportation planning include agricultural, open space and habitat preservation, improved water quality, positive health effects, and the reduction of smog forming pollutants.

Growing more sustainably has the potential to provide additional greenhouse gas and energy savings by encouraging more compact, mixed-use developments resulting in reduced demand for electricity and heating and cooling energy. These land use-related energy savings will contribute toward the Plan's energy efficiency measures to achieve the goal of reducing electricity and natural gas usage. ARB is continuing to evaluate the greenhouse gas emissions reductions that may be additional to the proposed measures in this plan.

Table 11: Regional Transportation-Related Greenhouse Gas Targets Recommendation
(MMTCO2E in 2020)

Measure No.	Measure Description	Reductions
T-3	Regional Transportation-Related Greenhouse Gas Targets[39]	5
	Total	**5**

7. Vehicle Efficiency Measures

Implement light-duty vehicle efficiency measures.

Several additional measures could reduce light-duty vehicle greenhouse gas emissions. The California Integrated Waste Management Board (CIWMB) with various partners continues to conduct a public awareness campaign to promote sustainable tire practices. ARB is pursuing a regulation to ensure that tires are properly inflated when vehicles are serviced. In addition, CEC in consultation with CIWMB is developing an efficient tire program focusing first on data gathering and outreach, then on potential adoption of minimum fuel-efficient tire standards, and lastly on the development of consumer information requirements for replacing tires. ARB is also pursuing ways to reduce engine load via lower friction oil and reducing the need for air conditioner use. ARB is actively engaged in the regulatory development process for the tire inflation component of this measure. Current information indicates the reduction of greenhouse gas emissions is likely to be less than estimated in the Draft Scoping Plan. ARB has adjusted the estimated reductions shown in Table 12 to reflect this.

[39] This number represents an estimate of what may be achieved from local land use changes. It is not the SB 375 regional target. ARB will establish regional targets for each MPO region following the input of the Regional Targets Advisory Committee and a public consultation process with MPOs and other stakeholders per SB 375.

Table 12: Vehicle Efficiency Recommendation
($MMTCO_2E$ in 2020)

Measure No.	Measure Description	Reductions
T-4	Vehicle Efficiency Measures	4.5
	Total	**4.5**

8. Goods Movement

Implement adopted regulations for the use of shore power for ships at berth. Improve efficiency in goods movement activities.

A significant portion of greenhouse gas emissions from transportation activities comes from the movement of freight or goods throughout the state. Activity at California ports is forecast to increase by 250 percent between now and 2020. Both the Goods Movement Emission Reduction Plan (GMERP) and the 2007 State Implementation Plan (SIP) contain numerous measures designed to reduce the public health impact of goods movement activities in California. ARB has already adopted a regulation to require ship electrification at ports. Proposition 1B funds, as well as clean air plans being implemented by California's ports, will also help reduce greenhouse gas emissions while cutting criteria pollutant and toxic diesel emissions. ARB is proposing to develop and implement additional measures to reduce greenhouse gas emissions due to goods movement from trucks, ports and other related facilities. The anticipated reductions would be above and beyond what is already expected in the GMERP and the SIP. This effort should provide accompanying reductions in air toxics and smog forming emissions. The estimated reduction of greenhouse gas emissions is shown in Table 13.

After further evaluation, ARB incorporated the Draft Scoping Plan's Heavy-Duty Vehicle-Efficiency measure into the Goods Movement measure. A Heavy-Duty Engine Efficiency measure could reduce emissions associated with goods movement through improvements which could involve advanced combustion strategies, friction reduction, waste heat recovery, and electrification of accessories. ARB will consider setting requirements and standards for heavy-duty engine efficiency in the future if higher levels of efficiency are not being produced either in response to market forces (fuel costs) or federal standards.

Table 13: Goods Movement Recommendation
($MMTCO_2E$ in 2020)

Measure No.	Measure Description	Reductions
T-5	Ship Electrification at Ports (Discrete Early Action)	0.2
T-6	Goods Movement Efficiency Measures • System-Wide Efficiency Improvements	3.5
	Total	**3.7**

9. Million Solar Roofs Program

Install 3,000 MW of solar-electric capacity under California's existing solar programs.

As part of Governor Schwarzenegger's Million Solar Roofs Program, California has set a goal to install 3,000 megawatts (MW) of new solar capacity by 2017 – moving the state toward a cleaner energy future and helping lower the cost of solar systems for consumers. The Million Solar Roofs Initiative is a ratepayer-financed incentive program aimed at transforming the market for rooftop solar systems by driving down costs over time. Created under Senate Bill 1 (Murray, Chapter 132, Statutes of 2006), the Million Solar Roofs Program includes CPUC's California Solar Initiative and CEC's New Solar Homes Partnership, and requires publicly-owned utilities (POUs) to adopt, implement and finance a solar incentive program. This measure would offset electricity from the grid, thereby reducing greenhouse gas emissions. The estimated emissions reductions are shown in Table 14.

Obtaining the incentives requires the building owners or developers to meet certain efficiency requirements: specifically, that new construction projects meet energy efficiency levels that exceed the State's Title 24 Building Energy Efficiency Standards, and that existing commercial buildings undergo an energy audit. Thus, the program is also a mechanism for achieving the efficiency targets for the Energy sector. By requiring greater energy efficiency for projects that seek solar incentives, the State would be able to reduce both electricity and natural gas needs and their associated greenhouse gas emissions.

Table 14: Million Solar Roofs Recommendation
($MMTCO_2E$ in 2020)

Measure No.	Measure Description	Reductions
E-4	Million Solar Roofs (including California Solar Initiative, New Solar Homes Partnership and solar programs of publicly owned utilities) • Target of 3000 MW Total Installation by 2020	2.1
	Total	**2.1**

10. Medium/Heavy-Duty Vehicles

Adopt medium and heavy-duty vehicle efficiency measures.

Medium- and heavy-duty vehicles account for approximately 20 percent of the transportation greenhouse gas inventory. Requiring retrofits to improve the fuel efficiency of heavy-duty trucks could include a requirement for devices that reduce aerodynamic drag and rolling resistance. In addition, hybridization of medium- and heavy-duty vehicles would also reduce greenhouse gas emissions through increased fuel efficiency. Hybrid trucks would likely achieve the greatest benefits in urban, stop-and-go applications, such as parcel delivery, utility services, transit, and other vocational work trucks. The recommendation for this sector is summarized in Table 15.

Table 15: Medium/Heavy-Duty Vehicle Recommendation
(MMTCO_2E in 2020)

Measure No.	Measure Description	Reductions
T-7	Heavy-Duty Vehicle Greenhouse Gas Emissions Reduction Measure - Aerodynamic Efficiency (Discrete Early Action)	0.9
T-8	Medium/Heavy-Duty Vehicle Hybridization	0.5
	Total	**1.4**

11. Industrial Emissions

Require assessment of large industrial sources to determine whether individual sources within a facility can cost-effectively reduce greenhouse gas emissions and provide other pollution reduction co-benefits. Reduce greenhouse gas emissions from fugitive emissions from oil and gas extraction and gas transmission. Adopt and implement regulations to control fugitive methane emissions and reduce flaring at refineries.

Energy Efficiency and Co-Benefits Audits for Large Industrial Sources

This measure would apply to the direct greenhouse gas emissions at major industrial facilities emitting more than 0.5 MMTCO_2E per year. In general, these facilities also have significant emissions of criteria air pollutants, toxic air pollutants, or both. Major industrial facilities include power plants, refineries, cement plants, and miscellaneous other sources. ARB would implement this measure through a regulation, requiring each facility to conduct an energy efficiency audit of individual combustion and other direct sources of greenhouse gases within the facility to determine the potential reduction opportunities, including criteria air pollutants and toxic air contaminants. The audit would include an assessment of the impacts of replacing or upgrading older, less efficient units such as boilers and heaters, or replacing the units with combined heat and power (CHP) units. The measure is summarized in Table 16.

The audit would help ARB to identify potential reductions of greenhouse gas emissions reductions, the associated costs and cost-effectiveness, their technical feasibility, and the potential to reduce air pollution impacts at the local or regional level. ARB will use the results to determine if certain emissions sources within a facility can make cost-effective reductions of greenhouse gas emissions that also provide reductions in other criteria or toxic pollutants. Where this is the case, rule provisions or permit conditions would be considered to ensure the best combination of pollution reductions. Nothing in this measure would delay known cost-effective strategies that otherwise would be required.

The California Long Term Energy Efficiency Strategic Plan (CPUC) discusses a number of strategies associated with improving industrial sector efficiency and greenhouse gas emissions reductions, including the development of certification protocols for industrial efficiency improvements to develop market recognition for efficiency gains.

Oil and Gas Recovery Operations and Transmission/Refineries

California is a major oil and gas producer. Crude oil, both from in-state and imported sources, is processed at 21 oil refineries in the state. In addition to conforming to the requirements of the cap-and-trade program and the audit measure, ARB has identified four specific measures for development and implementation, two for oil and gas recovery operations and gas transmission, and two for refineries. Other industrial measures that were under consideration affect greenhouse gas emissions sources that are fully regulated under cap and trade, which ARB concluded would provide cost-effective reductions of greenhouse gas emissions. All measures would be designed to secure a combination of cost-effective reductions in greenhouse gas emissions, criteria air pollutants and air toxics. Two measures would be developed to reduce methane emissions in the oil and gas production and gas transmission processes from leaks and incomplete combustion of methane (used as fuel). These measures would include improved leak detection, process modifications, equipment retrofits, installation of new equipment, and best management practices. The first measure would affect oil and gas producers. The second would impact operators of natural gas pipeline systems. These fugitive emissions are not proposed to be covered by a cap and trade program, although combustion-related emissions from these operations are proposed to be covered. The WCI partner jurisdictions are currently evaluating the inclusion of fugitive methane emissions to the extent that adequate quantification methods exist. During implementation of this measure, ARB will determine whether these emissions will also be covered in California's cap-and-trade program. If the emissions are covered under the cap, ARB will evaluate the need for the measures described here.

Two measures would be developed for oil refineries. The first would limit the greenhouse gas emissions from refinery flares while preserving flaring as needed for safety reasons. The second would remove the current fugitive methane exemption in most refinery Volatile Organic Compounds (VOC) regulations. This exemption was established because methane does not appreciably contribute to urban smog, but is inappropriate given the role that methane plays in global warming. ARB believes these measures would provide cost-effective greenhouse gas, criteria pollutants and air toxics emissions reductions. Most combustion and other process emissions at refineries would be governed by the cap-and-trade program. As with the oil and gas production measures above, the need for these measures would be evaluated if fugitive methane is included in the WCI cap-and-trade program.

Table 16: Industrial Emissions Recommendation
($MMTCO_2E$ in 2020)

Measure No.	Measure Description	Reductions
I-1	Energy Efficiency and Co-Benefits Audits for Large Industrial Sources	TBD
I-2	Oil and Gas Extraction GHG Emissions Reduction	0.2
I-3	GHG Leak Reduction from Oil and Gas Transmission	0.9
I-4	Refinery Flare Recovery Process Improvements	0.33
I-5	Removal of Methane Exemption from Existing Refinery Regulations	0.01
	Total	**1.4**

12. High Speed Rail

Support implementation of a high speed rail system.

A high speed rail (HSR) system is part of the statewide strategy to provide more mobility choice and reduce greenhouse gas emissions. This measure supports implementation of plans to construct and operate a HSR system between northern and southern California. As planned, the HSR is a 700-mile-long rail system capable of speeds in excess of 200 miles per hour on dedicated, fully-grade separated tracks with state-of-the-art safety, signaling and automated rail control systems. The system would serve the major metropolitan centers of California in 2030 and is projected to displace between 86 and 117 million riders from other travel modes in 2030.

For Phase 1 of the HSR, between San Francisco and Anaheim, 2020 is projected to be the first year of service, with 26 percent of the projected 2030 full system ridership levels. The anticipated reduction of greenhouse gas emissions are shown in Table 17. HSR system ridership and the benefits associated with it are anticipated to increase over time as additional portions of the planned system are completed. Over the long term, the system also has the potential to support the reduction of greenhouse gas emissions in the transportation sector from land use strategies, by providing opportunities for and encouraging low-impact transit-oriented development.

HSR implementation was initiated recently when California voters approved Proposition 1A, the “Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century,” as it appeared on the November 2008 ballot. HSR is anticipated to begin in 2010, with full implementation anticipated in 2030.

Table 17: High Speed Rail Recommendation
($MMTCO_2E$ in 2020)

Measure No.	Measure Description	Reductions
T-9	High Speed Rail	1.0
	Total	**1.0**

13. Green Building Strategy

Expand the use of green building practices to reduce the carbon footprint of California's new and existing inventory of buildings.

Collectively, energy use and related activities by buildings are the second largest contributor to California's greenhouse gas emissions. Almost one-quarter of California's greenhouse gas emissions can be attributed to buildings.[40] As the Governor recognized in his Green Building Initiative (Executive Order S-20-04), significant reductions in greenhouse gas emissions can be achieved through the design and construction of new green buildings as well as the sustainable operation, retrofitting, and renovation of existing buildings.

A Green Building strategy offers a comprehensive approach to reducing direct and upstream greenhouse gas emissions that cross-cuts multiple sectors including Electricity/Natural Gas, Water, Recycling/Waste, and Transportation. Green buildings are designed, constructed, renovated, operated, and maintained using an integrated approach that reduces greenhouse gas emissions by maximizing energy and resource efficiency. Employing a whole-building design approach can create tremendous synergies that result in multiple benefits at little or no net cost, allowing for efficiencies that would never be possible on an incremental basis.

A Green Building strategy will produce greenhouse gas saving through buildings that exceed minimum energy efficiency standards, decrease consumption of potable water, reduce solid waste during construction and operation, and incorporate sustainable materials. Combined these measures can also contribute to healthy indoor air quality, protect human health and minimize impacts to the environment. A Green Building strategy also includes siting considerations. Buildings that are sited close to public transportation or near mixed-use areas can work in tandem with transportation-related strategies to decrease greenhouse gas emissions that result from that sector.

In July 2008, the California Building Standards Commission (CBSC) adopted the Green Building Standards Code (GBSC) for all new construction in the state. While the current version of the commercial green building code is voluntary, CBSC anticipates adopting a mandatory code in 2011 which will institute minimum environmental performance standards for all occupancies. The Green Building Strategy includes Zero Net Energy (ZNE) goals for new and existing homes and commercial buildings consistent with the recently-adopted California Long Term Energy Efficiency Strategic Plan. ARB encourages local governments to raise the bar by adopting "beyond-code" green building requirements. To assist this effort, State government would develop and regularly tighten voluntary standards, written in GBSC language for easy adoption by local jurisdictions.

[40] Greenhouse gas emission estimates from electricity, natural gas, and water use in homes and commercial buildings.

As we approach the 2020 and 2030 targets for zero energy buildings, these "percent above code" targets must shift to "percent of ZNE" targets. Zero energy new and existing buildings can be an overarching and unifying concept for energy efficiency in buildings, as discussed above (building energy efficiency measures E-1 and CR-1). In order to achieve statewide GHG emission reductions, these targets should be expanded to address other aspects of environmental performance. For example, these targets could be re-framed as a carbon footprint reduction goal for a 35 percent reduction in both energy and water consumption. For commercial buildings, a 2011 target should be established such that a quarter of all new buildings reduce energy and water consumption by at least 25 percent beyond code.

Furthermore, retrofitting existing residential and commercial buildings would achieve substantial greenhouse gas emissions reduction benefits. This Scoping Plan recommends the establishment of an environmental performance rating system for homes and commercial buildings and further recommends that California adopt mechanisms to encourage and require retrofits for buildings that do not meet minimum standards of performance.

An effective green building framework can operate to deliver reductions of greenhouse gas emissions in multiple sectors. The green building strategies provide a vehicle to achieve the statewide electricity and natural gas efficiency targets and lower greenhouse gas emissions from the waste and water transport sectors. Achieving these green building emissions reductions will require coordinated efforts from a broad range of stakeholders, and new financing mechanisms to motivate investment in green building strategies.

Achieving significant greenhouse gas emissions reductions from new and existing buildings will require a combination of green building measures for new construction and retrofits to existing buildings. The State of California will set an example by requiring all new State buildings to exceed existing Green Building Initiative energy goals and achieve nationally-recognized building sustainability standards such as Leadership in Energy and Environmental Design - New Construction (LEED-NC) "Gold" certification. Existing State buildings would also be retrofitted to achieve higher standards equivalent to LEED-EB for existing buildings (EB) "Silver." All new schools should be required to meet the Collaborative for High Performance Schools (CHPS) 2009 criteria. Existing schools applying for modernization funds should also be required to meet CHPS 2009 criteria.

ARB estimates that the greenhouse gas savings from green building measures as approximately 26 $MMTCO_2E$, as shown in Table 18 below. Most of these reductions are accounted for in the Electricity, Waste and Water sectors. Because of this, ARB has assigned all emissions reductions that occur as a result of green building strategies to other sectors for purposes of meeting AB 32 requirements, but will continue to evaluate and refine the emissions from this sector. As such, this strategy will require implementation from various entities within California, including CEC, PUC, State Architect, and others, each taking the lead in their area of authority and expertise.

Table 18: Green Buildings Recommendation
(MMTCO_2E in 2020)

Measure No.	Measure Description	Reductions
GB-1	Green Buildings[41]	26
	Total	**26**

14. High Global Warming Potential Gases

Adopt measures to reduce high global warming potential gases.

High global warming potential (GWP) gases pose a unique challenge. Just a few pounds of high GWP materials can have the equivalent effect on global warming as several *tons* of carbon dioxide. For example, the average refrigerator has about a half-pound of refrigerant and about one pound of "blowing agents" used to make the insulating foam. If these gases were released into the atmosphere, they would have a global warming impact equivalent to five metric tons of CO_2.

High GWP chemicals are very common and are used in many different applications such as refrigeration, air conditioning systems, fire suppression systems, and the production of insulating foam. Because these gases have been in use for years, old refrigerators, air conditioners and foam insulation represent a significant "bank" of these materials yet to be released. High GWP gases are released primarily in two ways. The first is through leaking systems, and the second is during the disposal process. Once high GWP materials are released, they persist in the atmosphere for tens or even hundreds of years. Recommended measures to address this growing problem take the form of direct regulations and use of mitigation fees.

ARB identified four Discrete Early Action measures to reduce greenhouse gas emissions from the refrigerants used in car air conditioners, semiconductor manufacturing, air quality tracer studies, and consumer products. ARB has identified additional potential reduction opportunities based on specifications for future commercial and industrial refrigeration, changing the refrigerants used in auto air conditioning systems, and ensuring that existing car air conditioning systems as well as stationary refrigeration equipment do not leak. Recovery and destruction of high GWP materials in the banks described above could also provide significant reductions.

[41] Although some of these emissions reductions may be additional, most of them are accounted for in the Energy, Waste, Water, and Transportation sectors. In addition, some of these reductions may occur out of state, making quantification more difficult. Because of this, these emissions reductions are not currently counted toward the AB 32 2020 goal.

ARB is also proposing to establish an upstream mitigation fee on the use of high GWP gases. Even with the reductions from the specific high GWP measures described above, this sector's emissions are still projected to more than double from current levels by 2020. This is because of the high growth in the sector due, in part, to the replacement of ozone-depleting substances being phased out of production. These emissions would be difficult to address via traditional approaches since the gases are used in small quantities in very diverse applications. Additionally, there are no proven substitutes or alternatives for some uses, and the relative low price of most high GWP compounds provides little incentive to develop alternatives, reduce leakage, or recover the gases at end-of-life.

An upstream fee would ensure that the climate impact of these substances is reflected in the total cost of the product, encouraging reduced use and end-of-life losses, as well as the development of alternatives. The fee would be variable and associated with the impact the product makes on public health and the environment. This could encourage product innovation because fees would correspondingly decrease as the manufacturer or producer redesigned their product or found lower-cost alternatives. This mitigation fee would complement many of the downstream high GWP regulations currently being developed.[42] Fees on high GWP gases would be set to be consistent with the cost of reducing greenhouse gas emissions and could be set to reduce multiple environmental impacts. Revenues could be used to mitigate greenhouse gas emissions either from other high GWP compounds or other greenhouse gases.

Table 19 summarizes the recommendations for measures in the High GWP sector. These measures address both high GWP gases identified in AB 32 and also other high GWP gases, such as ozone-depleting substances that are only partially covered by the Montreal Protocol. The emissions reductions shown are only for the six greenhouse gases explicitly identified in AB 32.

[42] Industrial process emissions of high GWP gases are also expected to be part of the cap-and-trade program. As ARB moves through the rulemaking for both the high GWP fee and the cap-and-trade program, staff will evaluate whether these are complementary approaches or if one or the other needs to be adjusted to prevent duplicative regulation of the industrial process emissions of these gases.

Table 19: High GWP Gases Sector Recommendation
(MMTCO$_2$E in 2020)

Measure No.	Measure Description	Reductions
H-1	Motor Vehicle Air Conditioning Systems: Reduction of Refrigerant Emissions from Non-Professional Servicing (Discrete Early Action)	0.26
H-2	SF_6 Limits in Non-Utility and Non-Semiconductor Applications (Discrete Early Action)	0.3
H-3	Reduction of Perfluorocarbons in Semiconductor Manufacturing (Discrete Early Action)	0.15
H-4	Limit High GWP Use in Consumer Products (Discrete Early Action) (Adopted June 2008)	0.25
H-5	High GWP Reductions from Mobile Sources • Low GWP Refrigerants for New Motor Vehicle Air Conditioning Systems • Air Conditioner Refrigerant Leak Test During Vehicle Smog Check • Refrigerant Recovery from Decommissioned Refrigerated Shipping Containers • Enforcement of Federal Ban on Refrigerant Release during Servicing or Dismantling of Motor Vehicle Air Conditioning Systems	3.3
H-6	High GWP Reductions from Stationary Sources • High GWP Stationary Equipment Refrigerant Management Program: o Refrigerant Tracking/Reporting/Repair Deposit Program o Specifications for Commercial and Industrial Refrigeration Systems • Foam Recovery and Destruction Program • SF_6 Leak Reduction and Recycling in Electrical Applications • Alternative Suppressants in Fire Protection Systems • Residential Refrigeration Early Retirement Program	10.9
H-7	Mitigation Fee on High GWP Gases[43]	5
	Total	**20.2**

[43] The 5 MMTCO$_2$E reduction is an estimate of what might occur with a fee in place. Additional emissions reductions from a fee would be expected as resulting revenues are used in mitigation programs. Using the funds to mitigate greenhouse gas emissions could substantially increase the emissions reductions from this measure.

15. Recycling and Waste

Reduce methane emissions at landfills. Increase waste diversion, composting and other beneficial uses of organic materials, and mandate commercial recycling. Move toward zero-waste.

California has a long track record of reducing greenhouse gas emissions by turning waste into resources, exemplified by the waste diversion rate from landfills of 54 percent (which exceeds the current 50 percent mandate) resulting from recovery of recyclable materials. Re-introducing recyclables with intrinsic energy value back into the manufacturing process reduces greenhouse gas emissions from multiple phases of product production including extraction of raw materials, preprocessing and manufacturing. Additionally, by recovering organic materials from the waste stream, and having a vibrant composting and organic materials industry, there is an opportunity to further reduce greenhouse gas emissions through the indirect benefits associated with the reduced need for water and fertilizer for California's Agricultural sector. Incentives may also be an effective way to secure greenhouse gas emissions reductions in this sector. Table 20 summarizes the emissions reductions from Recycling and Waste sector.

Reduction in Landfill Methane

Methane emissions from landfills, generated when wastes decompose, account for one percent of California's greenhouse gas emissions. Greenhouse gas emissions can be substantially reduced by properly managing all materials to minimize the generation of waste, maximize the diversion from landfills, and manage them to their highest and best use. Capturing landfill methane results in greenhouse gas benefits, as well as reductions in other air pollutants such as volatile organic compounds. ARB is working closely with the California Integrated Waste Management Board (CIWMB) to develop a Discrete Early Action measure for landfill methane control that will be presented to ARB in January.

CIWMB is also pursuing efforts to reduce methane emissions by diverting organics from landfills, and to promote best management practices at smaller uncontrolled landfills. Landfill gas may also provide a viable source of liquefied natural gas (LNG) vehicle fuel. Reductions from these types of projects would be accounted for in the Transportation sector.

High Recycling / Zero Waste

This measure reduces greenhouse gas emissions primarily by reducing the substantial energy use associated with the acquisition of raw materials in the manufacturing stage of a product's life-cycle. As virgin raw materials are replaced with recyclables, a large reduction in energy consumption should be realized. Implementing programs with a systems approach that focus on consumer demand, manufacturing, and movement of products will result in the reduction of greenhouse gas emissions and other co-benefits. Reducing waste and materials at the source of generation, increased use of organic materials to produce compost to benefit soils and to produce biofuels and energy, coupled with increased recycling – especially in the commercial sector – and Extended Producer Responsibility (EPR) plus Environmentally Preferable Purchasing (EPP) also have the potential to reduce emissions, both in-state and within the connected global economy. This measure could also assist in meeting the 33 percent renewables energy goal through deployment of anaerobic digestion for production of fuels/energy.

As noted by ETAAC, recycling in the commercial sector could be substantially increased. This will be implemented through mandatory programs and enhanced partnerships with local governments. The provision of appropriate financial incentives will be critical. ARB will work with CIWMB to develop and implement these types of programs. ARB will also work with CIWMB, the California Department of Food and Agriculture, the Department of Transportation, and others to provide direct incentives for the use of compost in agriculture and landscaping. Further, CIWMB will explore the use of incentives for all Recycling and Waste Management measures, including for commercial recycling and for local jurisdictions to encourage the collection of residentially and commercially-generated food scraps for composting and in-vessel anaerobic digestion.

Table 20: Recycling and Waste Sector Recommendation - Landfill Methane Capture and High Recycling/Zero Waste
($MMTCO_2E$ in 2020)

Measure No.	Measure Description	Reductions
RW-1	Landfill Methane Control (Discrete Early Action)	1
RW-2	Additional Reductions in Landfill Methane • Increase the Efficiency of Landfill Methane Capture	TBD
RW-3	High Recycling/Zero Waste • Mandatory Commercial Recycling • Increase Production and Markets for Organics Products • Anaerobic Digestion • Extended Producer Responsibility • Environmentally Preferable Purchasing	 5 2 2 TBD TBD
	Total	**10**[(44)]

[44] Reductions from RW-2 and RW-3 are not counted toward the AB 32 goal. ARB is continuing to work with CIWMB to quantify these emissions and determine what portion of the reductions can be credited to meeting the AB 32 2020 goal. These measures may provide greater emissions reductions than estimated.

16. Sustainable Forests

Preserve forest sequestration and encourage the use of forest biomass for sustainable energy generation.

The 2020 Scoping Plan target for California's forest sector is to maintain the current 5 $MMTCO_2E$ of sequestration through sustainable management practices, potentially including reducing the risk of catastrophic wildfire, and the avoidance or mitigation of land-use changes that reduce carbon storage. California's Board of Forestry and Fire Protection has the existing authority to provide for sustainable management practices, and will, at a minimum, work to maintain current carbon sequestration levels. The Resources Agency and its departments will also have an important role to play in implementing this measure.

In addition, the Resources Agency is supporting voluntary actions, including expenditure of public funds for projects focused largely on conserving biodiversity, providing recreation, promoting sustainable forest management and other projects that also provide carbon sequestration benefits. The federal government must also use its regulatory authority to, at a minimum, maintain current carbon sequestration levels for land under its jurisdiction in California.

Forests in California are now a carbon sink. This means that atmospheric removal of carbon through sequestration is greater than atmospheric emissions from processes like fire and decomposition of wood. However, several factors, such as wildfires and forest land conversion, may cause a decline in the carbon sink. The 2020 target would provide a mechanism to help ensure that current carbon stocks are, at a minimum, maintained and do not diminish over time. The 5 $MMTCO_2E$ emission reduction target is set equal to the magnitude of the current estimate of net emissions from California's forest sector. As technical data improve, the target can be recalibrated to reflect new information.

California's forests will play an even greater role in reducing carbon emissions for the 2050 greenhouse gas emissions reduction goals. Forests are unique in that planting trees today will maximize their sequestration capacity in 20 to 50 years. As a result, near-term investments in activities such as planting trees will help us reach our 2020 target, but will also play a greater role in reaching our 2050 goals.

Monitoring carbon sequestered on forest lands will be necessary to implement the target. The Board of Forestry and Fire Protection, working with the Resources Agency, the Department of Forestry and Fire Protection and ARB would be tasked with developing a monitoring program, improving greenhouse gas inventories, and determining what actions are needed to meet the 2020 target for the Forest sector. Future climate impacts will exacerbate existing wildfire and insect disturbances in the Forest sector. These disturbances will create new uncertainties in reducing emissions and maintaining sequestration levels over the long-term, requiring more creative strategies for adapting to these changes. In the short term, focusing on sustainable management practices and land-use issues is a practical approach for moving forward.

Future land use decisions will play a role in reaching our greenhouse gas emissions reduction goals for all sectors. Loss of forest land to development increases greenhouse gas emissions levels because less carbon is sequestered. Avoiding or mitigating such conversions will support efforts to meet the 2020 goal. When significant changes occur, the California Environmental Quality Act is a mechanism providing for assessment and mitigation of greenhouse gas emissions.

Going forward there are a number of forestry-related strategies that can play an important role in California's greenhouse gas emissions reduction efforts. Biomass resources from forest residue will factor into the expansion of renewable energy sources (this is currently accounted for in the Energy sector). Similarly, fuels management strategies have the potential to reduce the risk of catastrophic fires. However, fuels management needs to be evaluated to determine whether, and if so under what circumstances, quantifiable greenhouse gas emission reductions are achieved. Additionally, public investments to purchase and preserve forests and woodlands would also provide greenhouse gas emission reductions that will be accounted for as projects are funded. Urban forest projects can also provide the dual benefit of carbon sequestration and shading to reduce air conditioning load.

Furthermore, the Forest sector currently functions as a source of voluntary reductions that would not otherwise occur and this role could expand even further in the future. ARB has already adopted a methodology to quantify reductions from forest projects, and recently adopted additional quantification methodologies. Table 21 summarizes the emission reductions from the forest measure.

Table 21: Sustainable Forests Recommendation
($MMTCO_2E$ in 2020)

Measure No.	Measure Description	Reductions
F-1	Sustainable Forest Target	5
	Total	**5**

17. Water

Continue efficiency programs and use cleaner energy sources to move and treat water.

Water use requires significant amounts of energy. Approximately one-fifth of the electricity and one-third of the non-power plant natural gas consumed in the state are associated with water delivery, treatment and use. Although State, federal, and local water projects have allowed the state to grow and meet its water demands, greenhouse gas emissions can be reduced if we can move, treat, and use water more efficiently. As is the case with energy efficiency, California has a long history of advancing water efficiency and conservation programs. Without this ongoing, critical work, baseline or business-as-usual greenhouse gas emissions associated with water use would be much higher than is currently the case.

Six greenhouse gas emissions reduction strategies measures are proposed for the Water sector, and are shown in Table 22. Three of the measures target reducing energy requirements associated with providing reliable water supplies and two measures are aimed at reducing the amount of non-renewable electricity associated with conveying and treating water. The final measure focuses on providing sustainable funding for implementing these actions. The greenhouse gas emissions reductions from these measures are indirectly realized through reduced energy requirements and are accounted for in the Electricity and Natural Gas sector.

In addition, a mechanism to make allowances available in a cap-and-trade program could be used to provide additional incentives for local governments, water suppliers, and third party providers to bundle water and energy efficiency improvements. This type of allowance set-aside will be evaluated during the rulemaking for the cap-and-trade program.

ARB recommends a public goods charge for funding investments in water management actions that improve water and energy efficiency and reduce GHG emissions. As noted by the Economic and Technology Advancement Advisory Committee, a public goods charge on water can be collected on water bills and then used to fund end-use water efficiency improvements, system-wide efficiency projects, water recycling, and other actions that improve water and energy efficiency and reduce GHG emissions. Depending on how the fee schedule is developed in a subsequent rulemaking process, a public goods charge could generate \$100 million to \$500 million. These actions would also have the co-benefit of improving water quality and water supply reliability for customers.

Table 22: Water Recommendation
(MMTCO$_2$E in 2020)

Measure No.	Measure Description	Reductions
W-1	Water Use Efficiency	1.4
W-2	Water Recycling	0.3
W-3	Water System Energy Efficiency	2.0
W-4	Reuse Urban Runoff	0.2
W-5	Increase Renewable Energy Production	0.9
W-6	Public Goods Charge	TBD
	Total	**4.8**[(45)]

[45] Greenhouse gas emission reductions from the water sector are not currently counted toward the 2020 goal. ARB anticipates that a portion of these reductions will be additional to identified reductions in the Electricity sector and is working with the appropriate agencies to refine the electricity/water emissions inventory.

18. Agriculture

In the near-term, encourage investment in manure digesters and at the five-year Scoping Plan update determine if the program should be made mandatory by 2020.

Encouraging the capture of methane through use of manure digester systems at dairies can provide emission reductions on a voluntary basis. This measure is also a renewable energy strategy to promote the use of captured gas for fuels or power production. Initially, economic incentives such as marketable emission reduction credits, favorable utility contracts, or renewable energy incentives will be needed. Quantified reductions for this measure (shown in Table 23) are not included in the sum of statewide reductions shown in Table 2 since the initial approach is voluntary. ARB and the California Climate Action Registry worked together on a manure digester protocol to establish methods for quantifying greenhouse gas emissions reductions from individual projects; the Board adopted this protocol in September 2008. The voluntary approach will be re-assessed at the five-year update of the Scoping Plan to determine if the program should become mandatory for large dairies by 2020.

Nitrogen fertilizer, which produces N_2O emissions, is the other significant source of greenhouse gases in the Agricultural sector. ARB has begun a research program to better understand the variables affecting fertilizer N_2O emissions (Phase 1), and based on the findings, will explore opportunities for emission reductions (Phase 2).

There may be significant potential for additional voluntary reductions in the agricultural sector through strategies, such as those recommended by ETAAC. These opportunities include increases in fuel efficiency of on-farm equipment, water use efficiency, and biomass utilization for fuels and power production.

Increasing carbon sequestration, including on working rangelands, hardwood and riparian woodland reforestation, also hold potential as a greenhouse gas strategies. As we evaluate the role that this sector can play in California's emissions reduction efforts, we will explore the feasibility of developing sound quantification protocols so that these and other related strategies may be employed in the future.

Table 23: Agriculture Recommendation
($MMTCO_2E$ in 2020)

Measure No.	Measure Description	Reductions
A-1	Methane Capture at Large Dairies[46]	1.0
	Total	**1.0**

[46] Because the emission reductions from this measure are not required, they are not counted in the total.

D. Voluntary Early Actions and Reductions

Many individual activities that are not currently addressed under regulatory approaches can nevertheless result in cost-effective, real, additional, and verifiable greenhouse gas emissions reductions that will help California meet its 2020 target. Ensuring that appropriate credit is available to these types of emissions reduction projects will also help jump-start a new wave of technologies that will feature prominently in California and the world's long-term efforts to combat climate change. ARB will pursue several approaches that will recognize and reward these types of projects.

1. Voluntary Early Action

ARB is required to design regulations to encourage early action to reduce greenhouse gas emissions, and to provide appropriate recognition or credit for that action. (HSC §38562(b)(1) and (3)) Recognizing and rewarding greenhouse gas emissions reductions that occur prior to the full implementation of the AB 32 program can set the stage for innovation by incentivizing the development and employment of new clean technologies and by generating economic and environmental benefits for California.

In February 2008, ARB adopted a policy statement encouraging the early reductions of greenhouse gas emissions.[47] The policy statement describes a process for interested parties to submit proposed emission quantification methodologies for voluntary greenhouse gas emissions reductions to ARB for review. The intent is to provide a rapid assessment of methodologies for evaluating potential greenhouse gas emissions reduction projects to encourage early actions. Where appropriate, ARB will issue Executive Orders to confirm the technical soundness of the methodologies, and the methodology would be available for use by other parties to demonstrate the creation of voluntary early reductions. ARB is currently in the process of evaluating a number of submitted project methodologies.

ARB will provide appropriate credit for voluntary early reductions that can be adequately quantified and verified through three primary means. First, within the cap-and-trade program, ARB would set aside a certain number of allowances from the first compliance period to use to reward voluntary reductions that occur before 2012. In addition, ARB will assure that the allocation process in the first compliance period does not disadvantage facilities that have made reductions after AB 32 went into effect at the start of 2007 and before 2012.[48] The third approach will be to design

[47]Board Meeting Agenda. California Air Resources Board. February 28, 2008. http://www.arb.ca.gov/board/ma/2008/ma022808.htm (accessed October 12, 2008)

[48] ARB will evaluate whether some reductions that occurred prior to AB 32 going into effect on January 1, 2007, should also receive credit under these rules. For example, many facilities in California registered with the California Climate Action Registry after its creation in 2002 to document early actions to reduce emissions by having a record of entities profiles and baselines. ARB will evaluate what reductions made prior to 2007 should be eligible for credit from the allowance set-aside as part of the cap-and-trade program rulemaking.

other regulations, to the extent feasible, to recognize and reward early action. These approaches are discussed in more detail in Appendix C.

2. Voluntary Reductions

Emissions reduction projects that are not otherwise regulated, covered under an emissions cap, or undertaken as a result of government incentive programs can generate "offsets." These are verifiable reductions whose ownership can be transferred to others. Voluntary offset markets have recently flourished as a way for companies and individuals to offset their own emissions by purchasing reductions outside of their own operations. These sorts of voluntary efforts to reduce greenhouse gas emissions can play an important role in helping the State meet its overall greenhouse gas reduction goals.

ARB will adopt methodologies for quantifying voluntary reductions. (HSC §38571) The Board adopted a methodology for forest projects in October 2007 and for urban forestry and manure digesters in September 2008. The recognition of voluntary reduction or offset methodologies does not in any way guarantee that these offsets can be used for other compliance purposes. The Board would need to adopt regulations to verify and enforce reductions achieved under these or other approved methodologies before they could be used for compliance purposes. (HSC §38571)

Allowance set-asides, in addition to being used to potentially reward voluntary early actions by facilities that will be included in the cap-and-trade program, could also be used to reward voluntary early action at other facilities not covered by the cap and to ensure that voluntary actions, such as voluntary renewable power purchases by individuals, businesses, and others, serve to reduce greenhouse gas emissions under the cap. An early action allowance set-aside could be utilized both by entities that are covered by the cap, and by those who develop emissions reducing projects outside of the cap, or purchase the reductions associated with those projects, and have not sold or used them. Additional discussion of voluntary offsets is included in Appendix C.

E. Use of Allowances and Revenues

Revenues may be generated from the implementation of various proposed components of the Scoping Plan, including by the use of auctions within a cap-and-trade system or through the imposition of more targeted measures, such as a public goods charge on water. These revenues could be used to support AB 32 requirements for greenhouse gas emissions reductions and associated socio-economic considerations. This section summarizes some of the recommendations and ideas that ARB has received to date. As discussed in the description of the cap-and-trade measure above, ARB will seek input from a broad range of experts in an open public process regarding the options for allocation and revenue use under consideration.

The Economic and Technology Advancement Advisory Committee (ETAAC) recommended the creation of a California Carbon Trust as a possible mechanism for using revenues generated by the program, leveraged with private funds, to further the overall program goals. ETAAC's recommendation is roughly based on the United Kingdom Carbon Trust. The United Kingdom program was established with public funds, but now functions as a stand-alone corporation, providing management and consulting services to corporations and small and medium businesses on reducing greenhouse gas emissions. It also funds innovations in carbon reduction technologies. ETAAC recommended the creation of a similar organization that would use revenue from the sale of carbon allowances or from carbon fees to:

- Fund research, development and demonstration projects,
- Help bring promising and high potential technologies through the often challenging early stages of development and get them to market,
- Manage the early carbon market and mitigate price volatility, purchasing credits and selling them or retiring them as needed,
- Dedicate resources to fund projects to achieve AB 32 Environmental Justice goals, or
- Support a green technology workforce training program.

The most appropriate use for some of the allowances and revenue generated under AB 32 may be to retain it within or return it to the sector from which it was generated. For example, CEC and CPUC specifically recommended that significant portions of the revenue generated from the electricity sector under a cap-and-trade program be used for the benefit of that sector to support investments in renewable energy, efficiency, new energy technology, infrastructure, customer utility bill relief, and other similar programs. In the case of more targeted revenues from a public goods charge, the intent would be to use the funds for program purposes within the sector in which it was raised, for example in the water sector. ARB will seek input from a broad range of experts in an open public process, and will work with other agencies, the WCI partner jurisdictions, and stakeholders to consider the options for use of revenues from the AB 32 program.

Possible uses of allowances and of the revenue generated under the program include:

- **Reducing costs of emissions reductions or achieving additional reductions –** Funding energy efficiency and renewable resource development could lower overall costs to consumers and companies, and provide the opportunity to achieve greater emissions reductions than would otherwise be possible. Program revenues could be used to fund programs directly, or create financial incentives for others. Allowance set-asides could also be used to provide incentives for voluntary renewable power purchases by individuals and businesses, and for increased energy efficiency.
- **Achieving environmental co-benefits –** Criteria and toxic air pollutants create health risks, and some communities bear a disproportionate burden from air pollution. Revenues could be used to enhance greenhouse gas emission reductions that also provide reductions in air and other pollutants that affect public health.

- **Incentives to local governments –** Funding or other incentives to local governments for well-designed land-use planning and infrastructure projects could lead to shorter commutes and encourage walking, bicycling and the use of public transit. Funding of other incentives for local governments could also be used to increase recycling, composting, and to generating renewable energy from anaerobic digestion.
- **Consumer rebates –** Utilities and other businesses could use revenues to support and increase rebate programs to customers to offset some of the cost associated with increased investments in renewable resources and to encourage increased energy efficiency.
- **Direct refund to consumers –** Revenue from the program could be recycled directly back to consumers in a variety of forms including per capita dividends, earned income tax credits, or other mechanisms.
- **Climate change adaptation programs –** Climate change will impact natural and human environments. Program revenues could be used to help the state adapt to the effects of climate change which will be detailed in the State's Climate Adaptation Strategy being prepared by the Resources Agency to be completed in early 2009.
- **Subsidies –** Revenues could be used to reduce immediate cost impacts to covered industries required to make substantial upfront capital investments to reduce greenhouse gas emissions.
- **RD&D funding –** Revenues could be used to support research, development, and deployment of green technologies.
- **Worker transition assistance –** Regulating greenhouse gas emissions will probably shift economic growth to some sectors and green technologies and away from higher carbon intensity industries. Worker training programs could help the California labor force be competitive in these new industries.
- **Administration of a greenhouse gas program –** A portion of revenues could be used to underwrite the State's AB 32 programs and operating costs.
- **Direct emission reductions –** Revenues could be used to purchase greenhouse gas reductions for the sole purpose of retirement, providing direct additional greenhouse gas emission reductions. Potential projects, such as afforestation and reforestation, would both sequester CO_2 and provide other environmental benefits.

Many of the potential uses of revenue would help ARB implement the community benefit section of the AB 32 (HSC §38565) which directs the Board, where applicable and to the extent feasible, to ensure that the greenhouse gas emissions reduction program directs public and private investment toward the most disadvantaged communities in California.

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III. EVALUATIONS

The primary purpose of the Scoping Plan is to develop a set of measures that will provide the maximum technologically feasible and cost-effective greenhouse gas emission reductions. In developing this Plan, ARB evaluated the effect of these measures on California's economy, environment, and public health. This Chapter outlines these analyses.

ARB conducted broad evaluations of the potential impacts of the Scoping Plan, and will conduct more specific evaluations during regulatory development (HSC §38561(d), and HSC §38562(b)). Prior to inclusion of market-based compliance mechanisms in a regulation, to the extent feasible, the Board will consider direct, indirect and cumulative emission impacts, and localized impacts in communities that are already adversely impacted by air pollution (HSC §38570(b)).

Based on the evaluation of the recommendations included in this Plan, implementing AB 32 is expected to have an overall positive effect on the economy. In addition, implementation of the measures in the Recommended Actions section (Chapter II) will reduce statewide oxides of nitrogen (NOx), volatile organic compounds (VOC) and atmospheric particulate matter (PM) emissions primarily due to reduced fuel consumption, with resulting public health benefits. ARB will also work at the measure-specific level to further maximize the public health benefits that can accompany implementation of greenhouse gas emissions reduction strategies. The following sections provide a summary of the ARB evaluations of the recommended measures included in this Scoping Plan. More detailed information on the evaluations and their results are provided in Appendices G and H.

A. Economic Modeling

To evaluate the economic impacts of the Scoping Plan, ARB compared estimated economic activity under a business-as usual (BAU) case to the results obtained when actions recommended in this Plan are implemented. The BAU case is briefly described below. The estimated costs and savings used as model inputs for individual measures are outlined in Appendix G, and additional documentation on the calculation of those costs and savings is provided in Appendix I. All dollar estimates are in 2007 dollars.

Under the BAU case, Gross State Product (GSP) in California is projected to increase from $1.8 trillion in 2007 to almost $2.6 trillion in 2020. The results of our economic analysis indicate that implementation of the Scoping Plan will have an overall positive net economic benefit for the state. Positive impacts are anticipated primarily because the investments motivated by several measures result in substantial energy savings that more than pay back the cost of the investments at expected future energy prices.

The business-as-usual case is a representation of what the State of the California economy will be in the year 2020 assuming that none of the measures recommended in the Scoping Plan are implemented. While a number of the measures in the plan will be implemented as the result of existing federal or State policies and do not require additional regulatory action resulting from the implementation of AB 32, they are not included in the BAU case to ensure that the economic impacts of all of the measures in the Scoping Plan are fully assessed.

The BAU case is constructed using forecasts from the California Department of Finance, the California Energy Commission, and other sources, and is described in more detail in Appendix G. ARB used a conservative estimate of future petroleum price in this analysis, $89 per barrel of oil in 2020. Aspects of the BAU case are subject to uncertainty, for example, the possibility that future energy prices could deviate from those that are included in the BAU case.

1. Macro-economic Modeling Results

Table 24 summarizes the key findings from the economic modeling. Gross State Product, personal income and employment are shown for 2007 and for two cases for 2020, the BAU case and for implementation of the Scoping Plan. For both the BAU case and the Scoping Plan case, Gross State Product increases by almost $800 billion between 2007 and 2020, personal income grows by 2.8 percent per year from $1.5 trillion in 2007 to $2.1 trillion in 2020, and employment grows by 0.9 percent per year from 16.4 million jobs in 2007 to 18.4 million (BAU) or 18.5 million (Scoping Plan) in 2020. The results consistently show that implementing the Scoping Plan will not only significantly reduce California's greenhouse gas emissions, but will also have a net positive effect on California's economic growth through 2020.

Table 24: Summary of Key Economic Findings from Modeling the Scoping Plan Using E-DRAM

Economic Indicator	2007	Business-as-Usual*		Scoping Plan		
		2020	Average Annual Growth	2020	Change from BAU	Average Annual Growth
Gross State Product ($Billion)	1,811	2,586	2.8%	2,593	0.3%	2.8%
Personal Income ($Billion)	1,464	2,093	2.8%	2,109	0.8%	2.8%
Employment (Million Jobs)	16.41	18.41	0.9%	18.53	0.7%	0.9%
Emissions ($MMTCO_2E$)	500**	596	1.4%**	422	-28%	-1.2%**
Carbon Prices (Dollars)	-	-	-	10.00	NA	-

* Business-as-usual is a forecast of the California economy in 2020 without implementation of any of the measures identified in the Scoping Plan.

** Approximate value. ARB is in currently estimating greenhouse gas emissions for 2007.

The macroeconomic modeling results presented here understate the benefits of market-based policies, including the cap-and-trade program. Consequently, our estimate of the economic impact of implementing the Scoping Plan understates the positive impact on the California economy. Nonetheless, using the current best estimates of the costs and savings of the measures, which are documented in Appendix I, the models demonstrate that implementing the Plan will have a positive effect on California's economy.

The modeling results reflect a carbon price for the cap-and-trade program of $10 per-ton. It is important to note that the $10 per-ton figure does not reflect the average cost of reductions; rather it is the *maximum* price at which reductions to achieve the cap are pursued based on the marketing program.

The positive impacts are largely attributable to savings that result from reductions in expenditures on energy. These savings translate into increased consumer spending on goods and services other than energy. Many of the measures entail more efficient use of energy in the economy, with savings that exceed their costs. In this way, investment in energy efficiency results in money pumped back into local economies. Table 25 summarizes the energy savings that are projected from implementation of the Scoping Plan. These savings are estimated to exceed $20 billion annually by 2020.

Table 25: Fuels and Electricity Saved in 2020 from Implementation of the Scoping Plan

	Gasoline	Diesel	Electricity	Natural Gas*
Use Avoided**	4,600 million gallons	670 million gallons	74,000 GWh	3,400 million therms
Value of Avoided Fuel Use (Million $2007)	$17,000	$2,500	$6,400***	$2,700
Percent Reduction from BAU	25%	17%	22%****	24%

* Not including natural gas for electric generation.

** These estimates are based on reduced use of these fuels due to increased efficiencies, reduced vehicle miles travelled, etc. Changes to the fuel mix, such as those called for under the RPS or the LCFS, are not included here. These estimates are not the same as the estimates of reduced fuel consumption used in the public health analysis.

*** Based on estimated avoided cost based on average base-load electricity, including generation, transmission and distribution.

**** This is as a percentage of BAU total California electricity consumption in 2020.

2. Impact on Specific Business Sectors

As indicated in Table 26 and Table 27, the effects of the Plan are not uniform across sectors. Implementation of the Scoping Plan would have the strongest positive impact on output and employment for the agriculture, forestry and fishing sector, the finance, insurance and real estate sector, and the mining sector. Similar to the statewide economic impacts projected by the model, however, these results also indicate that relative to the business-as-usual case, the impacts due to implementation of the Plan change current growth projections for most sectors by only very small amounts.

Table 26 and Table 27 also show that a decrease in output is projected for the utility and retail trade sectors as compared to the business-as-usual case, and a decrease in employment is projected for the utility sector. In the utility sector, the modeling indicates that implementation of the Scoping Plan would significantly reduce the need for additional power generation and natural gas consumption, which subsequently reduces the growth in output for this sector. This results in a reduction from business-as-usual for economic output and employment of approximately 17 and 15 percent respectively in 2020. The primary reason for these projections is the implementation of efficiency measures and programs for both consumers and producers. While increasing spending on efficiency and renewable energy is expected to increase employment, many of the resulting jobs will not appear in the utility sector.

The retail trade sector, which is projected to grow by nearly 50 percent in both the business-as-usual and the Scoping Plan case, is also projected to experience a slight net decline in output relative to business-as-usual. Since gasoline is considered a consumer retail purchase under this model, the reduced growth is mostly due to the decrease of approximately $19 billion in retail transportation fuel purchases, which is largely offset by the positive $14 billion increase in spending at other retail enterprises.

Table 26: Summary of Economic Output by Sector from Modeling the Scoping Plan Using E-DRAM

Sector	Output ($Billions)			
	2007	Business-as-Usual	Scoping Plan	Percent Change from BAU
Agriculture, Forestry and Fishing	76	109	113	3.9%
Mining	27	29	31	7.2%
Utilities	51	72	60	-16.7%
Construction	114	164	166	1.7%
Manufacturing	673	943	948	0.5%
Wholesale Trade	120	171	173	1.0%
Retail Trade	207	296	291	-1.6%
Transportation and Warehousing	76	109	111	1.9%
Information	164	235	238	1.1%
Finance, Insurance and Real Estate	391	559	572	2.3%
Services	636	910	927	1.9%
Government	-	-	-	-
Total	**2,535**	**3,597**	**3,630**	**0.8%**

Table 27: Summary of Employment Changes by Sector from Modeling the Scoping Plan Using E-DRAM

Sector	Employment (thousands)			
	2007	Business-as-Usual	Scoping Plan	Percent Change from BAU
Agriculture, Forestry and Fishing	398	449	464	3.5%
Mining	26	26	26	1.3%
Utilities	60	67	57	-14.7%
Construction	825	929	934	0.5%
Manufacturing	1,821	2,046	2,057	0.5%
Wholesale Trade	703	791	793	0.1%
Retail Trade	1,688	1,901	1,916	0.8%
Transportation and Warehousing	447	503	510	1.2%
Information	398	448	450	0.4%
Finance, Insurance and Real Estate	911	1,026	1,046	2.0%
Services	5,975	6,729	6,773	0.7%
Government	3,100	3,491	3,502	0.3%
Total	**16,352**	**18,405**	**18,528**	**0.6%**

3. Household Impacts

Implementation of the Scoping Plan will provide low- and middle-income households savings on the order of a few hundred dollars per year in 2020 compared to the business-as-usual case, primarily as a result of increased energy efficiencies.

Low-Income Households: Based on current U.S. Department of Health and Human Services poverty guidelines, we evaluated the projected impacts of the plan on households with earnings at or below both 100 and 200 percent of the poverty guidelines. For all households, including those with incomes at 100 percent and 200 percent of the poverty level, implementation of the Scoping Plan produces a slight increase in per-capita income relative to the business-as-usual case.

At the same time, the analysis projects an increase of approximately 50,000 jobs available for lower-income workers[49] relative to business-as-usual as a result of implementing the Plan. The largest employment gains come in the retail, food service, agriculture, and health care fields. A decline in such jobs is projected in the retail gasoline sector due to the overall projected decrease in output from this sector. This decline, however, is more than offset by the increases experienced in other areas.

Another important factor to consider when analyzing the impact of the Scoping Plan on households is how it will affect household expenditures. As indicated in Table 28, analysis based on the modeling projections estimates a savings (i.e., reduced expenditures) of around $400 per household in 2020 for low-income households under both federal poverty guideline definitions. These savings are driven primarily by the implementation of the clean car standards and energy efficiency measures in the Scoping Plan that over time are projected to outweigh potential increases in electricity and natural gas prices that may occur. As the measures in the Scoping Plan are implemented, ARB will work to ensure that the program is structured so that low income households can fully participate in and benefit from the full range of energy efficiency measures. Many of California's energy efficiency efforts are targeted specifically at low income populations, and the CPUC's Long Term Strategic Plan for energy efficiency has redoubled its objective for the delivery of energy efficiency measures to low income populations. Additional information regarding the data in Table 28 can be found in Appendix G.

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[49] Low-income jobs are defined as those with a median hourly wage below $15 per hour (2007 dollars) based on wage data and staffing pattern projections from the California Employment Development Department. The shares of low-wage occupations for each industry are then applied to the corresponding E-DRAM sector employment projections.

Table 28: Impact of Implementation of the Scoping Plan on Total Estimated Household Savings in 2020 (2007 $)

Income at 100% of Poverty Guideline	Income at 200% of Poverty Guideline	Middle Income*	High Income**	All Households***
$400	$400	$500	$500	$500

* All households between 200% and 400% of the poverty guidelines.

** All households above 400% of the poverty guidelines.

*** Average of households of all income levels.

The analysis indicates that implementation of the Scoping Plan is likely to result in small savings for most Californians, with little difference across income levels. Largely due to increased efficiencies, low-income households are projected to be slightly better off from an economic perspective in 2020 as a result of implementing AB 32.

Middle-Income Households: Implementation of the plan produces a small increase in household income across all income levels, including middle-income households, relative to the business-as-usual case.[50] In terms of how jobs for middle-income households[51] would be impacted, the modeling indicates a slight overall increase of almost 40,000 in 2020.

As shown in Table 28, the analysis projects a net-savings in annual household expenditures of about $500 in 2020 for middle-income households. These savings are driven by the emergence of greater energy efficiencies that will be implemented as a result of the plan.

4. WCI Economic Analysis

The Scoping Plan recommends that California develop a cap-and-trade program that links to the broader regional market being developed by the Western Climate Initiative (WCI). In order to examine the economic impacts of WCI program design options, WCI Partner jurisdictions contracted with ICF International and Systematic Solutions, Inc. (SSI) to perform economic analyses using ENERGY 2020, a multi-region, multi-sector energy model. The WCI economic modeling results are reported in full in Appendix D and are discussed in the Background Report on the Design Recommendations for the WCI Regional Cap-and-Trade Program, also included in Appendix D.

To help inform the program design process, the WCI analysis examined the implications of key design decisions, including: program scope, allowance banking,

[50] For purposes of our analysis we define "middle-income" households as those earning between 200% and 400% of the federal poverty guidelines.

[51] Hourly wage between $15 and $30 per hour.

and the use of offsets. Due to time and resource constraints, the modeling was limited to the eight WCI Partner jurisdictions in the Western Electric Coordinating Council (WECC) area, thereby excluding from the analysis three Canadian provinces, Manitoba, Quebec, and Ontario. Future analyses are planned that will integrate these provinces so that a full assessment of the WCI Partner jurisdictions can be performed.

The WCI modeling work is not directly comparable to the ARB results reported here. The WCI analysis relies on a more aggregated set of greenhouse gas emissions reduction measures rather than the specific individual policies recommended in the Scoping Plan; it uses somewhat different assumptions regarding what measures are included in the "business-as-usual" case, and it models the entire WECC rather than California. Nevertheless, the results of the WCI modeling provide useful insight into the economic impact of greenhouse gas emissions reduction policies.

Consistent with the conclusions of the ARB evaluation, overall the WCI analysis found that the WCI Partner jurisdictions can meet the regional goal of reducing emissions to 15 percent below 2005 levels by 2020 (equivalent to the AB 32 2020 target) with small overall savings due to reduced energy expenditures exceeding the direct costs of greenhouse gas emissions reductions. The savings are focused primarily in the residential and commercial sectors, where energy efficiency programs and vehicle standards are expected to have their most significant impacts. Energy-intensive industrial sectors are estimated to have small net costs overall (less than 0.5 percent of output).

The WCI analysis does not examine the potential macroeconomic impacts of the costs and savings estimated with ENERGY 2020. The WCI Partner jurisdictions are planning to continue the analysis so that macroeconomic impacts, such as income, employment, and output, can be assessed. Once completed, the macroeconomic impacts can be compared to previous studies of cap-and-trade programs considered in the United States and Canada.

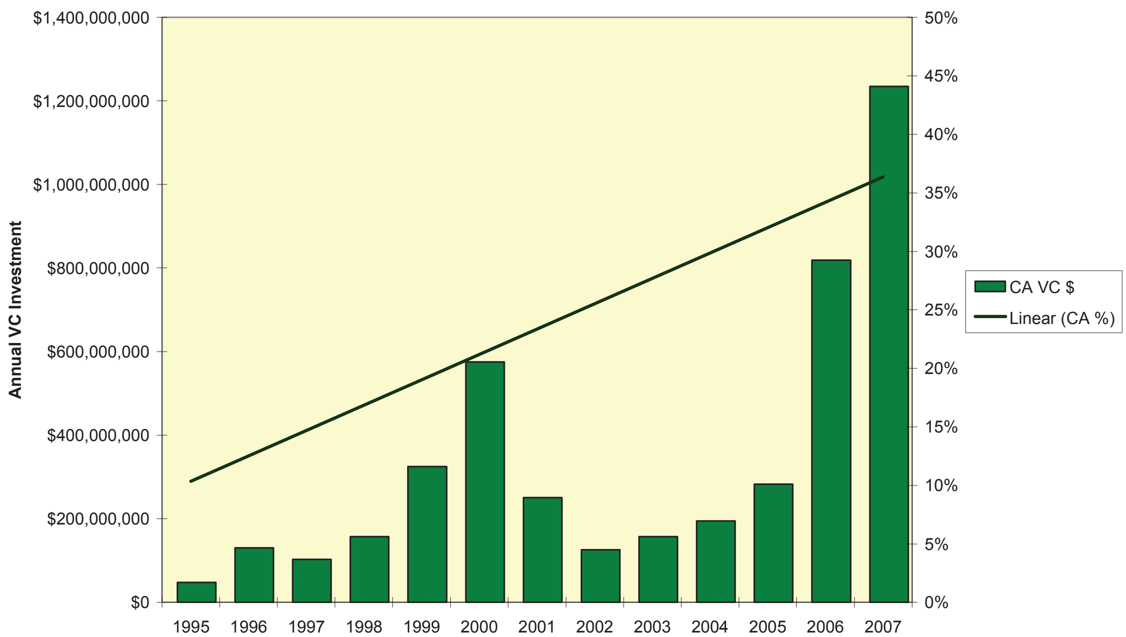
B. Green Technology

The development of green technologies and a trained workforce equipped to design, develop and deploy them will be key to the success of California's long-term efforts to combat global warming. Bold, long-range environmental policies help drive innovation and investment in emission-reducing products and services in part by attracting private capital. Typically, the private sector under invests in research and development for products that yield public benefits. However, when environmental policy is properly designed and sufficiently robust to support a market for such products, private capital is attracted to green technology development as it is to any strategic growth opportunity.

California's leadership in environmental and energy efficiency policy has helped attract an increasing share of venture capital investment in green technologies. According to statistics from PricewaterhouseCoopers and the National Venture Capital Association, California's share of U.S. venture capital investment in innovative energy technologies increased dramatically from 1995 to 2007 (see Figure 5 below).[52] The same period saw a stream of pioneering environmental policy initiatives, including energy efficiency codes for buildings and appliances, a renewables portfolio standard for electricity generation, climate change emissions standards for light-duty automobiles and, most recently, AB 32. Flows of venture capital into California are escalating as a direct result of the focus on reductions of greenhouse gas emissions. As mentioned above, California captured the largest single portion of global venture capital investment ($800 million out a total of two billion dollars) during the second quarter of 2008.

Figure 5

California's Growing Share of Venture Capital Investment in Energy Innovation, 1995-2007 (current $, % share)



Source: PricewaterhouseCoopers MoneyTree Report, available at: [https://www.pwcmoneytree.com].

A survey of clean technology investors by Global Insight and the National Venture Capital Association found that public policy influences where venture capitalists invest.[53] Furthermore, investments in green technology solutions produce jobs at a higher rate than investments in comparable conventional technologies.[54] Venture capitalists estimate that

[52] Based on historical trend data for the 'Industrial/Energy' industry for California and the United States from the PricewaterhouseCoopers MoneyTree Report. https://www.pwcmoneytree.com/MTPublic/ns/nav.jsp?page=historical (accessed October 12, 2008)

[53] Clean Tech Entrepreneurs & Cleantech Venture Network LLC. *Creating Cleantech Clusters: 2006 Update*. May 2006. p.43 http://www.e2.org/ext/doc/2006%20National%20Cleantech%20FORMATTED%20FINAL.pdf (accessed October 12, 2008)

[54] Report of the Renewable and Appropriate Energy Laboratory. *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* Energy and Resources Group/Goldman School of Public Policy at

each $100 million in venture capital funding, over a period of two decades, helps create 2,700 jobs, $500 million in annual revenues, and many indirect jobs.[55]

Access to capital controlled by institutional investors is also enhanced by policies that encourage early adoption of green technologies. When California-based corporations use green technologies to reduce their exposure to climate change risk, institutional investors reward them by facilitating their access to capital. The Investor Network on Climate Risk – including institutional investors with more than $8 trillion of assets under management – endorsed an action plan in 2008 that calls for requiring asset managers to consider climate risks and opportunities when investing; investing in companies developing and deploying clean technologies; and expanding climate risk scrutiny by investors and analysts.[56]

Additional capital for green technologies helps drive increased employment, both indirectly, as energy savings are plowed back into other sectors of the economy, and directly, as new green products are successfully commercialized.

McKinsey & Company projects average annual returns of 17 percent on global investments in energy productivity, and estimates the global investment opportunity at $170 billion annually through 2020.[57] Meanwhile, global investment in energy efficiency and renewable energy has grown from $33 billion to more than $148 billion in the last four years. Beyond 2020, green technologies are expected to attract investment of more than $600 billion annually.[58] In short, green technology is now a *bona fide* global growth industry.

Today, green technology businesses directly employ at least 43,000 Californians, primarily in energy efficiency and energy generation, according to a 2008 study from the California Economic Strategy Panel. Green jobs are concentrated in manufacturing (41 percent), and professional, scientific and technical services (28 percent), with median annual earnings of

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University of California, Berkeley. April 13, 2004. http://rael.berkeley.edu/old-site/renewables.jobs.2006.pdf (accessed October 12, 2008)

[55] Report prepared for the National Venture Capital Association. *Venture Impact 2004: Venture Capital Benefits to the U.S. Economy*. Prepared by: Global Insight. June 2004. http://www.globalinsight.com/publicDownload/genericContent/07-20-04_fullstudy.pdf (accessed October 12, 2008)

[56] The Investor Network on Climate Risk. *Final Report, 2008 Investor Summit on Climate Risk*. February 14, 2008. http://www.ceres.org//Document.Doc?id=331 (accessed October 12, 2008)

[57] McKinsey Global Institute. *The Case for Investing in Energy Productivity.* McKinsey & Company. February, 2008. p.8 http://www.mckinsey.com/mgi/reports/pdfs/Investing_Energy_Productivity/Investing_Energy_Productivity.pdf (accessed October 12, 2008)

[58] United Nations Environment Programme-New Energy Finance Ltd. *Global Trends in Sustainable Energy Investment 2008: Analysis of Trends and Issues in the Financing of Renewable Energy and Energy Efficiency* 2008. p.12 ISBN: 978-92-807-2939-9 http://www.unep.fr/energy/act/fin/sefi/Global_Trends_____2008.pdf (accessed October 12, 2008)

$35,725 and $56,754, respectively.[59] By 2030, under a moderate growth scenario, green businesses nationwide are expected to generate revenues of $2.4 trillion, (2006 dollars), and employ 21 million Americans.[60]

As a leader in green technology development and use, California has already realized substantial economic benefits from the adoption of energy efficiency policies. State energy efficiency measures have saved enough energy over the past 30 years to avoid construction of two dozen 500-megawatt power plants. Today, California's per capita electricity consumption is 40 percent below the national average, and the carbon intensity of California's economy is among the lowest in the nation.[61]

Renewable energy, such as solar, wind, biomass, geothermal, will also bring new employment opportunities to Californians while spurring economic growth. California enjoys significant comparative advantages for renewable energy: concentrated innovation resources, a large potential customer base, key natural resources such as reliable solar and wind, and supportive regulatory programs, including the California Renewables Portfolio Standard, the Million Solar Roofs Initiative, the California Global Warming Solutions Act of 2006, and the Solar Water Heating and Efficiency Act of 2007.

Other researchers have estimated that under a national scenario with 15 percent renewables penetration by 2020, California will experience a net gain in direct employment of 140,000 jobs.[62] Because investments in green technologies produce jobs at a higher rate than investments in conventional technologies, jobs losses that occur in traditional fossil fuel industries will be more than compensated for by gains in the clean energy sector.

Furthermore, if California's renewable energy suppliers field products that are sufficiently competitive to penetrate the export market, employment and earnings dividends for the state will also increase. California renewable energy industries servicing the export market can generate up to 16 times more employment than those that only manufacture for domestic

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[59] California Economic Strategy Panel with Collaborative Economics. *Clean Technology and the Green Economy*. March 2008. P.14-15 http://www.labor.ca.gov/panel/pdf/DRAFT_Green_Economy_031708.pdf (accessed October 12, 2008)

[60] The American Solar Energy Society. *Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century*. 2007. p.39 ISBN 978-0-89553-307-3 http://www.ases.org/images/stories/ASES-JobsReport-Final.pdf (accessed October 12, 2008)

[61] California Energy Commission. *2007 Integrated Energy Policy Report*. Document No. CEC-100-2007-008-CMF. 2007. p. 3 http://www.energy.ca.gov/2007publications/CEC-100-2007-008/CEC-100-2007-008-CMF.PDF (accessed October 12, 2008)

[62] Tellus Institute and MRG Associates. *Clean Energy: Jobs for America's Future.* As cited in: Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate? Energy and Resources Group/Goldman School of Public Policy at University of California, Berkeley. April 13, 2004. http://rael.berkeley.edu/old-site/renewables.jobs.2006.pdf (accessed October 12, 2008)

consumption, according to a study by the Research and Policy Center of Environment California.[63]

C. Cost-Effectiveness

As noted in several provisions of AB 32, cost-effectiveness is an important requirement to be considered in the design and implementation of emission reduction strategies. (See HSC §§38505, 38560, 38561, 38562.) AB 32 defines "cost-effective" or "cost-effectiveness" as "the cost per unit of reduced emissions of greenhouse gases adjusted for its global warming potential." (HSC §38505(d)) This definition specifies the metric (i.e., dollars per ton) by which the Board must express cost-effectiveness, but it does not provide criteria to assess if a regulation is or is not cost-effective. It also does not specify whether there should be a specific upper-bound dollar per ton cost that can be considered cost-effective, or how such a bound would be determined or adjusted over time. ARB has investigated different approaches that could be used to evaluate the cost-effectiveness of regulations and is recommending the following approach.

The estimated cost per ton of greenhouse gas emissions reduced by the measures recommended in this Plan ranges from $-408 (net savings) to $133, with all but one (the Renewables Portfolio Standard) costing less than $55 per ton. The RPS is being implemented for energy diversity purposes, not just greenhouse gas reductions, and the $133 per ton figure does not take these other benefits into account. Therefore, it should not be used as a reference to define the range of cost-effective greenhouse gas measures. These estimates are based on the best information available as ARB prepared this Plan. Updated estimates and greater certainty will be provided as the measures are further developed during the rulemaking process.

In the meantime, the current estimates provide a range illustrating the cost per ton of the mix of measures that collectively meet the 2020 target. This range will assist the Board in evaluating the cost-effectiveness of individual measures when considering adoption of regulations. The range of acceptable cost-effectiveness may change if effective lower-cost measures and options are identified. Because both the projections of "business-as-usual" 2020 emissions and the degree of reductions from any given measures may be greater or less than current estimates, the determination should remain flexible to accommodate a higher or lower estimate of cost-effectiveness. In addition, the approach must provide flexibility to pursue measures that simultaneously achieve policy objectives other than greenhouse gas emissions reduction (such as energy diversity).

The criteria for judging cost-effectiveness will be updated as additional technological data and strategies become available. As ARB moves from adoption of the Scoping Plan to

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[63] Environment California Research and Policy Center. *Renewable Energy and Jobs. Employment Impacts of Developing Markets for Renewables in California*. July 2003. As cited in: Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate? Energy and Resources Group/Goldman School of Public Policy at University of California, Berkeley. April 13, 2004. http://rael.berkeley.edu/old-site/renewables.jobs.2006.pdf (accessed October 12, 2008)

developing specific regulations, and as regulations continue to be adopted, updated cost-effectiveness estimates will be established in a rigorous and transparent process with full stakeholder participation. As ARB progresses from proposed measures and estimated costs to actual regulations, the comparison of cost-effectiveness would move toward the well established practice of comparing the cost-effectiveness of new regulations to the cost-effectiveness of previously enacted and/or similar regulations. This approach is consistent with how cost-effectiveness is evaluated for strategies to reduce criteria and toxic pollutants.

D. Small Business Impact

Small businesses play an important role in California's economy. As required under AB 32, ARB analyzed the impact that implementation of the Scoping Plan would have on small businesses in the state. The analysis indicates that the primary impacts on small businesses as a result of AB 32 will come in the form of changes in the costs of goods and services that they procure, and in particular, changes in energy expenditures. Due to the number of measures in the plan that will deliver significantly greater energy efficiencies, our analysis projects that implementation of the plan will have a positive impact on small business in California even after taking into account the higher per-unit energy prices that are likely to occur between now and 2020. Small businesses also will benefit as a result of the robust economic growth and the increases in jobs, production, and personal income that are projected between now and 2020 as AB 32 is implemented. Additional information is provided in Appendix G.

Recent analysis from Energy and Environmental Economics, Inc. (E3) forecasts that a package of greenhouse gas emissions reduction measures similar to those recommended in this Plan would deliver a five percent decrease in electricity expenditures for the average California electricity customer relative to business-as-usual in 2020.[64] This projection is based on the assumption that increases in electricity prices will be more than offset by the continued expansion of energy efficiency measures and that more efficient technologies will be developed and implemented.[65] For purpose of this analysis, expenditures on natural gas are assumed to remain the same, balancing the projected 29 percent decrease in natural gas consumption in California with the model's projected natural gas price increase of almost 9 percent.

Based on this assessment, implementation of the Scoping Plan will likely have minor but positive impacts on small businesses in the state. These benefits are attributable primarily to the measures in the plan that will deliver significantly greater energy and fuel efficiencies. Even when higher per unit energy prices are taken into account, these efficiencies will decrease overall energy expenditures for small businesses. Additionally, as previously described, the California economy is projected to experience robust economic growth

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[64] Based on their GHG Calculator, CPUC/CEC GHG Docket (CPUC Rulemaking.06.04.009, CEC Docket 07-OIIP-01), available at http://www.ethree.com/cpuc_ghg_model.html.

[65] The E3 analysis focuses on direct programmatic measures and does not include the incremental price impact of the cap-and-trade program, which will depend upon allowance price, allocation strategy, the capped sector industry response, and other program design decisions.

between now and 2020 as AB 32 is implemented. Small businesses will experience many of the benefits associated with this growth in the form of more jobs, greater production activity, and rising personal income.

The projected decrease in electricity expenditures is especially important for small businesses since they typically spend more on energy as a percentage of revenue compared to larger enterprises. For example, firms with a single employee spend approximately 3.3 percent of each sales dollar on electricity, while businesses with between ten and forty-nine employees spend around 1.2 percent. As a result, smaller businesses are likely to experience a greater relative benefit from decreased energy expenditures relative to their larger counterparts.

From the broader economic perspective, these changes will make California more competitive as a location for small business, moving it from 7th highest to 19th among all states in terms of the percentage of revenue that businesses expend on electricity.[66] As was noted above for low income households, care must be taken to ensure that the program is structured to allow small businesses to participate in and benefit from the energy efficiency measures.

While ARB's analysis indicates a positive impact on small businesses from AB 32 implementation, to ensure that these benefits are realized to the fullest potential it will take additional outreach and communication efforts on the part of ARB and many other state and local entities. There are a number of existing programs that are designed to help small businesses achieve greater efficiencies in energy use. These programs can be enhanced and expanded upon, and new programs and efforts can be developed to ensure that all small businesses in California are aware of and able to take cost-effective steps to reduce energy use and enjoy the associated economic savings. For example, as discussed more completely in Chapter IV, ARB and our partners in State government are working together to develop an on-line small business "toolkit" designed for small and medium-sized businesses to provide a one-stop shop of technical and financial information resources. As further development and implementation of the measures in the plan proceeds, we will work with other state and local partners to ensure that small businesses can both benefit from and play a role in helping to achieve our greenhouse gas emission reduction requirements.

E. Public Health/Environmental Benefits Analyses

AB 32 requires ARB to evaluate the environmental and public health impacts of the Scoping Plan. The analysis of this plan is focused primarily on the quantification of public health benefits from air quality improvements that would result from implementation. Unlike traditional pollutants and toxic emissions, global warming pollutants do not typically have localized impacts. At ambient levels, carbon dioxide, which makes up over 80 percent of global warming pollutants in California, has no direct environmental or public health consequences. Climate change caused by greenhouse gas pollutants emitted in another state

[66] Although the natural gas data is less specific, a similar scenario is expected where increased prices are typically offset by greater efficiencies for most small businesses.

or country has the same potential to damage our public health and the environment as does climate change due to pollutants emitted within California. Although this analysis does not consider the public health impacts of climate change, the potential public health impacts are great, and have been well documented elsewhere. However, many of the measures aimed at reducing global warming pollutants also provide co-benefits to public health and California's natural resources.

The environmental and cumulative impacts of the Plan are discussed in the California Environmental Quality Act (CEQA) document that is included in Appendix J. As the Scoping Plan is implemented, and specific measures are developed, ARB will conduct further CEQA analyses, including cumulative and multi-media impacts. As ARB further develops its approach for consideration of these issues in future rulemakings, and updates needed analytical tools and data sets, we will consult with outside experts and the EJAC. ARB recognizes that the adoption of the Scoping Plan will launch a variety of regulatory proceedings in many different venues. ARB will work closely with other California State agencies including: the Office of Planning and Research, Environmental Protection Agency, Resources Agency, Integrated Waste Management Board, Department of Public Health, Office of Environmental Health Hazard Assessment, State Water Resources Control Board, Department of Toxic Substances Control, Department of Water Resources, Board of Forestry, Department of Fish and Game, Public Utilities Commission, California Energy Commission, and others to identify and address potential multi-media environmental impacts early in the regulatory development process.

California's actions to reduce greenhouse gas emissions will help transition the State to new technologies, improved efficiencies, and land use patterns also necessary to meet air quality standards and other public health goals. California's challenging public health issues associated with air pollution are already the focus of comprehensive regulatory and incentive programs. These programs are reducing smog forming pollutants and toxic diesel particulate matter at a rapid pace. However, to meet increasingly stringent air quality standards and air toxics reduction goals, transformative changes are needed in the 2020 timeframe and beyond. Implementation of AB 32 will provide additional support to existing State efforts devoted to protecting and improving public health.

1. Key Air Quality-Related Public Health Benefits

The primary direct public health benefits of the Scoping Plan are reductions in smog forming emissions and toxic diesel particulate matter. The most significant reductions are of oxides of nitrogen (NOx), which forms both ozone and particulate pollution (PM2.5), and directly emitted PM2.5, which includes diesel particulate matter. The analysis focuses on PM2.5 impacts and quantifies 2020 public health benefits of this plan in terms of avoided premature deaths, hospitalizations, respiratory effects, and lost work days. Additional benefits associated with the reductions in ozone forming emissions were not quantified since statewide 2020 photochemical modeling is not available.

The estimated air quality-related public health benefits of the Scoping Plan are above and beyond the much greater benefits of California's existing programs, which are reducing air pollutant emissions every year. This continuing progress is the result of California's plans for meeting air quality standards ("State Implementation Plans" or SIPs), reducing emissions from goods movement activities, and addressing health risk from diesel particulate matter. These programs address both existing and new sources of air pollution, taking into account population and economic growth. The additional benefits of the Scoping Plan in 2020 are significant, and in the longer term, can be expected to increase with further reductions in fossil fuel combustion, the primary basis for the estimated public health benefits.

The recommended measures in the Scoping Plan that reduce smog forming ("criteria") pollutants are shown in Table 29 along with the estimated reductions. Statewide, these measures would reduce approximately 61 tons per day of NOx and 15 tons per day of PM2.5 in 2020. As shown in Table 30, this equates to an estimated air quality-related public health benefit of 780 avoided premature deaths statewide. In comparison, reductions in PM2.5 from California's existing programs and 2007 SIP measures are estimated to result in 12,000 avoided premature deaths statewide in the same timeframe.

Table 29: Statewide Criteria Pollutant Emission Reductions in 2020 from Proposed Scoping Plan Recommendation[67]
(tons per day)

Measure	NOx	PM2.5
Light-Duty Vehicle • Pavley I and Pavley II GHG Standards • Vehicle Efficiency Measures	1.6	1.4
Goods Movement Efficiency Measures	16.9	0.6
Medium and Heavy-Duty Vehicle GHG Emission Reduction • Aerodynamic Efficiency • Hybridization • Engine Efficiency	5.6	0.2
Local Government Actions and Regional Targets	8.7	1.4
Energy Efficiency and Conservation (Electricity)	7.0	4.0
Energy Efficiency and Conservation (Natural Gas)	10.4	0.8
Solar Water Heating	0.3	0.03
Million Solar Roofs	1.0	0.6
Renewables Portfolio Standard	9.8	5.6
Total	**61**	**15**

[67] Table 29 does not include the criteria pollutant co-benefits of additional greenhouse gas reductions that would be achieved from the proposed cap-and-trade regulation because we cannot predict in which sectors they would be achieved.

Table 30: Estimates of Statewide Air Quality-Related Health Benefits in 2020

Health Endpoint	Health Benefits of Existing Measures and 2007 SIP *mean*	Health Benefits of Recommendations in the Proposed Scoping Plan *mean*
Avoided Premature Death	12,000	780
Avoided Hospital Admissions for Respiratory Causes	1,300	87
Avoided Hospital Admissions for Cardiovascular Causes	2,600	170
Avoided Asthma and Lower Respiratory Symptoms	190,000	12,000
Avoided Acute Bronchitis	15,000	980
Avoided Work Loss Days	1,200,000	77,000
Avoided Minor Restricted Activity Days	7,000,000	450,000

In addition to the quantified air-quality-related health benefits, our analysis indicates that implementation of the Scoping Plan can deliver other public health benefits as well. These include potential health benefits associated with local and regional transportation-related greenhouse gas targets that can facilitate greater use of alternative modes of transportation, such as walking and bicycling. These types of moderate physical activities reduce many serious health risks including coronary heart disease, diabetes, hypertension and obesity.[68] Finally, it is important to note that the steps California is taking to address global warming, along with actions by other regions, states, and nations, will help mitigate the public health effects of heat waves, more widespread incidence of illness and disease, and other potentially severe impacts.

The measures in the Scoping Plan are designed primarily to help spur the transition to a lower carbon economy. However, in addition to improving air quality, these measures can also improve California's environmental resources, including land, water, and native species. Land resources will be affected by regional transportation-related targets leading to improved land use planning, and forest carbon sequestration targets which can result in better stewardship of California lands and reduced wildfire risk. A number of conservation measures will aid in effective management of the State's precious water resources. Demand for waste disposal and hazardous materials should decrease as measures to encourage recycling and reuse transform our wastes into fuel, energy, and other useful products are implemented. Additional analysis of the way that implementation of the Scoping Plan will impact these environmental resources will be conducted as we proceed. Many of these measures serve the dual purpose of mitigating greenhouse gas emissions and helping California adapt to the impacts of climate change.

[68] Appendix H contains a reference list of studies documenting the public health benefits of alternative transportation.

2. Approach

ARB quantified the potential reductions of NOx and PM2.5 from implementation of the Plan's recommendations, and the public health benefits associated with the resulting potential air quality improvement. These analyses compare NOx and PM2.5 emissions in 2020 with the implementation of the Scoping Plan with NOx and PM2.5 emissions in 2020 in the absence of the Scoping Plan – a "business-as-usual" scenario. The methodology used to evaluate the public health benefits of the emission reductions is similar to the methodology used in ARB's 2006 Goods Movement Emission Reduction Plan (GMERP), as updated in the recent staff report for estimating premature death from exposure to particulate matter.[69] This methodology is based on a peer-reviewed methodology developed by the U.S. Environmental Protection Agency (U.S. EPA). ARB augmented U.S. EPA's methodology by incorporating the result of new epidemiological studies relevant to California's population, including regionally specific studies, as they became available.

AB 32 directs ARB to conduct several levels of analysis as we proceed through the development and implementation of a comprehensive greenhouse gas emissions reduction strategy. As part of the Scoping Plan development, ARB is required to assess both the economic and non-economic impacts of the plan as noted above. Additionally, AB 32 requires ARB to undertake additional analysis at the time of adoption of regulations, including market-based compliance mechanisms.

Although not yet at the stage of regulatory development and adoption, in this analysis ARB conducted an evaluation of the air quality-related public health benefits associated with the Scoping Plan based on a community level emissions analysis example. As regulations that rely on market-based compliance mechanisms are further developed for consideration by the Board, more detail about the specific regulatory proposals will be developed, enabling ARB to more closely evaluate the potential for direct, indirect and cumulative impacts.

3. Existing Programs for Air Quality Improvement in California

The public health analysis of the Scoping Plan presents air-quality benefits that will occur in addition to the benefits of California's comprehensive air quality programs designed to meet health-based standards and reduce health risk from air toxics. It is also important to note that under both a "business-as-usual" scenario and under the implementation of the Scoping Plan, the population and economy of California are projected to continue to grow. New businesses and industries will continue to be sited in California, bringing both economic opportunity and potential environmental impacts. Federal, State, and local laws and regulations have established requirements to ensure that new and modified sources of pollution are carefully evaluated and that

[69] Air Resources Board. *Methodology for Estimating Premature Deaths Associated with Long-term Exposure to Fine Airborne Particulate Matter in California.* October 24, 2008. http://www.arb.ca.gov/research/health/pm-mort/pm-mort_final.pdf (accessed December 9, 2008)

significant impacts are mitigated. Emissions from existing businesses are also tightly controlled by local air pollution control districts. Statewide programs are in place to reduce emissions from cars, trucks, and off-road equipment, along with smog check, cleaner gasoline and diesel fuels, and regulations to reduce evaporative emissions from consumer products, paints, and refueling. Additional information about the existing regulatory framework for sources of air pollution is provided in Appendix H.

It is important to evaluate the air quality and public health benefits of the Scoping Plan in the context of the State's on-going air quality improvement efforts. California's long-standing air pollution control programs have substantially improved air quality in the state and will continue to do so in the future. By 2020, these programs will deliver reductions in statewide NOx emissions of 441 tons per day and direct fine particle emission reductions of 34 tons per day. Through 2020, three key ARB efforts will deliver deep reductions in air pollutant emissions despite continuing growth:

- Diesel Risk Reduction Plan
- Goods Movement Emission Reduction Plan
- 2007 State Implementation Plan

Measures in these plans will result in the accelerated phase-in of cleaner technology for virtually all of California's diesel engine fleets including trucks, buses, construction equipment, and cargo handling equipment at ports. Adoption and implementation of these and other measures are critical to achieving clean air and public health goals statewide.

The U.S. Environmental Protection Agency has set a new, more stringent, national ambient air quality standard for ozone that will have compliance deadlines well past 2020 for the most severely impacted areas like southern California.[70] The unmitigated impacts of climate change will make it harder to meet this standard and to provide healthful air to Californians.

4. Statewide Analysis

For this evaluation, ARB examined the recommended measures to determine the potential for impacts on air, land, water, native species and biological resources, and waste and hazardous materials. Local government, State government, and green building sectors were not included in this evaluation as they represent means of implementation of the greenhouse gas emission reduction measures. As noted, the main focus of this analysis is on air quality. To the extent feasible, ARB quantified estimated emissions reductions in criteria pollutants associated with each recommended measure except cap-and-trade. Reductions in NOx and PM2.5 were

[70] U.S. Environmental Protection Agency. *National Ambient Air Quality Standards for Ozone. Final Rule.* 73 Federal Register 16436. March 27, 2008. http://www.epa.gov/fedrgstr/EPA-AIR/2008/March/Day-27/a5645.pdf (accessed October 12, 2008)

used to estimate public health benefits. The estimated statewide reductions are 61 tons per day of NOx and 15 tons per day of PM2.5. Further analysis of the potential criteria pollutant benefits of a cap-and-trade program will be done as part of regulatory development.

5. Regional Assessment: South Coast Air Basin Example

In order to assess potential air quality benefits of the Scoping Plan on a regional level, ARB evaluated associated criteria pollutant reductions in the South Coast Air Basin as an example case. Existing programs will reduce current NOx emissions by almost 50 percent in 2020. With the new 2007 SIP measures, NOx emissions will be reduced almost 60 percent. Because of the large population and high pollutant concentrations in this region, greater benefits occur from each ton of pollution reduced. The estimated air quality-related public health benefits of the Scoping Plan for the South Coast region are shown in Table 31. The significant air quality-related public health benefits in this region are largely attributed to the additional reductions in PM2.5.

Table 31: Estimated Air Quality-Related Health Benefits of Existing Program, 2007 SIP, and Scoping Plan in the South Coast Air Basin, 2020

Health Impacts / Scenario	Benefits from Existing Program	Additional Benefits from 2007 SIP	Additional Co-Benefits from Scoping Plan
Premature Deaths Avoided	4,800	2,000	360
Hospitalizations Avoided – Respiratory	550	230	40
Hospitalizations Avoided – Cardiovascular	1,100	440	77
Asthma & Lower Respiratory Symptoms Avoided	80,000	35,000	6,200
Acute Bronchitis Avoided	6,400	2,800	500
Work Loss Days Avoided	510,000	220,000	38,000
Minor Restricted Activity Days Avoided	3,000,000	1,300,000	220,000

6. Community Level Assessment: Wilmington Example

ARB also conducted an evaluation of the potential air quality impacts of the Scoping Plan in the community of Wilmington as an illustration of the potential for localized impacts. Wilmington is in southern Los Angeles County and includes a diverse range of stationary and mobile emissions sources, including the ports of Los Angeles and Long Beach, railyards, major transportation corridors, refineries, power plants, and other industrial and commercial operations. Like the regional analysis, additional emission reductions from the 2007 SIP were estimated and show significant reductions in Wilmington by 2020 – approximately a 45 percent reduction in NOx and a 40 percent reduction in directly-emitted PM2.5. Mobile source emissions are projected to continue to be proportionately greater than stationary source emissions in 2020 even as mobile source emissions decline.

For this assessment, ARB evaluated criteria pollutant emission reductions in the Wilmington study area assuming that the source-specific quantified measures are implemented, including measures to reduce emissions from oil and gas extraction and refineries. It was further assumed that the non-source specific program elements, such as the proposed cap-and-trade program, result in a 10 percent reduction in fuel combustion by affected sources within the study area. For example, it is estimated that industrial sources would achieve greenhouse gas emission reductions through efficiency measures that reduce on site fuel use by 10 percent either in response to a cap-and-trade program, or due to the results of the facility energy efficiency audits. While it is likely that the actual onsite reductions will differ across individual facilities from the assumed uniform ten percent reduction,[71] the analysis identifies how reductions at these facilities affect the overall level of co-benefits.

The estimated NOx co-benefit of about 1.7 tons per day is small relative to the projected reductions of 24 tons per day that will occur as a result of the SIP and other measures. For example, an 8 ton per day NOx reduction is expected from cleaner port trucks. In comparison, the potential NOx benefit from a 10 percent efficiency improvement in major goods movement categories is estimated at about 1.5 tons per day. The estimated PM2.5 co-benefits, on the order of 0.12 tons per day, are also small relative to the projected reductions of 2.3 tons per day that will occur as a result of the SIP and other measures. Approximately 30 percent (0.04 ton per day) of the PM 2.5 co-benefit reduction is associated with assumed energy efficiency measures at the four large refineries in the study area, while another 30 percent would occur due to a 10 percent efficiency improvement by goods movement sources.

The co-benefit emissions reductions in the study area would produce regional air quality-related health benefits. A relatively small portion of these benefits would occur in the study area (approximately 300,000 area residents). Health benefits due to reductions in NOx are mostly at the regional levels, since NOx emissions have usually travelled some distance before they are transformed into PM via atmospheric reactions. Point source combustion PM emissions persist in the atmosphere and increase exposures both in the area where they are emitted and broadly throughout the region. Based on previous modeling studies of the impact of port and rail yard PM emissions in the South Coast Air Basin conducted by ARB, PM exposures will be reduced far beyond the study area, and a majority of the health benefits are expected to occur in areas outside of the Wilmington community.[72]

Using the previously described methodology that correlates emission reductions in the air basin with expected regional health benefits there would be an estimated

[71] The reductions at any one facility could be much greater or lesser than 10 percent For example, very small or no reductions might occur because available cost-effective industrial emission reductions have already been implemented at a particular site.

[72] ARB analysis indicates that about 20 percent of the health benefits would occur in the Wilmington area.

24 avoided premature deaths attributed to emission reductions that occur in Wilmington as a result of the Scoping Plan.[73]

F. Summary of Societal Benefits

AB 32 requires ARB to "consider the overall societal benefits, including reductions in other air pollutants, diversification of energy sources, and other benefits to the economy, environment, and public health" (HSC § 38562(b)(6)) when developing regulations to implement the Scoping Plan. ARB conducted an initial assessment of societal benefits associated with AB 32 implementation. This section summarizes those that have been identified during development of the Scoping Plan, including diversification of energy sources, mobility, regressivity, and job creation. More detailed economic and environment/public health analyses can be found in Appendix G and H, respectively. The impact of low income households (regressivity), impacts on small businesses, and impact on jobs are described in the Economic Analysis section and Appendix G.

1. Energy Diversification

Generally, energy-related measures in this Scoping Plan are expected to result in a transformation of the State's energy portfolio, driven primarily by the Low Carbon Fuel Standard (LCFS), which addresses transportation fuel, and the 33 percent RPS, which increases renewably-produced electricity production and distribution to households and businesses.

The LCFS aims to achieve at least a 10 percent reduction in the carbon intensity of California's transportation fuels by 2020. As the State moves toward less dependence upon one source of fuel for transportation, our economy will be less at risk from significant fluctuations in fuel prices. Measures within the Scoping Plan will force energy diversification in California toward low-carbon intensive energy sources and encourage significant growth in infrastructure, capital, and investment in biofuels.

The move toward 33 percent renewables will, by definition, increase the diversification of California's electrical supply. Increased use of wind, solar, geothermal and biomass (including from the organic fraction of municipal solid waste) generation will all add to ensuring the state has a broader portfolio of energy inputs.

Based on ARB's economic analysis, the combined energy diversification and increased energy efficiency expected from implementation of the Scoping Plan is predicted to result in: a 25 percent decrease in gasoline usage (4.6 billion gallons), a 17 percent decrease in diesel fuel use (670 million gallons), a 22 percent decrease in electricity (74,000 GWh reduction) and a 24 percent reduction in natural gas (3,400 therms).

[73] See Appendix H

The cap-and-trade program, offsets, and other measures that contain market-based features may also help diversify California's energy portfolio by incentivizing the development and deployment of clean and efficient energy generating technologies.

2. Mobility and Shifts in Land Use Patterns

Mobility is analyzed through multiple approaches in the Scoping Plan. Appendix C includes an analysis of a proposed measure for regional transportation-related greenhouse targets. Reductions in vehicle miles traveled (VMT) are expected to result from regional and local planning which target land use, building and zoning improvements.

As the Scoping Plan is implemented, measures that support shifts in land use patterns are expected to emphasize compact, low impact growth in urban areas over development in greenfields. Communities could realize benefits, such as improved access to transit, improved jobs-housing balance, preservation of open spaces and agricultural fields, and improved water quality due to decreased runoff. Local and regional strategies promoting appropriate land use patterns could encourage fewer miles traveled, lowering emissions of greenhouse gases, criteria pollutants and PM. More compact communities with improved transit service could increase mobility, allowing residents to easily access work, shopping, childcare, health care and recreational opportunities.

Furthermore, if open spaces and desirable locations become more accessible and communities are designed to encourage walkability between neighborhoods and shopping, entertainment, schools and other destinations, residents are likely to increase their levels of physical activity. Research shows that regular physical activity can reduce health risks, including coronary heart disease, diabetes, hypertension, anxiety and depression, and obesity. Measures in the Scoping Plan encourage Californians to use alternatives to personal vehicle travel that could result in increased personal exercise. To complement these changes, future community developments may evolve to include trails and pedestrian access to major centers. However, where compact development may increase proximity to large sources of pollution, such as high traffic arterials, distribution centers, and industrial facilities, it will be critical to analyze the anticipated and unanticipated impacts and benefits, to ensure that increases in exposure to vehicular air pollution and other toxics and particulates do not occur .

G. California Environmental Quality Act Functional Equivalent Document

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential adverse environmental impacts of proposed projects. ARB's analysis of the potential adverse environmental impacts of the Scoping Plan is presented in Appendix J. The analysis summarizes and discusses the specific strategies in the Scoping Plan that, if adopted and implemented, will reduce greenhouse gas emissions throughout the state. The evaluation is programmatic by necessity; it allows consideration of broad policy alternatives and program-wide mitigation measures at a time when an agency has greater flexibility to deal with basic problems of cumulative impacts. A programmatic document also plays an important role in establishing a structure within which future reviews of related actions can be effectively conducted. The Secretary of California's Resources Agency determined that ARB meets the criteria for a Certified Regulatory Program and requires ARB to prepare a substitute document. This functionally equivalent document (FED) is intended to disclose potential adverse impacts and identify mitigation measures specific to the actions identified in the Scoping Plan. The analysis generally found that the proposed Low Carbon Fuel Standard, Renewables Portfolio Standard and Water measures have the most potential to cause adverse environmental impacts due to the potential for land conversion when projects are undertaken. Additional environmental analysis will be needed when regulations are adopted and at the individual project level to identify mitigation for project specific impacts.

H. Administrative Burden

ARB conducted a assessment of the administrative burden of implementing the Scoping Plan recommendation. (HSC §38562 (b)(7)) The recommendation calls for ARB to develop a cap-and-trade program – a market-based regulatory program to cap and reduce emissions from the Industrial, Electricity, Natural Gas, and Transportation sectors. This program would require stringent monitoring and reporting on the part of the regulated community, and comprehensive enforcement on the part of ARB. Sources under the cap would need to analyze the best approach for their company to comply with a cap – assessing the cost of reducing emissions and comparing that to the cost of purchasing emission reductions in a market. Although ARB has not previously developed this type of market regulation, there is extensive experience to draw upon from within California, nationally, and internationally. In addition, the other regulatory components of the recommendation would require ARB and other State agencies to adopt a series of measures requiring regulatory development, outreach to stakeholders and the public, implementation by industry, and enforcement for numerous measures and programs.

I. De Minimis Emission Threshold

A minimum level at which regulations are determined not to apply is termed the 'de minimis threshold.' In recommending a de minimis level, ARB must take into account the relative contribution of each source or source category to statewide greenhouse gas emissions and the adverse effect on small business. (HSC §38561(e)) This threshold acts as a buffer below which the burden of regulation is determined to outweigh the potential harmful effect of the minimal level of emissions. However, it should not be assumed that an individual source of greenhouse gas emissions that is minimal if taken by itself will fall below the threshold. ARB often looks at the aggregate emissions from a source category or related source category when determining regulatory applicability.

A source category may be evaluated as the aggregate of businesses doing the same type of work (e.g., semiconductor manufacturers), a type of equipment (cargo handling equipment, cars), a process or product (cans of pressurized duster), or other aggregated sources of emissions. Emissions of greenhouse gases from any individual entity within these source categories by themselves could be small. However, when emissions from the source category are evaluated, the relative contribution to climate change can be significant.

As ARB developed the Scoping Plan, potential measures were evaluated against criteria that included the relative contribution of the source to climate change. After this review and considering the level of emissions needed to meet the 1990 target established by AB 32, ARB recommends a de minimis level 0.1 $MMTCO_2E$ annual emissions per source category.[74] Source categories whose total aggregated emissions are below this level are not proposed for emission reduction requirements in the Scoping Plan but may contribute toward the target via other means.

ARB and other agencies implementing measures included in the Scoping Plan should carefully consider this de minimis level in developing regulations, and only regulate smaller source categories if there is a compelling necessity.

As each regulation to implement the Scoping Plan is developed, ARB and other agencies will consider more specific de minimis levels below which the regulatory requirements would not apply. These levels will consider the cost to comply, especially for small businesses, and other factors.

[74] The Forest sector was not included in determining the de minimis level because this sector serves both as a source and a sink for carbon, making the concept of a de minimis level less applicable.

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IV. IMPLEMENTATION: Putting the Plan into Action

Adoption of this Scoping Plan will be a groundbreaking step forward for California. However it is only the beginning of a journey that will last for decades, gradually moving the State into a low-carbon, clean energy future. Putting the Scoping Plan into action will be challenging but with adequate commitment and leadership from Californians up and down the state, it will be a success.

A. Personal Action

The greenhouse gas emission reductions required under AB 32 cannot be realized without the active participation of the people of California. While many of the measures in this Plan must be taken by large sources of emissions, such as power plants and industrial facilities, it is the voluntary commitment and involvement of millions of individuals and households throughout the State that will truly make this California's Plan.

Shifts in individual choices and attitudes drive changes in the economy and in institutions. This dynamic of changing individual behavior will influence California's effort to reduce greenhouse gas emissions. For example, as market forces and environmental awareness encourage more people to drive low-greenhouse gas emitting vehicles, the auto manufacturers will respond with more innovative models and more intensive research. Regulations requiring auto manufacturers to provide these cars will complement the market demand.

This means that thinking about climate change and our carbon footprint will naturally become part of how individuals make decisions about travel, work, and recreation. Some families may choose to purchase a more efficient vehicle when it comes time to replace their current model. Households may choose to lower their thermostat to 68 degrees Fahrenheit during the colder months, and raise it to 78 degrees when air conditioning is required. Some households may choose to swap out incandescent light bulbs for more efficient compact fluorescent lights. Others may choose to install solar water heaters, or arrays of solar electric panels on their roofs to take advantage of renewable energy, and lower their household energy bills. Many households may choose to plant trees to shade and cool their homes, and use landscaping and plants that require less water.

This Plan recommends measures that will help support many of these individual decisions to improve energy efficiency. Statewide measures and regional efforts will result in programs to promote public transportation or riding in carpools, subsidize the purchase of energy efficient appliances, or provide incentives to better insulate and weatherize older homes. ARB is fully committed to assuring California consumers have the widest possible choice of vehicles that emit fewer greenhouse gases than today's models, including the most advanced technology vehicles produced anywhere in the world.

Californians have embraced statewide programs that support positive change in home and business behavior. In less than two decades, separating household waste and recycling at home and work have become commonplace, as has the widespread purchase of appliances with the Energy Star label to save energy. Reducing our carbon footprint by moving toward a cleaner more efficient economy will produce a wide range of benefits to individuals, through lower energy bills and a healthier environment for all.

Conservation can also play a key role. By employing practices to use our resources more sparingly, consumers can both save money and reduce greenhouse gas emissions. On August 18, 2008, Governor Arnold Schwarzenegger launched the EcoDriving program – a comprehensive effort to save consumers money at the gas pump, reduce fuel use and cut CO_2 emissions. By following a set of easy-to-use best practices for driving and vehicle maintenance, a typical EcoDriver can improve mileage by approximately 15 percent. Furthermore, safety is improved when driving speeds are reduced, a key EcoDriving strategy.

Similarly, consumers and businesses can save money and reduce greenhouse gas emissions by conserving resources at homes, offices and commercial buildings. For example, wireless monitor devices to provide instantaneous energy-usage information inside the home are being developed to show users how many kilowatt hours they're consuming at any given moment – as well as how much it's costing them.[75] Providing real-time information on appliance energy use can greatly assist consumers in conserving electricity use.

Many Californians concerned about climate change have also begun to buy carbon offsets to mitigate the impact of their daily activities. These can take various forms, including options that allow consumers to add 'carbon credits' when buying airline tickets, or paying a small monthly charge on utility bills to buy green power. ARB will be working to establish clear rules for voluntary reductions and offsets that might be used for compliance with AB 32. These rules will also help establish clear guidelines for these types of voluntary carbon credit programs and provide California's businesses and consumers greater assurance that money spent on these programs result in real reductions in greenhouse gas emissions.

For more information about how to reduce one's personal carbon footprint, visit www.coolcalifornia.org. This web site provides a carbon footprint calculator and a "top ten" list of ways to save energy at home.

B. Public Outreach and Education

To be successful, a climate action program needs an effective public outreach and education program. The Plan calls for a robust statewide program designed to generate awareness and involvement in California's climate change efforts.

[75] The Sacramento Municipal Utility District (SMUD) is subsidizing PowerCost Monitors to 5,000 customers as a part of a demonstration program. [www.smud.org/residential/saving-energy/monitor.html]

The Climate Action Team will convene a steering team that includes State agencies and other public agencies such as the state's air districts, and public and private utilities, which have a strong track record of successful efforts at public education to reduce driving (Spare the Air) or promote energy efficiency and reduce energy demand. With the release of the California Energy Efficiency Strategic Plan, the CPUC has committed to the launch of a new brand for California Energy Efficiency in 2009, focused on energy efficiency opportunities and coordinated with climate change messaging under AB 32. The steering committee will develop a coordinated array of messages and draw upon a wide range of messengers to deliver them. These will include regional and local governments whose individual outreach campaigns can reinforce the broader State outreach themes while also delivering more targeted messages directly tied to specific local and regional programs.

To ensure that all Californians are included in efforts to address climate change, California will also support highly localized efforts at public education and outreach at the community and neighborhood level. This includes service club organizations and existing faith-based communities – churches, mosques and synagogues. Other private-sector entities including businesses and local chambers of commerce will be invited to partner in spreading the word.

1. Involving the Public and Stakeholders in Measure Development

In keeping with the requirements of AB 32 and the legacy of four decades of regulatory development at ARB, we have worked to make this process fully transparent and will continue to do so as regulations to implement the plan are developed. We will continue our efforts to involve the public to the greatest extent feasible at every stage of the process, including informal and formal rulemaking activities. This will include disadvantaged communities and those with localized concerns, as well as affected industries and small businesses.

Local and community meetings and outreach have been and will continue to be a central element of all rulemaking, with State agencies working closely with disadvantaged communities, EJAC, public health experts, and other stakeholders to fully evaluate the impacts associated with California's greenhouse gas emissions reduction strategies. State agencies involved in measure development will continue to meet periodically with communities to assess any challenges to implementation, or to discover possible new measures or approaches. Stakeholders will be invited to participate in the many additional workshops, workgroups and seminars that will be held as individual measures are developed.

2. Education and Workforce Development

The transition to a clean energy future presents California with a tremendous opportunity to continue growing its green economy and to expand the growth of green job opportunities throughout the state. Making this transition will require a technically educated workforce that is equipped with the skills to develop and deploy 21st century technologies. Investments in training, career technical education, worker transition assistance, and collaboration between public and private partners will be key to ensuring that California fully reaps the economic and job opportunities that will accompany implementation of AB 32.

Setting California on track to a low-carbon future beyond 2020 will be a multi-generational challenge. To meet this challenge, climate-related education in schools must be a central element of California's plan. By 2010, California will develop climate change education components to the State's new K-12 model school curriculum as part of the Education and the Environment Initiative (AB 1548, Pavley, Chapter 665, Statutes of 2003). Expanding the knowledge and opportunities of young people to participate in promoting their own and their communities' environmental health will be an important theme for all these efforts. In the meantime, ARB's educational outreach will continue through the Cool California web pages (www.coolcalifornia.org) and the continued support of student educators through the California Climate Champions programs. ARB will also rely on partners throughout the state to develop and display options for curricula that will enhance the K-12, community college, trade technical training programs, and programs at four-year colleges.

The demand for workers to fill green jobs is rising. There are currently more than 3,000 green businesses in the state, accounting for about 44,000 jobs: 36 percent of these jobs are in professional, scientific, and technical services; 19 percent are in construction; and 15 percent are in manufacturing.[76] Some of these jobs are in new fields, yet many others are simply augmentations of existing skills and vocations such as electrical, construction, machining, auto tech, and heating ventilation and air conditioning. As we move toward 2020, tens of thousands of new green job opportunities will be created.[77] Whether these opportunities come in entirely new fields of employment or in existing areas, it will be critical for California to have a trained workforce available.

Ensuring that California can continue to meet the demand for green jobs will require close coordination between workforce development agencies, businesses, State and local governments, labor unions, and community colleges and universities. Many organizations are already developing strategies and identifying steps to simultaneously meet industry workforce needs and help build a more sustainable economy. For instance, the California Labor and Workforce Development Agency (LWDA) provides a comprehensive range of employment and training services in partnership with State and local agencies and organizations. Similar additional efforts will be crucial in ensuring that the transition to a green economy benefits working

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[76] California Economic Strategy Panel. *Clean Technology and the Green Economy; Growing Products, Services, Businesses and Jobs in California's Value Network*, Draft, March 2008. http://www.labor.ca.gov/panel/pdf/DRAFT_Green_Economy_031708.pdf

[77] Tellus Institute and MRG Associates. *Clean Energy: Jobs for America's Future.* As cited in: *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* Energy and Resources Group/Goldman School of Public Policy at University of California, Berkeley. April 13, 2004. p. 11 http://rael.berkeley.edu/old-site/renewables.jobs.2006.pdf

families in California by providing a steady supply of livable-wage jobs. In the area of energy efficiency, the California Long Term Energy Efficiency Strategic Plan, adopted by the CPUC, details a vision and supporting strategies for the development of a workforce trained and engaged to achieve California's energy-efficiency objectives.

The following strategies will be key to ensure that California's workforce is equipped to help lead the transition to a clean energy future:

- **Strengthen and expand access to Career and Technical Education (CTE) in California public schools for the next generation of workers who will build a green economy.** Over the past several decades, there has been a steady decline in career and technical education. In 2007, less than one-third of all high school students in the state were enrolled in some form of CTE.[78] To take full advantage of the emerging green economy and meet the goals of AB 32, California needs to expand opportunities for CTE in schools. This could include pursuing strategies such as requiring CTE coursework for all middle- and high-school students; increasing the number of CTE credentialed teachers; expanding investment in facilities and equipment for career and technical education; and aligning educational curricula more closely with the skill and workforce needs of the emerging green economy.

- **Ensure an adequate pipeline of skilled workers who are trained in the new technologies of a greener economy.** While some green jobs will be in new businesses and new occupations, most green jobs are variations of traditional occupations in sectors like construction, utilities, manufacturing and transportation.[79] In light of the fact that forty percent of the nation's skilled workers are slated to retire in the next 5 to 10 years,[80] there is an urgent need for educational and training programs to fill these jobs. Strategies to create a steady pipeline of skilled workers include expanding curriculum choices in schools, colleges, and universities to fully reflect career opportunities available in an economy increasingly centered on clean technologies. Other strategies include offering a greater array of industry- and technology-specific courses that would link directly with postsecondary training such as apprenticeship programs, vocational training, or college.

- **Ensure that California's higher education institutions continue to produce the next generation of clean tech engineers, scientists and business leaders.** In addition to providing valuable research on potential climate-change mitigation and adaptation strategies, California's world-class research institutions are the

[78] Get REAL. *Aligning California's Public Education System with the 21st Century Economy Policy Paper for Discussion at Governor Arnold Schwarzenegger's Summit on Career and Technical Education*, March 6, 2007

[79] Ibid.

[80] The New Apollo Program, Clean Energy, Good Jobs: A National Economic Strategy for the New American Century, July 2008. p. 20 http://apolloalliance.org/downloads/fullreportfinal.pdf (accessed October 12, 2008)

incubators for many of the clean tech companies that will contribute to California's environmental and economic future. It will be critical for California to continue to cultivate university research and training programs in a way that takes full advantage of this valuable state resource.

A successful transition to a clean energy future depends heavily on California's ability to provide a well-trained workforce to meet the demands of the growing green economy. ARB and our key partners will continue working throughout the state to ensure that an adequate supply of skilled workers is positioned to take advantage of the growing opportunities for high quality jobs and careers that implementation of AB 32 will bring.

3. Small Businesses

Small businesses play a crucial role in California's economy. As noted in Chapter III, our analysis indicates that this plan will have a net positive impact on small businesses. These impacts are attributable primarily to the measures in the plan that will deliver significantly greater energy and fuel efficiencies. However, as also noted in the analysis, ensuring that these benefits are realized to the fullest potential will require additional outreach and communication efforts by ARB and many other state and local entities.

One of ARB's Early Action measures is designed to help businesses during AB 32 implementation. With our State partners, we are developing an on-line small business "toolkit" designed for small and medium-sized businesses that will provide a one-stop shop for technical and financial resources. Toolkit components will include a business-specific calculator to assess a company's carbon footprint; a voluntary greenhouse gas inventory protocol for measuring greenhouse gas emissions; recommended best practices for energy, transportation, building, purchasing, and recycling; case studies demonstrating how small and medium California businesses have reduced greenhouse gas emissions; program financing resources; peer-networking opportunities; and an awards program to recognize reductions of greenhouse gas emissions among California businesses.

ARB will also continue working with the many business associations, organizations, and other State partners, such as the Small Business Advocate's AB 32 Small Business Task Force, the Labor and Workforce Development Agency, and Business, Transportation, and Housing Agency that have the resources, input and expertise to provide. These partners will help to further develop and implement an effective outreach plan to provide technical assistance to businesses through a variety of means, including attendance at business events, workshops, and working with local economic development agencies.

C. Implementation of the Plan

This Scoping Plan outlines the regulations and other mechanisms needed to reduce greenhouse gas emissions in California. ARB and other State agencies will work closely with stakeholders and the public to develop regulatory measures and other programs to implement the Plan. ARB and other State agencies will develop any regulations in accordance with established rulemaking guidelines. Table 32 shows the status of the proposed measures in the plan.

Table 32: Status of Scoping Plan Measures

Existing Laws, Regulations, Policies And Programs
Light-Duty Vehicle Greenhouse Gas Standards (Pavley I)
Renewables Portfolio Standard (to 20%)
Solar Hot Water Heaters
Million Solar Roofs
High Speed Rail
Measures Strengthening & Expanding Existing Policies & Programs
Electricity Efficiency
Natural Gas Efficiency
Renewables Portfolio Standard (from 20% to 33%)
Sustainable Forests
Light-Duty Vehicle Greenhouse Gas Standards (Pavley II)
Discrete Early Actions
Low Carbon Fuel Standard
High GWP in Consumer Products (Adopted)
Smartways
Landfill Methane Capture
High GWP in Semiconductor Manufacturing
Ship Electrification (Adopted)
SF6 in non-electrical applications
Mobile Air Conditioner Repair Cans
Tire Pressure Program
New Measures
California Cap-and-Trade Program Linked to WCI Partner Jurisdictions
Increase Combined Heat and Power
Regional Transportation-Related GHG Targets
Goods Movement Systemwide Efficiency
Vehicle Efficiency Measures
Medium/Heavy Duty Vehicle Hybridization
High GWP Reductions from Mobile Sources
High GWP Reductions from Stationary Sources
Mitigation Fee on High GWP Gases
Oil and Gas Extraction
Oil and Gas Transmission
Refinery Flares
Removal of Methane Exemption from Existing Refinery Regulations

Rulemakings will take place over the next two years. As with all rulemaking processes, there will be ample opportunity for both informal interaction with technical staff in meetings and workshops, and formal interaction. ARB will consider all information and stakeholder input during the rulemaking process. Based on this information, ARB may modify proposed measures to reflect the status of technological development, the cost of the measure, the cost-effectiveness of the measures and other factors before presenting them to the Board for consideration and adoption.

In addition to these existing approaches, AB 32 imposes other requirements for the rulemaking process. Section 38562(b) explicitly added requirements for any regulations adopted for greenhouse gas emissions reductions. ARB also recognizes the need to expand the scope of analysis required when adopting future greenhouse gas emission reduction regulations. These expanded evaluations include the unique enforcement nature of climate change-related regulations and the possible extended permitting considerations and timelines that must be taken into account when establishing compliance dates. An important consideration in developing regulations will be the potential impact on California businesses. The potential for leakage, the movement of greenhouse gas emissions (and economic activity) out of state, will be carefully evaluated during the regulatory development.

As noted above, as the Scoping Plan is implemented and specific measures are developed, ARB and other implementing agencies will also conduct further CEQA analyses, including cumulative and multi-media impacts. ARB must design equitable regulations that encourage early action, do not disproportionately impact low-income and minority communities, ensure that AB 32 programs complement and do not interfere with the attainment and maintenance of ambient air quality standards, consider overall societal benefits (such as diversification of energy resources), minimize the administrative burden, and minimize the potential for leakage. AB 32 requires that, to the extent feasible and in furtherance of achieving the statewide greenhouse gas emission limit, ARB must consider the potential for direct, indirect and cumulative emission impacts from market-based compliance mechanisms, including localized impacts in communities that are already adversely impacted by air pollution, design the program to prevent any increase in emissions, and maximize additional environmental and economic benefits prior to the inclusion of market-based compliance mechanisms in the regulations. As ARB further develops its approach for consideration of these issues in future rulemakings, and updates needed analytical tools and data sets, we will consult with outside experts and the EJAC.

ARB already conducts robust environmental and environmental justice assessments of our regulatory actions. Many of the requirements in AB 32 overlap with ARB's traditional evaluations. In adopting regulations to implement the measures recommended in the Scoping Plan, or including in the regulations the use of market-based compliance mechanisms to comply with the regulations, ARB will ensure that the measures have undergone the aforementioned screenings and meet the requirements established in HSC §38562 (b) (1-9) and §38570 (b) (1-3).

D. Tracking and Measuring Progress

Many State agencies, working with the diverse set of greenhouse gas emissions sources, have collaborated in the process of developing the strategies presented in this plan. As the agency responsible for ensuring that AB 32 requirements are met, ARB must track the regulations adopted and other actions taken by both ARB and other State agencies as the plan is implemented.

The emissions reductions enumerated in this plan are estimates that may be modified based on additional information. As the proposed measures are developed over the coming years, it is possible that some of these strategies will not develop as originally thought or not be technologically feasible or cost-effective at the level given in the plan. It is equally likely that new technologies and strategies will emerge after the initial adoption schedule required in AB 32, that is, regulation adoption by January 1, 2011. If promising new tools or strategies emerge, ARB and other affected State agencies will evaluate how to incorporate the new measures into the AB 32 program. In this way, new strategies ensuring that the commitments in the plan remain whole and that the 2020 goal can be met will be incorporated into the State strategy.

ARB will update the plan at least once every five years (HSC §38561(h)). These updates will allow ARB to evaluate the progress made toward the State's greenhouse gas emission reduction goals and correct the Plan's course where necessary. This section discusses the tracking and measurement of progress that ARB envisions. The Report Cards and audits, along with an evaluation of new technologies – both emerging and those recently incorporated into the Plan – will also provide valuable input into ARB's update process. Continuous atmospheric monitoring of greenhouse gases may also be useful for determining the effectiveness of emission reduction strategies and for future inventory development.

1. Report Card

SB 85 (Budget Committee, Chapter 178, Statutes of 2007) requires every State agency to prepare an annual "Report Card," detailing measures the agency has adopted and taken to reduce greenhouse gas emissions, including the actual emissions reduced as a result of those actions. The information must be submitted to CalEPA, which is then required to compile all the State agency data into a report format, which is made available on the Internet and submitted to the Legislature. The information allows comparisons of each agency's projected and actual greenhouse gas emissions reductions with the targets established by the CAT or the Scoping Plan. This would be the State's 'Report Card' on its efforts to reduce greenhouse gas emissions.

Agencies are also required, as funds are available, to have an outside audit of greenhouse gas-related actions completed every three years to verify actual and projected reductions.

2. Tracking Progress by Implementing Agencies

As the lead agency responsible for implementing AB 32, ARB must track the progress of both our efforts and the efforts of our partners in implementing their respective provisions of this plan. Communication between ARB and the other implementing agencies will be especially important as regulations and programs are developed. In support of the Report Card requirement noted above, ARB will work with CalEPA to develop a process to track and report on progress toward the plan's goals and commitments.

3. Progress Toward the State Government Target

The CAT recently established a State Government Subgroup to work with State agencies to create a statewide approach to meet the Scoping Plan's commitment to reduce greenhouse gas emissions by a minimum of 30 percent by 2020 below the State's estimated business-as-usual emissions – approximately a 15 percent reduction from current levels. State agencies must lead by example by doing their part to reduce emissions and employ practices that can also be transferred to the private sector. The statewide plan will serve as a guide for State agencies to achieve realistic, measurable objectives within specific timelines. This newly created State Government Subgroup will assist State agencies through these steps in a timely manner.

4. Mandatory Reporting Regulation

ARB's mandatory reporting rule, adopted in December 2007, will help the State obtain facility-level data from the largest sources of greenhouse gas emissions in California. This data will help ARB better understand these sources to develop the proposed emissions reduction measures outlined in this plan.

The regulation requires annual reporting from the largest facilities in the state, accounting for 94 percent of greenhouse gas emissions from industrial and commercial stationary sources in California. There are approximately 800 separate sources that fall under the new reporting rules, which include electricity generating facilities, electricity retail providers and power marketers, oil refineries, hydrogen plants, cement plants, cogeneration facilities, and industrial sources that emit over 25,000 tons of carbon dioxide each year from on-site stationary source combustions such as large furnaces. This last category includes a diverse range of facilities such as food processing, glass container manufacturers, oil and gas production, and mineral processing.

Affected facilities will begin tracking their greenhouse gas emissions in 2008, to be reported beginning in 2009 with a phase-in process to allow facilities to develop reporting systems and train personnel in data collection. Emissions for 2008 may be based on best available data. Beginning in 2010, emissions reports will be more rigorous and will be subject to third-party verification. Reported emissions data will allow ARB to improve its facility-based emissions inventory data. Originally, the statewide greenhouse gas inventory was based on aggregated sector data and could not be broken down to the facility level. The facility-level reporting required under the Mandatory Reporting regulation will improve data on greenhouse gas emissions for individual facilities and their emitting processes. This information could also help improve emissions inventories for criteria pollutants, and provide additional data for assessing cumulative emission impacts on a community level.

ARB emissions reporting requirements are expected to be modified over time as AB 32 is implemented.

E. Enforcement

Enforcement is a critical component of all of the State's regulatory programs, both to ensure that emissions are actually reduced and to provide a level playing field for entities complying with the law. To meet the 2020 target this plan calls for aggressive action by a number of State agencies. Each of those agencies will employ its full range of compliance and enforcement options to ensure that planned reductions are achieved. The remainder of this section discusses ARB's portion of the enforcement program in more detail.

ARB has an extensive and effective enforcement program covering a wide variety of regulated sources, from heavy-duty vehicle idling, to consumer products, to fuel standards and off-road equipment. To increase the effectiveness of its enforcement efforts and provide greater assurance of compliance, ARB also partners with local, State and federal agencies to carry out inspections and, when necessary, prosecute violators.

ARB will continue its strong enforcement presence as the State's primary air pollution control agency. A critical function of this responsibility is to ensure that all enforcement actions are timely, effective, and appropriate with the severity of the situation. ARB will also continue its close working relationship with local air districts in the development and enforcement of applicable regulations contained within the Scoping Plan and collaborate with the appropriate State agencies on greenhouse gas emission reductions measures.

For the stationary source regulations called for in the plan, ARB will work closely with the local air districts that have primary responsibility for implementing and enforcing criteria pollutant regulations. Not only are local air districts familiar with the individual facilities and their compliance history, but information contained in district permits can be used to verify the accuracy of greenhouse gas emissions reported by sources subject to ARB mandatory reporting requirements. Using this data, regulators can also examine any correlation between greenhouse gases and toxic or criteria air pollutants as a result of emissions trading or direct regulations.

ARB will also continue to partner with the California Highway Patrol and other State and local enforcement agencies on mobile source and other laws and regulations where joint enforcement authorities apply.

Although many of the measures in the Scoping Plan are modeled on existing ARB regulations, a multi-sector, regional cap-and-trade program would bring unique enforcement challenges. ARB and CalEPA have begun the process of engaging and consulting with other State agencies, such as California's Department of Justice, Public Utilities Commission, Energy Commission, as well as the Independent System Operator, on market tracking and enforcement. These working group meetings are ongoing and will culminate in a comprehensive enforcement plan to accompany the proposed cap-and-trade program when the Board considers regulatory requirements. This enforcement plan would describe the administrative structures needed for market monitoring, prosecution, and penalty setting. Public input regarding these issues would also be a key part of the public stakeholder process conducted during development of the cap-and-trade programs regulations.

Accurate measurement and reporting of all emissions would be necessary to assure accountability, establish the integrity of allowances, and provide sufficient transparency to sustain confidence in the market. To ensure compliance, ARB would administer penalties for entities that hold an insufficient quantity of allowances to cover their emissions or fail to report their greenhouse gas emissions. Missed compliance deadlines would also result in the application of stringent administrative, civil, or criminal penalties.

This plan recommends that California implement a cap-and-trade program that links with other Western Climate Initiative partner programs to create a regional market system. This system would require California to formalize enforcement agreements with its WCI partner jurisdictions for all phases of cap-and-trade program operations, including verification of emissions, certification of offsets based on common protocols, and detection of and punishment for non-compliance. As needed, California would also work with federal regulatory and enforcement agencies that oversee trading markets, such as the Commodity Futures Trading Commission and the Federal Energy Regulatory Commission. While California would work with other jurisdictions on joint enforcement activities, ARB will exercise all of its authority under HSC §38580 and other provisions of law to enforce its regulations against any violator wherever they may be.

F. State and Local Permitting Considerations

Some of the proposed emissions reduction strategies in this Scoping Plan may require affected entities to modify or obtain state or local permits. California's existing permit process ensures that health and safety concerns are evaluated, met, and when appropriate, mitigated. The State recognizes the potential for conflicts between various federal, state and local permitting requirements, which may cross various media – air, water, etc. CalEPA is actively involved in identifying and addressing these regulatory overlap issues with the ultimate goal of consolidating permits where feasible while maintaining all permit requirements. Two such examples are CalEPA's digester permit working group and the CalEPA-Air District Compost Emissions Work Group.

ARB recognizes that the permitting process may affect the viability of certain strategies and that the length of the permitting process could affect the timing of emissions reductions.

ARB, along with CalEPA and other State agencies, will continue to evaluate steps to ensure that permit requirements harmonize across the affected media.

This Plan has been developed with an understanding of the important cross-media impacts. These efforts will continue during the implementation of the Plan. Particular focus on the potential permitting impacts and cross-media consequences of a proposed rule will take place during the rulemaking process.

G. Role of Local Air Districts

Local air districts are ARB's partners in addressing air pollution. ARB takes primary responsibility for transportation, off-road equipment and consumer products. Local districts lead in controlling industrial, commercial and other stationary sources of air emissions. AB 32 recognizes the need to develop a program that meshes with local and regional activities. Although AB 32 does not provide an explicit role for air districts, their local presence as advocates for clean air and their resources, experience and expertise in regulating and enforcing rules for stationary sources make them a logical choice to have an important role in several aspects of implementing California's greenhouse gas program. ARB would partner with local air districts to develop and effectively enforce both source-specific requirements on industrial sources, and to enforce related programs, such as the high GWP rules, that affect a large number of local businesses.

ARB and local air districts are also actively working to coordinate emission reporting requirements. Some districts, like the South Coast Air Quality Management District, have developed software to allow their industrial sources to simultaneously report their criteria pollutant emissions to the District and their greenhouse gas emissions to ARB. Many air district staff are being trained as third-party verifiers to confirm the greenhouse gas emissions information provided by industrial sources under the mandatory reporting regulation, and, similarly, could provide verification of voluntary greenhouse gas reductions in the future.

Local air districts will be key in both encouraging greenhouse gas emissions reductions from other regional and local government entities, and providing technical assistance to quantify and verify those reductions. Local agencies are an important component of ARB's outreach strategy.

Many local air districts have already taken a leadership role in addressing greenhouse gas emissions in their communities. These efforts are intended to encourage early voluntary reductions. For example, local districts are "lead agencies" under the California Environmental Quality Act (CEQA) for some projects. In order to ensure high-quality mitigation projects, some districts have established programs to encourage local greenhouse gas reductions that could be used as CEQA mitigation. As the State begins to institutionalize mechanisms to generate and verify greenhouse gas emissions reductions, ARB and the districts must work together to smoothly transition to a cohesive statewide program with consistent technical standards.

H. Program Funding

Administration, implementation, and enforcement of the emissions reduction measures contained in the Scoping Plan will require a stable and continuing source of funding. AB 32 authorizes ARB to collect fees to fund implementation of the statute. ARB recently initiated a rulemaking for a fee program to fund administration of the program.

Approximately $36 million per year will be needed on an ongoing basis to fund implementation by ARB and other State agencies, based on the positions and funding included in the 2009-2010 fiscal year budget. Additional revenues are needed to repay the loans from State funds that were used to pay ARB and CalEPA expenses in the startup of the program. ARB is moving on an expedited schedule to develop a fee regulation and expects to take a regulation to the Board in mid 2009, with the aim of beginning to collect fees in the 2009/2010 fiscal year.

V. A VISION FOR THE FUTURE

California has the know-how, ingenuity, research capabilities, and culture of innovation to meet the challenge of addressing climate change. However, reaching the goals we have set for ourselves will not be easy. Successful implementation of many of the proposed programs and measures described in this plan will require strong leadership and a shared understanding of the need to reach viable and lasting solutions quickly.

This challenge will also require establishing a wide range of partnerships, both within California and beyond our borders. We will need to support additional research, and further develop our culture of innovation and technological invention. In order to continue the momentum and the commitment to a clean energy future, we will need to both build on existing solutions and develop new ones.

The following sections lay out some of the elements that will be necessary to forge a broad-based institutional strategy to address climate change both within California and beyond. Also discussed is the need to build partnerships on the regional, national and international levels to ensure that our actions complement and support those being taken on a global scale. This section also looks forward to 2030, showing that California is on the trajectory needed to do our part to stabilize global climate.

A. Collaboration

1. Working Closely with Key Partners

True climate change mitigation will require many parties to work together for a global mitigation plan. California and other states are filling a vacuum created by the current lack of leadership at the federal level. By its bold actions, California is moving the United States closer to a seat at the table among the developed countries that have agreed to reduce their carbon emissions, and lead a new international effort for an agreement to replace the Kyoto Protocol that expires in 2012.

Any national climate program must be built on a partnership with State and local governments to ensure that states can continue their role as incubators of climate change policy and can implement effective programs such as vehicle standards, energy efficiency programs, green building codes, and alternative fuel development.

California will work for climate solutions with key federal agencies, including the U.S. Department of Energy and their national labs, the U.S. Environmental Protection Agency, the U.S. Bureau of Land Management, the U.S. Department of Agriculture, the U.S. Department of Transportation, and others.

Through the Western Climate Initiative and in collaboration with other regional alliances of states, California can promote its own best practices and learn from others while helping to formulate the structure of a regional and ultimately national cap-and-trade program.

2. International

As one of the largest economies in the world, California is committed to working at the international level to reduce global greenhouse gas emissions. As part of this effort, Governor Schwarzenegger and other U.S. governors taking the lead in climate change are co-hosting a Global Climate Summit on Finding Solutions Through Regional and Global Action. This summit, held on November 18th and 19th, 2008, began a state-province partnership with leaders from the U.S., Australia, Brazil, Canada, China, India, Indonesia, Mexico, the European Union, and other nations, taking urgent steps to contain global climate change and jointly setting forth a blueprint for the next global agreement on climate change solutions.

California is also a charter member of the International Carbon Action Partnership (ICAP), an organization composed of countries and regions that have adopted carbon caps and that are actively pursuing the implementation of carbon markets through mandatory cap-and-trade systems. California's continued involvement in ICAP will be very beneficial for sharing experiences and knowledge as we design our own market program.

In addition to participating in ICAP, California hopes to engage developing countries to pursue a low-carbon development path. With developing nations expected to suffer the most from the effects of climate change, California and others have an obligation to share information and resources on cost-effective technologies and approaches for mitigating both emissions and future impacts as changes in climate and the environment occur.

California recognizes the "common but differentiated responsibilities" among developed and developing countries (as articulated in the Kyoto Protocol), but the reality is that rapidly escalating greenhouse gas emissions in developing countries could possibly negate any efforts undertaken in California. To the extent that we are part of the global economy, California's demand for goods manufactured in developing countries further exacerbates growth of greenhouse gas emissions globally. Therefore, it is critical for California to help support the adoption of low-carbon technologies and sustainable development in the developing world.

California can advance the international policy debate through state-provincial partnerships for achieving early climate action in developing countries. This approach envisions commitments by developed countries to provide capacity building through technological assistance and investment support in return for developing countries adopting enhanced mitigation actions. California will consider working with developing countries or provinces that have, at a minimum, pledged to achieve greenhouse gas intensity targets in certain carbon-intensive sectors through mechanisms, such as minimum performance standards or sector benchmarks. California also recognizes that developing countries have the challenge and responsibility to reduce domestic emissions in a way that will promote sustainable development, but not undermine their economic growth.

One possible manifestation of these collaborations could be the establishment of sectoral agreements that help to grow developing countries' economies in a low-carbon manner. In a sectoral approach, energy-intensive sectors adopt programs for reducing greenhouse gas emissions and/or energy use. Such sector-based approaches seem likely to win the support of developing countries and could also reduce concerns in developed countries about international competitiveness and carbon leakage.

A state-provincial partnership related to imported commodities (such as cement) would enable California to provide incentives to reduce greenhouse gas emissions associated with products that are imported by our state. California should continue to develop current relations and existing partnership arrangements with China – now the largest emitter of greenhouse gases in the world – because in addition to other compelling reasons much of the state's imported cement originates in China. California should also work to establish similar relations with India and other countries to share research on both greenhouse gas mitigation and climate change adaptation activities. Projects in the Mexican border region may also be of particular interest, considering the opportunity to realize considerable co-benefits on both sides of the border.

Deforestation accounts for approximately 20 percent of global greenhouse gas emissions. California has set a strong precedent in the effort to incorporate forest management and conservation into climate policy by adopting the CCAR forest methodology in October 2007. California also hopes to engage developing countries, including Brazil and Indonesia, to reduce emissions and sequester carbon through eligible forest carbon activities. Activities aimed at Reducing Emissions from Deforestation and Forest Degradation (REDD) were excluded from the rules governing the first Kyoto commitment period, but there is considerable momentum behind the effort to include provisions that would recognize such activities in a post-2012 international agreement. Providing incentives to developing countries to help cut emissions by preserving standing forests, and to sequester additional carbon through the restoration and reforestation of degraded lands and forests and improved forest management practices, will be crucial in bringing those countries into the global climate protection effort. California recognizes the importance of establishing mechanisms that will facilitate global partnerships and sustainable financing mechanisms to support eligible forest carbon activities in the developing world.

B. Research

1. Unleash the Potential of California's Universities and Private Sector

Bringing greenhouse gas emissions down to a level that will allow the climate to stabilize will take a generation or longer. Many of the ultimate solutions to achieve stabilization will be developed and implemented well into the future. Innovation in energy and climate will come from people who are now in school. These young people will face unprecedented challenges, and they will need both wisdom and imagination to craft solutions. California's respected public and private academic institutions must continue to develop and fund programs based on climate change science that cut across disciplines to address the multi-dimensional aspects of climate change.

2. Public-Private Partnerships

To most effectively address the climate change dilemma, we must encourage collaborations between academia and the private sector. Industry is well-positioned to quickly attack problems. Combining the vast knowledge housed in universities with businesses' acumen and agility can unleash a powerful collaborative force to tackle the problems associated with climate change.

Several important programs have already been initiated at California universities, including Stanford's Global Climate and Energy Project and the University of California at Berkeley's Energy Biosciences Institute (EBI).[81] These and other efforts need to be recognized and encouraged, along with others that can link the results of research directly to policy decisions that the State must make.

Carbon Sequestration

In addition to terrestrial carbon sequestration or natural carbon sinks, such as forests and soil, CO_2 can be prevented from entering the atmosphere through carbon capture and storage (CCS). This consists of separating CO_2 from industrial and energy-related sources and transporting the CO_2 to a storage location for long-term isolation from the atmosphere. Potential technical storage methods include geological storage, industrial fixation of CO_2 into inorganic carbonates, and other strategies. Large point sources of CO_2 that may pursue CCS include large power plants, fossil fuel-based hydrogen production plants, and oil refineries.[82]

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[81] The EBI is being developed in cooperation with Lawrence Berkeley National Laboratory, the University of Illinois at Urbana-Champaign and BP.

[82] Intergovernmental Panel on Climate Change. *Carbon Dioxide Capture and Storage: A Special Report of Working Group III of the IPCC*. Cambridge University Press, UK; 2005. http://www.ipcc.ch/ipccreports/srccs.htm (accessed October 12, 2008)

According to a 2005 report by the Intergovernmental Panel for Climate Change (IPCC), a power plant with CCS could reduce CO_2 emissions to the atmosphere by approximately 80 to 90 percent compared to a plant without CCS (including the energy used to capture, compress and transport CO_2).[83] While more research and development needs to occur, California should both support near-term advancement of the technology and ensure that an adequate framework is in place to provide credit for CCS projects when appropriate.

The State is currently an active member of the West Coast Regional Carbon Sequestration Partnership (WESTCARB), a public-private collaboration to characterize regional carbon sequestration opportunities in seven western states and one Canadian province. Established in 2003, this research project is comprised of more than 80 public and private organizations. WESTCARB is conducting technology validation field tests, identifying major sources of CO_2 in its territory, assessing the status and cost of technologies for separating CO_2 from process and exhaust gases, and determining the potential for storing captured CO_2 in secure geologic formations.[84]

C. Reducing California's Emissions Further – A Look Forward to 2030

In order to assess whether implementing this plan achieves the State's long-term climate goals, we must look beyond 2020 to see whether the emissions reduction measures set California on the trajectory needed to do our part to stabilize global climate.

Governor Schwarzenegger's Executive Order S-3-05 calls for an 80 percent reduction below 1990 greenhouse gas emission levels by 2050. This results in a 2050 target of about 85 $MMTCO_2E$ (total emissions), as compared to the 1990 level (also the 2020 target) of 427 $MMTCO_2E$. Climate scientists tell us that the 2050 target represents the level of greenhouse gas emissions that advanced economies must reach if the climate is to be stabilized in the latter half of the 21st century. Full implementation of the Scoping Plan will put California on a path toward these required long-term reductions. Just as importantly, it will put into place many of the measures needed to keep us on that path.

Figure 6 depicts what an emissions trajectory might look like, assuming California follows a linear path from the 2020 AB 32 emissions target to the 2050 goal needed to help stabilize climate. While the measures needed to meet the 2050 goal are too far in the future to define in detail, we can examine the policies needed to keep us on track through at least 2030.

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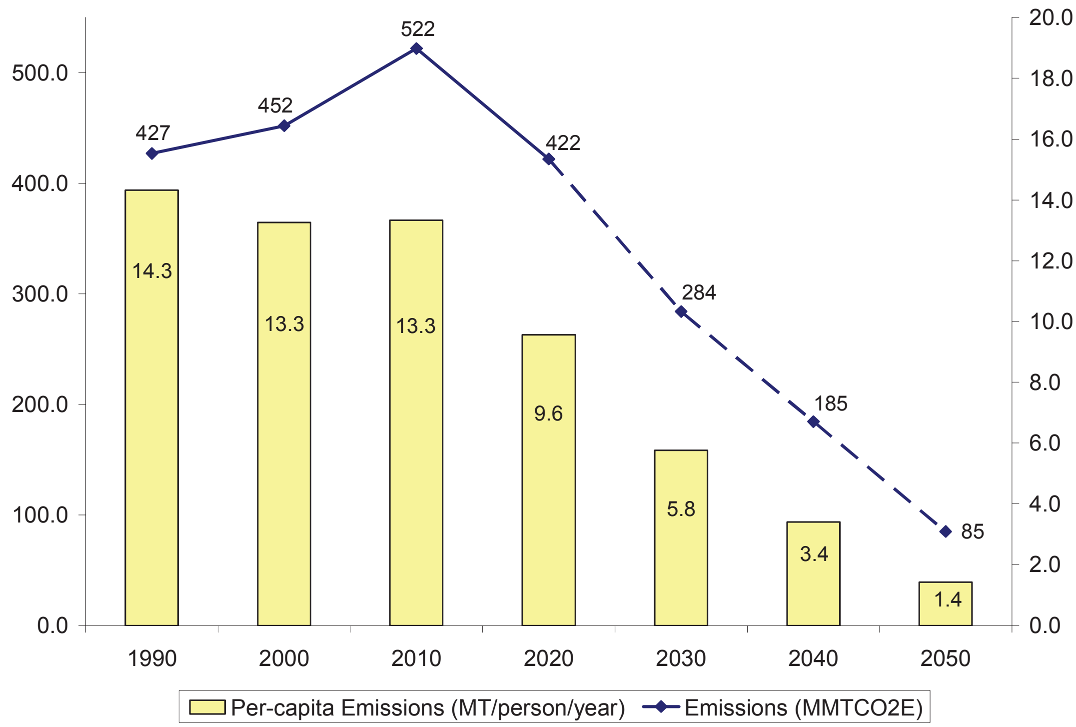
[83] Ibid

[84] WESTCARB. *WESTCARB Overview.* http://www.westcarb.org/about_overview.htm (accessed October 12, 2008)

Figure 6: Emissions Trajectory Toward 2050



To stay on course toward the 2050 target our State's greenhouse gas emissions need to be reduced to below 300 $MMTCO_2E$ by 2030. This translates to an average reduction of four percent per year between 2020 and 2030. An additional challenge comes from the fact that California's population is expected to grow by about 12 percent between 2020 and 2030. To counteract this trend, per-capita emissions must decrease at an average rate of slightly less than five percent per year during the 2020 to 2030 period.

Are such reductions possible by 2030? What measures might be able to provide the needed reductions? How do the needed measures relate to the efforts put into place to reach the 2020 goal? All of these are critical questions, and are addressed below.

The answer to the first question is yes, the reductions are possible. Furthermore, the measures needed are logical expansions of the programs recommended in the Scoping Plan that get us to the 2020 goal. We could keep on track through 2030 by extending those programs in the following ways:

- Using a regional or national cap-and-trade system to further limit emissions from the 85 percent of greenhouse gas emissions in capped sectors (Transportation Fuels and other fuel use, Electricity, Residential/Commercial Natural Gas, and Industry). By 2030 a comprehensive cap-and-trade program could lower emissions in the capped sectors from 365 $MMTCO_2E$ in 2020 to around 250 $MMTCO_2E$ in 2030;

- Achieving a 40 percent fleet-wide passenger vehicle reduction by 2030, approximately double the almost 20 percent expected in 2020;
- Increasing California's use of renewable energy;
- Reducing the carbon intensity of transportation fuels by 25 percent (a further decrease from the 10 percent level set for 2020);
- Increasing energy efficiency and green building efforts so that the savings achieved in the 2020 to 2030 timeframe are approximately double those accomplished in 2020; and
- Continuing to implement sound land use and transportation policies to lower VMT and shift travel modes.

The effects of these strategies are presented in Table 33.

Table 33: Potential Distribution of California Greenhouse Gas Emissions by Sector in 2030

Sector	Potential Emissions ($MMTCO_2E$)
Transportation Fuels*	102
Other Fuel Use*	149
Uncapped Sectors	33
Total	**284**

* Capped sector

With these polices and measures in place, per-capita electricity consumption would decrease by another five percent. Well over half of our electricity demand could be met with zero or near zero greenhouse gas emitting technologies, assuming nuclear and large hydro power holds constant at present-day levels. In response to a lower cap on emissions, existing coal generation contracts would not be renewed, or carbon capture and storage would be utilized to minimize emissions. The remaining electricity generation would come from natural gas combustion either in cogeneration applications or from highly efficient generating units.

By 2030, the transportation sector would undergo a similarly massive transition both in terms of the vehicle fleet and the diversity of fuel supplies. Due to the combination of California's clean car standards (ARB's ZEV program and the Low Carbon Fuel Standard), the number of battery-electric vehicles, plug-in hybrid electric vehicles, and fuel cell vehicles would increase dramatically, to about a third of the vehicle fleet. Flex-fuel vehicles would comprise a large fraction of the remaining fleet, with more efficient gasoline and diesel vehicles making up the difference. Electricity, advanced biofuels, improved gasoline and diesel, renewable natural gas and hydrogen would all play a role in powering this high-tech fleet of efficient vehicles.

Regional land use and transportation strategies would grow in importance and would reverse the trend of per-capita vehicle miles traveled, a reduction of about eight percent below business-as-usual in 2030. With ambitious but reasonable action, statewide passenger vehicle greenhouse gas emissions could be reduced to half of 2020 levels in 2030, which is also about half of business-as-usual for 2030. Efficiency strategies and low carbon fuels for heavy-duty and off-road vehicles, as well as for ships, rail, and aviation, would need to be greatly expanded in order to achieve additional reductions from the transportation sector in 2030.

In tandem with efficiency measures that lower demand for electricity, natural gas and transportation fuels, California's cap-and-trade program would incent large industrial sources as well as commercial and residential natural gas customers to further reduce emissions. By tightening the cap over time, it is expected that facilities in the industrial and natural gas sectors would achieve reductions well beyond those needed to meet the 2020 emissions cap.

The Scoping Plan proposes several measures for reducing high GWP gases that collectively, will substantially reduce emissions. With a transition toward reduced consumption of these gases, improved containment in their end uses, and substitution of low GWP alternative gases, it is expected that emissions from this sector could decrease by 75 percent between 2020 and 2030.

For uncapped sectors, we assume that the agriculture sector will reduce emissions by about 15 percent between 2020 and 2030. Net forest uptake of CO_2 must be preserved or enhanced, likely through both expansion of forests and reduction in carbon loss from forest fires, which are predicted to increase over this time period. This example assumes a 10 percent reduction in direct landfill emissions from the recycling and waste sector; however, aggressive implementation of the suite of measures proposed in this Plan could further reduce emissions from this sector by 2030.

In total, the measures described above would produce reductions to bring California's statewide greenhouse gas emissions to an estimated 284 $MMTCO_2E$ in 2030. While the potential mix of future climate policies articulated in this section is only an example, it serves to demonstrate that the measures in the Scoping Plan can not only move California to its 2020 goal, but also provide an expandable framework for much greater long-term greenhouse gas emissions reductions.

D. Conclusion

California's commitment to address global warming has never been greater. The vast amount of interest, support, and input that ARB has received since this plan began to take shape is evidence of a clear understanding of the need to take action and support for the State's efforts to lead the way. The time has come to shift away from a 'business-as-usual' approach to climate change and to move toward the lasting and sustainable goal of a clean energy future.

Reaching our goals will take a great deal of leadership, commitment, and a willingness to embrace new approaches and seek out new solutions. California's plan to reduce greenhouse gas emissions must also take into account the impacts of this transition and be designed in particular to address the needs of low-income communities, small businesses, and California's working families.

Reaching our goals will also require involvement and support from all levels of government in California, and a coordinated effort with other states, regions, and countries. The solutions and technologies we develop here will be used around the world to help others transition to a clean energy future and contribute to the fight against global warming.

Reaching our goals will also require flexibility. As we move forward, we must be prepared to make mid-course corrections. AB 32 wisely requires ARB to update its Scoping Plan every five years, thereby ensuring that California stays on the path toward a low carbon future.

This plan is part of a new chapter for California that in many ways began with the passage and signing of AB 32. It proposes a comprehensive set of actions designed to reduce greenhouse gas emissions in California, improve our environment, reduce our dependence on oil, diversify our energy sources, save energy, create new jobs, and enhance public health. The challenge California has taken on is large but the opportunities are even greater. It is now time to turn this plan into action.

ACKNOWLEDGMENTS

This Scoping Plan was prepared by the Air Resources Board. This document was made possible by the hard work of numerous contributors. Below is a list of advisory committees and State agencies that directly provided input to this Scoping Plan.

Team Support

Climate Action Team

Climate Action Team Sector Subgroups

- Agriculture
- Cement
- Energy
- Forest
- Green Buildings
- Land Use
- Recycling and Waste Management
- State Fleet
- Water-Energy
- Economics

Advisory Committees

Market Advisory Committee

Environmental Justice Advisory Committee

Economic and Technology Advancement Advisory Committee

State Agencies

Governor's Office of Planning and Research

California Environmental Protection Agency

Business, Transportation and Housing Agency

Resources Agency

State and Consumer Services Agency

Department of Food and Agriculture

California Energy Commission

California Public Utilities Commission

California Transportation Commission

Department of Conservation

Department of Forestry and Fire Protection

Department of General Services

Department of Parks and Recreation

Department of Public Health

Department of Toxic Substances Control

Department of Transportation

Department of Water Resources

Housing and Community Development

Integrated Waste Management Board

Office of Environmental Health Hazard Assessment

State Water Resources Control Board

Department of Pesticide Regulation

BOARD RESOLUTION

State of California
Air Resources Board

Climate Change Scoping Plan

Resolution 08-47

December 11, 2008

Agenda Item No.: 08-10-2

WHEREAS, the Legislature has enacted the Global Warming Solutions Act of 2006 (AB 32; Health and Safety Code section 38500 et seq.), which declares that global warming poses a serious threat to the environment of California and creates a comprehensive multi-year program to reduce greenhouse gas (GHG) emissions that cause global warming;

WHEREAS, the adverse impacts of climate change include more droughts, more frequent and extreme heat waves, erratic storm and flood events, decreases in winter snowpack, a rise in sea level, increases in water temperatures, an increase in coastal erosion, intrusion of sea water, an increase in the duration of wildfire season, and increased occurrences of unhealthy ozone levels;

WHEREAS, climate change mitigation and adaptation measures can be complementary and are often intricately linked;

WHEREAS, AB 32 designates the Air Resources Board (ARB or the Board) as the State agency charged with monitoring and regulating sources of GHG emissions in California in order to reduce these emissions;

WHEREAS, section 38561(a) of the Health and Safety Code directs the Board, on or before January 1, 2009, to prepare and approve a Scoping Plan for achieving the maximum technologically feasible and cost-effective reductions in GHG emissions by 2020;

WHEREAS, section 38561(a) of the Health and Safety Code also requires ARB to consult with all State agencies having jurisdiction over sources of GHGs on all elements of the Scoping Plan that pertain to energy-related matters, to ensure reduction activities adopted and implemented by ARB are complementary, non-duplicative and can be implemented in an efficient and cost-effective manner;

WHEREAS, section 38561(b) of the Health and Safety Code requires the Scoping Plan to identify and make recommendations on direct emission reduction measures, alternative compliance mechanisms, market-based compliance mechanisms, and potential monetary and nonmonetary incentives for sources and categories of sources that the Board finds necessary or desirable to facilitate the achievement of the maximum feasible and cost-effective reductions of GHG emissions by 2020;

WHEREAS, section 38561(c) of the Health and Safety Code requires ARB to consider all relevant information pertaining to greenhouse gas emissions reduction programs in other states, localities, and nations, including the northeastern states of the United States, Canada and the European Union in making the determinations required in Health and Safety Code section 38561(b);

WHEREAS, section 38561(d) of the Health and Satety Code requires ARB to evaluate the total potential costs and total potential economic and noneconomic benefits of the Scoping Plan to California's economy, environment, and public health, using the best available economic models, emissions estimation techniques, and other scientific methods;

WHEREAS, section 38561(e) of Health and Safety Code requires ARB, in developing its plan, to take into account the relative contribution of each source or source category to statewide GHG emissions, and the potential for adverse effects on small businesses, and to recommend a de minimis threshold of GHG emissions below which emission reduction requirements will not apply;

WHEREAS, section 38561(f) of the Health and Safety Code requires ARB, in developing its plan, to identify opportunities for emission reductions measures from all verifiable and enforceable voluntary actions, including, but not limited to, carbon sequestration projects and best management practices;

WHEREAS, section 38561(g) of the Health and Safety Code requires ARB to conduct a series of public workshops to give interested parties an opportunity to comment on the Scoping Plan, and that a portion of these workshops should take place in regions that have the most significant exposure to air pollution, including, but not limited to communities with minority populations, communities with low-income populations, or both;

WHEREAS, section 38652(b) of the Health and Safety Code requires ARB, in adopting greenhouse gas regulations, to the extent feasible and in furtherance of achieving the statewide greenhouse gas emissions limit, to design the regulations in a manner that is equitable and seeks to minimize costs and maximize the total benefits to California; ensure that activities taken to comply with the regulations do not disproportionately impact low-income communities; ensure that activities undertaken pursuant to the regulations complement efforts to achieve and maintain ambient air quality standards and to reduce toxic air contaminant emissions; consider the cost-effectiveness of the regulations; consider overall societal benefits; minimize administrative burden; and minimize leakage;

WHEREAS, section 38565 of the Health and Safety Code requires ARB to ensure that greenhouse gas emission reduction rules, regulations, programs, mechanisms and incentives under ARB's jurisdiction, where applicable and to the extent feasible, direct public and private investment toward the most disadvantaged communities in California;

WHEREAS, sections 39600 and 39601 of the Health and Safety Code authorize the ARB to adopt standards, rules and regulations and to do such acts as may be necessary for the proper execution of the powers and duties granted to and imposed upon the ARB by law;

WHEREAS, ARB has adopted and is implementing numerous programs to reduce criteria pollutants, diesel particulate, and air toxics emissions, including the 2007 State Implementation Plan, the Goods Movement Emissions Reduction Plan, and the Diesel Risk Reduction Plan;

WHEREAS, local air pollution control and air quality management districts are currently responsible for implementing many programs that regulate air pollution from stationary and area sources;

WHEREAS, the Board acknowledges the importance of ensuring adequate and reliable energy supplies while the State implements AB 32;

WHEREAS, in preparing the Proposed Scoping Plan, ARB staff considered advice and input from the Environmental Justice Advisory Committee and the Economic and Technology Advancement Advisory Committee;

WHEREAS, in June 2008 ARB staff prepared and circulated for public review a *Draft Climate Change Scoping Plan* (Draft Plan); staff then held three public workshops to discuss the Draft Plan, considered public comments received on the Draft Plan, and modified the Draft Plan in response to these comments;

WHEREAS, in October 2008 ARB staff prepared and circulated for public review a *Proposed Climate Change Scoping Plan*, in accordance with the requirements set forth in Health and Safety Code section 38561;

WHEREAS, the California Environmental Quality Act (CEQA) requires that no project which may have significant adverse environmental impacts may be adopted as originally proposed if feasible alternatives or mitigation measures are available to reduce or eliminate such impacts, unless specific overriding considerations are identified which outweigh the potential adverse consequences of any unmitigated impacts;

WHEREAS, CEQA allows public agencies to prepare a plan or other written documentation in lieu of an environmental impact report (i.e., a functional equivalent environmental document), once the Secretary of the Resources Agency has certified an agency's regulatory program pursuant to section 21080.5 of the Public Resources Code;

WHEREAS, pursuant to section 21080.5 of the Public Resources Code, the Secretary of the Resources Agency has certified that portion of ARB's regulatory program that involves the adoption, approval, amendment, or repeal of standards, rules, regulations, or plans;

WHEREAS, Board regulations under ARB's certified regulatory program provide that prior to taking final action on any proposal for which significant environmental issues have been raised, the decision maker shall approve a written response to each such issue;

WHEREAS, on October 15, 2008, ARB staff prepared and circulated for public review, in accordance with CEQA and Board regulations, a functional equivalent environmental document which is set forth in Appendix J to the *Proposed Climate Change Scoping Plan*;

WHEREAS in consideration of the *Proposed Climate Change Scoping Plan*, the written and oral testimony presented by the public, industry and government agencies, and the environmental documentation prepared by Board staff, the Board finds that:

1. ARB staff has consulted with all State agencies, including the Public Utilities Commission (PUC) and the State Energy Resources Conservation and Development Commission (CEC), having jurisdiction over sources of greenhouse gases on all elements of the Plan that pertain to energy-related matters, as required by Health and Safety Code section 38561(a);

2. ARB has carefully considered the joint opinion adopted by the PUC and CEC on October 17, 2008, which recommends strategies to help reduce greenhouse gas emissions from the electricity and natural gas sectors;

3. The recommendations in the *Proposed Scoping Plan* are necessary or desirable to facilitate the achievement of the maximum feasible and cost-effective reductions of greenhouse gas emissions by 2020;

4. ARB has considered all relevant information pertaining to greenhouse gas emissions reduction programs in other states, localities, and nations, including the northeastern states of the United States, Canada and the European Union, as provided in Health and Safety Code section 38561(c);

5. ARB staff prepared an analysis to evaluate the total potential costs and total potential economic and noneconomic benefits of the *Proposed Climate Change Scoping Plan* to California's economy, environment, and public health; this analysis was prepared using the best available economic models, emissions estimation techniques, and other scientific methods, as required by Health and Safety Code section 38561(d);

6. In developing the *Proposed Climate Change Scoping Plan*, ARB took into account the relative contribution of each source or source category to

statewide GHG emissions, and the potential for adverse effects on small businesses, as provided in Health and Safety Code section 38561(e);

7. The *Proposed Climate Change Scoping Plan* recommends a de minimis threshold of GHG emissions below which emission reduction requirements will not apply, as provided in Health and Safety Code section 38561(e);

8. The *Proposed Climate Change Scoping Plan* identifies opportunities for emission reductions measures from all verifiable and enforceable voluntary actions, as provided in Health and Safety Code section 38561(f);

9. In accordance with Health and Safety Code section 38561(g), ARB staff organized over 250 public workshops, workgroup events and formal meetings throughout the State, and participated in over 350 meetings and conferences involving external stakeholders, including workshops in regions of the state that have the most significant exposure to air pollutants;

10. The *Proposed Climate Change Scoping Plan* meets all of the requirements of AB 32.

WHEREAS, pursuant to the requirements of the California Environmental Quality Act and the Board's regulations under its certified regulatory program, the Board further finds that:

11. ARB staff prepared a functional equivalent environmental document for the *Proposed Climate Change Scoping Plan* which indicates that there may be potential adverse environmental impacts from the measures included in the Plan; however, these impacts are speculative and cannot be quantified or further described until the details of the measures are developed and set forth in actual proposed regulations;

12. The Board has considered alternatives to the measures identified in the *Proposed Climate Change Scoping Plan* and has identified no feasible alternatives at this time which would reduce or eliminate any potential adverse environmental impacts, while at the same time ensuring that necessary reductions in greenhouse gas emissions will be achieved;

13. At this time there are no feasible mitigation measures that ARB can impose to lessen the potential adverse impacts of the *Proposed Climate Change Scoping Plan* on the environment, and no less stringent alternatives that will accomplish the goals imposed by AB 32 with fewer potential environmental impacts;

14. None of modifications to the *Proposed Climate Change Scoping Plan* alter any of the conclusions reached in the functional equivalent environmental

document, or would require recirculation of the document as provided in CEQA Guidelines section 15088.5;

15. The potential adverse environmental impacts of the measures included in the *Proposed Climate Change Scoping Plan* are outweighed by the substantial reduction in greenhouse gas emissions and public health benefits that will result from their adoption and implementation;

16. The considerations identified above override any adverse environmental impacts that may occur from adoption and implementation of the *Proposed Climate Change Scoping Plan*;

17. As regulations implementing the *Proposed Climate Change Scoping Plan* are developed, detailed environmental impact analyses, including a discussion of regulatory alternatives and mitigation measures, will be performed as part of the rulemaking process;

18. As regulations implementing the *Proposed Climate Change Scoping Plan* are developed, specific economic impact analyses will be performed in conjunction with the rulemaking process and will be considered by the Board in acting on those regulations;

19. In accordance with Public Resources Code 21081(a)(2), for Scoping Plan measures that are within the responsibility and jurisdiction of another public agency, that agency shall be responsible for completing the appropriate environmental review and, with respect to each significant effect identified in the environmental review, shall be responsible for adopting feasible changes or alterations to the measures to mitigate or avoid, as appropriate, the significant environmental effects that have been identified. An initial list of agencies responsible for Plan measures is included in Appendix C of the Plan.

20. ARB regulations which have been adopted and are included in the measures recommended in the *Proposed Climate Change Scoping Plan* were subjected to environmental review by the Board at the time of their adoption and no further analysis is required at this time; and

21. The Executive Officer is the decision maker for the purposes of responding to environmental issues raised on the *Proposed Climate Change Scoping Plan*, and by approving this Resolution 08-47 the Board is not prejudging any of the responses that will be made by the Executive Officer to these environmental issues.

NOW, THEREFORE, BE IT RESOLVED, that subject to the Executive Officer's approval of written responses to environmental issues that have been raised, the Board is initiating steps toward the final approval of the *Proposed Climate Change Scoping*

Plan and its Appendices, as set forth in Attachments A and B hereto, with the modifications identified at the December 11, 2008 public hearing.

BE IT FURTHER RESOLVED that the Executive Officer is the decision maker for the purposes of title 17, California Code of Regulations, section 60007; the Board directs the Executive Officer to prepare and approve written responses to all significant environmental issues that have been raised, and then to either: (1) return the *Proposed Climate Change Scoping Plan* to the Board for further consideration if it is determined that such action is warranted, or (2) take final action to approve the *Proposed Climate Change Scoping Plan* with the modifications identified at the December 11, 2008 public hearing, any conforming modifications that may be appropriate, and any modifications that are necessary to ensure that all feasible measures or feasible alternatives that would substantially reduce any significant adverse environmental impacts have been incorporated into the final action.

BE IT FURTHER RESOLVED that once final action has been taken by the Executive Officer to approve the *Climate Change Scoping Plan*, as agreed to and modified by the Board, the Board directs the Executive Officer to make the modified Plan available to the public.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to perform the environmental analyses required by CEQA in conjunction with future rulemaking actions to implement the *Climate Change Scoping Plan*, and to ensure that the potential environmental impacts identified in the Plan, and any other impacts are subsequently identified, are avoided or mitigated to the extent feasible.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to ensure that the requirements of Health and Safety Code section 38562(b) are met for all proposed regulations to implement the *Climate Change Scoping Plan*, and that the requirements of Health and Safety Code section 38570(b) are met for all proposed regulations to implement market-based compliance mechanisms.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to design greenhouse gas regulations that affect stationary sources so that they utilize, to the extent practicable and appropriate, local air district permitting programs and compliance determination mechanisms.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to provide funding to the local air districts using State funding mechanisms to reimburse districts for involvement in specific, identified activities related to implementation and enforcement of greenhouse gas emission reduction measures.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to develop a joint workplan with the local air districts to define how to efficiently and effectively implement and administer the Scoping Plan.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to develop a program to provide GHG emissions verifier training without cost to District staff who meet required education and experience qualifications.

BE IT FURTHER RESOLVED that the Board recognizes that emission sources subject to ARB's mandatory reporting regulation must report directly to the State and directs the Executive Officer to develop a software tool that will allow the export of data to the districts.

BE IT FURTHER RESOLVED that the Board recognizes that consistent implementation and enforcement of greenhouse gas emission reduction programs is crucial to minimize administrative burdens and that the future cap-and-trade program, including reporting and verification of offsets, should be administered at the state level.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to establish a working group of public health agencies and organizations, including, but not limited to, the Department of Public Health, the Office of Environmental Health Hazard Assessment, and local public health agencies, to review and provide input to the staff on proposed greenhouse gas reduction measures.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to develop a methodology using available information to assess the potential cumulative air pollution impacts of proposed regulations to implement the Scoping Plan.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to identify communities already adversely impacted by air pollution as specified in Health and Safety Code section 38570 (b)(1) before the adoption of a cap-and-trade program.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to design the implementation of AB 32, including the cap-and-trade system, to complement California's criteria and toxic air contaminant programs and be consistent with ARB's environmental justice policies, in furtherance of achieving the statewide greenhouse gas emissions limit.

BE IT FURTHER RESOLVED that the Board recognizes that through the SB 375 (Stats. 2008, Chapter 728) process, local governments and transportation agencies are key partners in ARB's efforts to reduce greenhouse gas emissions, that improved land use and transportation planning is needed to provide Californians with affordable, high quality options for housing and mobility that will result in reduced greenhouse gas emissions, and that the greenhouse gas reductions associated with more sustainable growth will increase over time.

BE IT FURTHER RESOLVED that the Board recognizes that the technical work of the SB 375 Regional Targets Advisory Committee (RTAC) is critical to building a solid foundation for Board consideration of regional targets.

BE IT FURTHER RESOLVED that as input to the SB 375 target setting process, the RTAC should recommend a method to evaluate the full potential for reducing greenhouse gas emissions in each major region of the state, and statewide, using improved land use patterns, indirect source rules, enhanced bike, walk, and transit infrastructure, and pricing policies where applicable (including congestion, toll, and parking pricing). This evaluation should be done for 2020 and 2035, employ the best available data and models, and identify barriers to achieving this full potential.

BE IT FURTHER RESOLVED that it is the Board's intent that the greenhouse gas emission reductions associated with the SB 375 regional targets represent the most ambitious achievable targets. The estimated reductions in the Scoping Plan will be adjusted to reflect the outcome of the Board's decision on SB 375 targets.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to solicit input from experts to advise ARB on its continuing evaluation of the economic effects of implementing AB 32, including identification of additional models or other economic analysis tools that could be used in the ongoing economic analysis. This will include opportunities for interested parties to share their economic modeling results.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to consider the effects of the program on the overall California economy as staff develops the cap-and-trade regulations and to take into account the joint opinion adopted by the PUC and the CEC on October 17, 2008, while recognizing that the joint opinion was developed based on consideration of the electricity and natural gas sectors, and that the recommendations in the opinion may need to be adapted to meet the needs of the California economy as a whole.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to solicit expert input on key questions related to the distribution or auction of allowances and the use of revenue.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer, as part of the cap-and-trade rulemaking, to consider the economic implications of different cap-and-trade program design options, including:

- various scenarios for allowance distribution (percent auction vs. free distribution, method of distribution);
- various scenarios for the use of auction revenue;
- the initial cap level and the rate of decline of the cap over time;
- the potential supply of offsets within and outside California; and

- the economic and co-benefit effects of limits on the use of offsets.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to coordinate the economic analysis of California's AB 32 program with the analysis conducted for the Western Climate Initiative.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to work with California small businesses during the development of Scoping Plan regulations, to consider the size of the business and type of industry in developing the regulations, and to identify financing programs that could help alleviate costs to small businesses.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to work with the CEC, the PUC and other agencies, as appropriate, to ensure that California's energy demands are met, and that the Scoping Plan and AB 32 are implemented in a manner to avoid disproportionate geographic impacts on energy rates.

BE IT FURTHER RESOLVED that the Board is committed to a cap-and-trade program as an important component of California's comprehensive program to achieve greenhouse gas reductions.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to consider the economic and public health impacts of proposed regulations to implement the Scoping Plan, as well as the requirements of section 38562(b) and 38570(b), as appropriate. For sector-specific regulations affecting sources that are also included in the cap-and-trade program, the staff shall also propose findings to identify the reasons that the emission reductions are best achieved using the proposed regulatory approach.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer, by December 31, 2009, to examine and report on:

- estimates of overall costs and savings and the cost-effectiveness of the reductions, including appropriate inclusion of reductions in co-pollutants;
- estimates of the timing of capital investments, annual expenditures to repay those investments, and the resulting cost savings;
- sensitivity of the results to changes in key inputs, including energy price forecasts and estimates of measure costs and savings; and
- impacts on small businesses.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to update the Board on the public health impacts of climate change as well as the impacts of potential measures that may be taken to mitigate climate change.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to report on the status of the Early Action Measures.

BE IT FURTHER RESOLVED that the Board, in coordination with California Environmental Protection Agency and other state agencies, will take responsibility for the tracking of Scoping Plan implementation and the development of accounting systems to promote consistency and avoid double counting of emission reductions, especially across sectors, to ensure achievement of the AB 32 goals.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to report on the status of Scoping Plan implementation to the Board twice a year.

I hereby certify that the above is a true and correct copy of Resolution 08-47, as adopted by the Air Resources Board.

Monica Vejar

Monica Vejar, Clerk of the Board

Exhibit C

Exhibit C

EDMUND G. BROWN JR.
Attorney General

State of California
DEPARTMENT OF JUSTICE

1515 CLAY STREET, 20TH FLOOR
P.O. BOX 70550
OAKLAND, CA 94612-0550

Public: (510) 622-2100
Telephone: (510) 622-2260
Facsimile: (510) 622-2121
E-Mail: Cliff.Rechtschaffen@doj.ca.gov

December 21, 2009

Dave Warner
Director of Permit Services
San Joaquin Valley Air Pollution Control District
1990 East Gettysburg Ave.
Fresno, CA 93726-0244

Re: District Policy And Guidance Document For Addressing GHG Emission Impacts under CEQA; Governing Board Meeting on Dec 17, 2009

Dear Mr. Warner:

I am writing concerning the Governing Board's meeting on December 17, 2009 at which the Board approved the District's Policy and Guidance documents for addressing Greenhouse Gas Impacts under the California Environmental Quality Act. We observed during the webcast of the Governing Board's meeting that certain representations were made by the District about our office's position on the policy, including our position in light of additions made to the policy by the District subsequent to the Board's November 5, 2009 meeting. I am writing to make clear that the Attorney General's position on the District's policy and guidance document is reflected in our November 4, 2009 letter (copy attached), and that our position has not changed since then.

Sincerely,

/s/

CLIFFORD L. RECHTSCHAFFEN
Special Assistant Attorney General

For EDMUND G. BROWN JR.
Attorney General

Attachment

Cc: Seyed Sadredin, Executive Director (w/o attachment)

EDMUND G. BROWN JR.
Attorney General

State of California
DEPARTMENT OF JUSTICE

1515 CLAY STREET, 20TH FLOOR
P.O. BOX 70550
OAKLAND, CA 94612-0550

Public: (510) 622-2100
Telephone: (510) 622-4038
Facsimile: (510) 622-2270
E-Mail: Timothy.Sullivan@doj.ca.gov

November 4, 2009

VIA E-MAIL & U.S. MAIL

Dave Warner
Director of Permit Services
San Joaquin Valley Air Pollution Control District
1990 East Gettysburg Ave.
Fresno, CA 93726-0244

RE: Final Draft Staff Report on Greenhouse Gas Emissions Under CEQA

Dear Mr. Warner:

We have reviewed the San Joaquin Valley Air Pollution Control District's September 17, 2009, Final Draft Staff Report on "Addressing Greenhouse Gas Emissions Under the California Environmental Quality Act."[1] We appreciate the Air District's extensive efforts and leadership in this area.[2] We are concerned, however, that the approaches suggested in the Staff Report will not withstand legal scrutiny and may result in significant lost opportunities for the Air District and local governments to require mitigation of greenhouse gas (GHG) emissions.

The Staff Report sets out a proposed threshold of significance for GHG emissions for stationary source projects under the Air District's permitting authority. A threshold of significance is, in effect, a working definition of significance to be applied on a project-by-project basis that can help a lead agency determine which projects normally will be determined to be less than significant, and which normally will be determined to be significant.[3] In the context of GHG emissions, the relevant question is whether the project's emissions, when considered in conjunction with the emissions of past, current, and probable future projects, are

[1] The Attorney General submits these comments pursuant to his independent power and duty to protect the natural resources of the State. (See Cal. Const., art. V., § 13; Cal. Gov. Code, §§ 12511, 12600-12612; *D'Amico v. Board of Medical Examiners* (1974) 11 Cal.3d 1, 14-15.)
[2] The Staff Report states that "[n]o state agency has provided substantial and helpful guidance on how to adequately address GHG emissions under CEQA, nor has there been guidance on how to determine if such impacts are significant." (Report at p. 2.) In fact, there are numerous sources of guidance, including information on the Attorney General's website (http://ag.ca.gov/globalwarming/ceqa.php), a Technical Advisory issued by the Governor's Office of Planning and Research (http://opr.ca.gov/ceqa/pdfs/june08-ceqa.pdf); and the Resources Agency's proposed CEQA Guidelines amendments (http://ceres.ca.gov/ceqa/guidelines/), which is accompanied by a detailed, 78-page Initial Statement of Reasons (http://ceres.ca.gov/ceqa/docs/Initial_Statement_of_Reasons.pdf).
[3] Cal. Code Regs., tit. 14, § 15064.7, subd. (a).

cumulatively considerable.[4] Thresholds can be a useful interim tool until cities and counties have in place programmatic approaches, e.g., Climate Action Plans, which allow local government to consider a wide variety of mitigation opportunities and can substantially streamline the CEQA process for individual projects.[5] Staff's proposed stationary source GHG threshold relies on implementation of GHG emission control technologies. Under this proposal, projects that implement currently unspecified GHG Best Performance Standards ("BPS") would be deemed to not have significant impacts, regardless of the total amount of GHGs emitted.

The Staff Report also recommends a threshold of significance for cities and counties to use in determining whether a development or transportation project's GHG emissions are significant under CEQA. Like the stationary source threshold, this threshold would also rely on performance measures that are not currently identified. BPS for these projects would be any combination of identified GHG reduction measures that reduce project-specific GHG emission by at least 29 percent as compared to "business as usual," as calculated based on a point system to be developed in the future by the Air District.

The Staff Report contains a useful analysis of possible GHG mitigation measures for a variety of stationary sources and for development and transportation projects. This discussion will certainly assist lead agencies and project proponents in considering what mitigation measures currently are available and should be considered. It is not clear to us, however, how much additional analysis the Air District plans to do to support the proposed CEQA thresholds of significance recommended in the Staff Report. A public agency proposing to adopt a CEQA threshold of significance should be able to answer at least the following questions about its proposed approach:

What defined, relevant environmental objective is the threshold designed to meet, and what evidence supports selection of that objective?

The Staff Report does not discuss a particular environmental objective that would be achieved by implementing the proposed thresholds, such as meeting a GHG emissions reduction trajectory consistent with that set forth in AB 32 and Executive Order S-03-05 within the Air District's jurisdiction.[6] It appears that the Air District has not yet determined what amount of

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[4] Cal. Code Regs., tit. 14, § 15064, subd. (h)(1); see also Initial Statement of Reasons at p. 17 ("Due to the global nature of GHG emissions and their potential effects, GHG emissions will typically be addressed in a cumulative impacts analysis.")

[5] See Proposed Cal. Code Regs., tit. 14, § 15183.5, subd. (b) (describing tiering and streamlining available under "Plans for the Reduction of Greenhouse Gas Emissions"), available at http://ceres.ca.gov/ceqa/docs/FINAL_Text_of_Proposed_Amendemts.pdf; Draft Initial Statement of Reasons (discussing proposed § 15183.5) , available at http://ceres.ca.gov/ceqa/docs/Initial_Statement_of_Reasons.pdf#page=56; see also See Attorney General's General Plan/CEQA Frequently Asked Questions, available at http://ag.ca.gov/globalwarming/pdf/CEQA_GP_FAQs.pdf.

[6] Pursuant to these mandates, California is committed to reducing GHG emissions to 1990 levels by 2020, and to 80 percent below 1990 levels by 2050. These objectives are consistent with the underlying environmental objective of stabilizing atmospheric concentrations of greenhouse gases at a level that will substantially reduce the risk of dangerous climate change. (See AB 32 Scoping Plan at p. 4 ["The 2020 goal was established to be an aggressive,

GHG reduction it is aiming to achieve. Setting a relevant environmental objective is an essential step in establishing any legally defensible threshold of significance; without it, there is nothing against which to gauge the success of the threshold in operation.

What is the evidence that adopting the threshold will meet this objective?

Because the BPS discussed in the Staff Report are described as "illustrative" only, it is not possible at this time to determine whether the BPS ultimately adopted will reduce GHG emissions in the San Joaquin Valley and, if so, by how much. There is no stated commitment to tie BPS proposed in the future to regional GHG reduction objectives.

How does the threshold take into account the presumptive need for new development to be more GHG-efficient than existing development?

The Staff Report seems to assume that if new development projects reduce emissions by 29 percent compared to "business as usual," the 2020 statewide target of 29 percent below "business as usual" will also be achieved, but it does not supply evidence of this. Indeed, it seems that new development must be more GHG-efficient than this average, given that past and current sources of emissions, which are substantially less efficient than this average, will continue to exist and emit.[7]

Will the threshold routinely require new projects to consider mitigation beyond what is already required by law?

Because "business as usual" for a development project is defined by the Staff Report as what was typically done in similar projects in the 2002-2004 timeframe, and requirements affecting GHG emissions have advanced substantially since that date, it appears that the Air District's proposal would award emission reduction "points" for undertaking mitigation measures that are already required by local or state law.[8]

Similarly, we are concerned that project proponents could "game" the system. Under the current proposal, each project will be considered against a hypothetical project that could have been built on the site in the 2002-2004 time period. It is not clear why the project should be compared against a hypothetical project if that hypothetical project could not legally be built

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but achievable, mid-term target, and the 2050 greenhouse gas emissions reduction goal represents the level scientists believe is necessary to reach levels that will stabilize climate."])

[7] We note that CAPCOA expressly found that an approach that would rely on 28 to 33 percent reductions from BAU would have a "low" GHG emissions reduction effectiveness. CAPCOA, CEQA and Climate Change (Jan. 2008) at p. 56, available at http://www.capcoa.org/CEQA/CAPCOA%20White%20Paper.pdf.

[8] To take one important example, Title 24 has undergone two updates since 2002-2004 – in 2005 and 2008. The 2008 Title 24 standards are approximately 15 percent more stringent that the 2005 version. In addition, a significant number of local governments have adopted green building ordinances that go beyond Title 24 in just the past few years, and many more are considering adopting such ordinances as part of their Climate Action Plans. See http://ag.ca.gov/globalwarming/pdf/green_building.pdf.

today,[9] and the approach would appear to offer an incentive to project proponents to artificially inflate the hypothetical project to show that the proposed project is, by comparison, GHG-efficient.[10]

Will operation of the threshold allow projects with large total GHG emissions to avoid environmental review? What evidence supports such a result?

It appears that any project employing certain, as of yet unidentified, mitigation measures would be considered to not be significant, regardless of the project's total GHG emissions, which could be very large. For instance, under the Air District's proposal, it would appear that even a new development on the scale of a small city would be considered to not have a significant GHG impact and would not have to undertake further mitigation, provided it employs the specified energy efficiency and transportation measures. This would be true even if the new development emitted hundreds of thousands of tons of GHG each year, and even though other feasible measures might exist to reduce those impacts.[11] The Staff Report has not supplied scientific or quantitative support for the conclusion that such a large-emitting project, even if it earned 29 "points," would not have a significant effect on the environment.

Will the threshold benefit lead agencies in their determinations of significance?

For the reasons set forth above, we fear that the recommended approach in its current form may unnecessarily subject lead agencies that follow them to CEQA litigation. This would be detrimental not only to the lead agencies, but to the many project proponents who may face unnecessary delay and legal uncertainty.[12]

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[9] The appropriate baseline under CEQA is not a hypothetical future project, but rather existing physical conditions. (Cal. Code Regs., tit. 14, § 15126.2, subd. (a).)

[10] A detailed analysis of the proposed amendments to Rule 2301 (emissions reduction credit banking) is beyond the scope of this letter. It is important, however, that any such plan comply with CEQA's requirements for additionality. As the most recent draft of the proposed CEQA Guidelines notes, only "[r]eductions in emissions that are not otherwise required may constitute mitigation pursuant to this subdivision." Proposed Cal. Code Regs., tit. 14, § 15126.4, subd. (c), available at http://ceres.ca.gov/ceqa/docs/Text_of_Proposed_Changes.pdf.

[11] In the advance of a programmatic approach to addressing GHG emissions, lead agencies must examine even GHG-efficient projects with some scrutiny where total emissions are large. Once a programmatic approach is in place, the lead agency will be able to determine whether even a larger-emitting project is, or is not, consistent with the lead agency's overall strategy for reducing GHG emissions. If it is, the lead agency may be able to determine that its incremental contribution to climate change is not cumulatively considerable.

[12] The Staff Report states that "[l]ocal land-use agencies are facing increasing difficulties in addressing GHG emissions in their efforts to comply with CEQA." (Report at p. 2.) We strongly believe that this experience is not universal. In fact, many cities and counties are actively taking up their role as "essential partners" in addressing climate change (see AB 32 Scoping Plan at p. 26) by making commitments to develop local Climate Action Plans.

We support staff's continued work in this area. However, before formally endorsing or adopting any particular threshold, we recommend that the Air District consider the issues that we have raised in this letter; if warranted, evaluate the approaches currently under consideration by other districts; and, if possible, work with those districts to devise approaches that are complementary and serve CEQA's objectives.

Sincerely,

/ s /

TIMOTHY E. SULLIVAN
Deputy Attorney General

For EDMUND G. BROWN JR.
Attorney General

Exhibit D

Exhibit D

CALIFORNIA NATURAL RESOURCES AGENCY

FINAL STATEMENT OF REASONS FOR REGULATORY ACTION

Amendments to the State CEQA Guidelines Addressing Analysis and Mitigation of Greenhouse Gas Emissions Pursuant to SB97

December 2009

CALIFORNIA NATURAL RESOURCES AGENCY
FINAL STATEMENT OF REASONS FOR REGULATORY ACTION

December 2009

INTRODUCTION

The California Natural Resources Agency ("the Resources Agency") has adopted certain amendments and additions to certain guidelines implementing the California Environmental Quality Act (Public Resources Code section 21000 *et seq.*) ("CEQA"). Specifically, these amendments implement the Legislature's directive in Public Resources Code section 21083.05 (enacted as part of SB97 (Chapter 185, Statutes 2007)). That section directs the Resources Agency to "certify and adopt guidelines prepared and developed by the Office of Planning and Research" "for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions[.]" (Pub. Resources Code, § 21083.05(a)-(b).)

CEQA generally requires public agencies to review the environmental impacts of proposed projects, and, if those impacts may be significant, to consider feasible alternatives and mitigation measures that would substantially reduce significant adverse environmental effects. Section 21083 of the Public Resources Code requires the adoption of guidelines to provide public agencies and members of the public with guidance about the procedures and criteria for implementing CEQA. The guidelines required by section 21083 of the Public Resources Code are promulgated in the California Code of Regulations, title 14, sections 15000-15387 (the "Guidelines" or "State CEQA Guidelines"). Public agencies, project proponents, and third parties who wish to enforce the requirements of CEQA, rely on the Guidelines to provide a comprehensive guide on compliance with CEQA. Subdivision (f) of section 21083 requires the Resources Agency, in consultation with the Office of Planning and Research ("OPR"), to certify, adopt and amend the Guidelines at least once every two years.

Section 21083.05, as noted above, requires the promulgation of Guidelines specifically addressing analysis and mitigation of the effects of greenhouse gas emissions. The Resources Agency has adopted the following changes to the Guidelines ("Amendments") to implement that directive:

Add sections: 15064.4, 15183.5 and 15364.5.

Amend sections: 15064, 15064.7, 15065, 15086, 15093, 15125, 15126.2, 15126.4, 15130, 15150, 15183, Appendix F and Appendix G.

In addition to guidelines implementing SB97, some of the amendments listed above are non-substantive corrections.

The Resources Agency considered reasonable alternatives to the Amendments. The Resources Agency has determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 and to update the Guidelines to reflect recent case law. Thus, the Amendments add no additional substantive requirements; rather, the Guidelines merely assist lead agencies in complying with CEQA's existing requirements. The Resources Agency rejected the no action alternative because it would not respond to the Legislature's directive in SB97. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts are due to existing requirements of CEQA and not the Amendments.

The Resources Agency also initially determined that the Amendments would not have a significant adverse economic impact on business. The Resources Agency has determined that this action would have no impacts on project proponents. However, the Resources Agency is aware that certain of the statutory changes enacted by the Legislature and judicial decisions, described in greater detail below, that are reflected in the Amendments could have an economic impact on project proponents, including businesses. Among other things, project proponents could incur additional costs in assisting lead agencies to comply with CEQA's requirement for analysis of greenhouse gas emissions. However, the Amendments to the Guidelines merely reflect these legislative and judicial requirements, and the Resources Agency knows of no less costly alternative. The Amendments clarify and update the Guidelines to be consistent with legislative enactments that have modified CEQA, and recent case law interpreting it, but does not impose any new requirements. Therefore, the Amendments would not have a significant, adverse economic impact on business.

Some comments were submitted during the public comment period and during the public hearings on the Proposed Amendments suggesting that the adverse economic impacts could result. For example, some suggested that the addition of forestry resources to the Appendix G checklist may increase the regulatory burden on the agricultural industry. Others suggested that application of the Guidelines to renewable energy projects or those implementing AB32 may be counterproductive. Despite those suggestions, no evidence was presented to the Resources Agency supporting those claims. Moreover, those comments did not provide any rationale challenging the Resources Agency's position that the Proposed Amendments implement existing requirements. Therefore, having considered all of the comments submitted on the Proposed Amendments, the Resources Agency concludes that its initial determination that the proposed action will not have a significant adverse economic impact remains correct.

The Amendments do not duplicate or conflict with any federal statutes or regulations. CEQA is similar in some respects to the National Environmental Policy Act ("NEPA"), 42 U.S.C. sections 4321-4343. Federal agencies are subject to NEPA, which requires environmental review of federal actions. State and local agencies are subject to CEQA, which requires environmental review before state and local agencies may approve or decide to undertake discretionary actions and projects in California. Although both NEPA and CEQA require an analysis of environmental impacts, the substantive and procedural requirements of the two statutes differ. Most significantly, CEQA requirements for feasible mitigation of environmental impacts exceed NEPA's mitigation provisions. A state or local agency must complete a CEQA review even for those projects for which NEPA review is also applicable, although Guidelines sections 15220-15229 allow state, local and federal agencies to coordinate review when projects are subject to both CEQA and NEPA. Because state and local agencies are subject to CEQA unless exemptions apply, and because CEQA and NEPA are not identical, guidelines for CEQA are necessary to interpret and make specific provisions of SB97 and do not duplicate the Code of Federal Regulations.

FINAL STATEMENT OF REASONS

The Administrative Procedure Act requires that an agency prepare a final statement of reasons supporting its proposed regulation. The final statement of reasons updates the information contained in the initial statement of reasons, contains final determinations as to the economic impact of the regulations, and provides summaries and responses to all comments regarding the proposed action. The initial statement of reasons, as updated and revised, are contained in full in this final statement of reasons. The summaries and responses to comments are included in the Natural Resources Agency's file of this rulemaking proceeding.

Below is a brief background on the science relating to the effects of greenhouse gas emissions, as well as the various initiatives that California is implementing to reduce those emissions. Following that background, OPR's public engagement process and the Natural Resources Agency's rulemaking process is briefly described. Next, this Final Statement of Reasons explains the purpose and necessity of each proposed change to the Guidelines. Finally, Thematic Responses, addressing the major themes that were raised in public comments, are provided.

BACKGROUND ON THE EFFECTS OF GREENHOUSE GAS EMISSIONS AND CALIFORNIA'S EFFORTS TO REDUCE THOSE EMISSIONS

This section provides a brief background on the potential effects of greenhouse gas emissions and California's efforts to reduce those emissions.

What Are Greenhouse Gases?

Certain gases in Earth's atmosphere naturally trap solar energy to maintain global average temperatures within a range suitable for terrestrial life. Those gases – which primarily include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride – act as a greenhouse on a global scale. (Health and Safety Code, § 38505(g).) Thus, those heat-trapping gases are known as greenhouse gases ("GHG").

The Legislature defined "greenhouse gases" to include the six gases mentioned above in California's Global Warming Solutions Act. (Health & Saf. Code, § 38500 et seq.) Similarly, the U.S. EPA has found that those same six gases could be regulated under the authority of the Clean Air Act. According to the U.S. EPA:

> (1) These six greenhouse gas share common properties regarding their climate effects; (2) these six greenhouse gases have been estimated to be the primary cause of human-induced climate change, are the best understood drivers of climate change, and are expected to remain the key driver of future climate change; (3) these six greenhouse gases are the common focus of climate change science research and policy analyses and discussions; [and] (4) using the combined mix of these gases as the definition (versus an individual gas-by-gas approach) is consistent with the science, because risks and impacts associated with greenhouse gas-induced climate change are not assessed on an individual gas approach….

(EPA, Endangerment Finding, 74 Fed. Reg. 66496, 66517 (December 15, 2009).) The United Nations Framework Convention on Climate Change also addresses these six gases. (*Id*. at p. 66519.)

<u>What Causes Greenhouse Gas Emissions?</u>

The incremental contributions of GHGs from innumerable direct and indirect sources result in elevated atmospheric GHG levels. (EPA, Draft Endangerment Finding, 74 Fed. Reg. 18886, 18904 (April 24, 2009) ("cumulative emissions are responsible for the cumulative change in the stock of concentrations in the atmosphere"); see also 74 Fed. Reg. 66496, 66538 (same in Final Endangerment Finding).) Some GHG emissions occur through natural processes such as plant decomposition and wildfires. One large source of GHG emissions, for example, is wildfire on forestlands and rangelands, which release carbon as a result of material being burned. (California Board of Forestry and Fire Protection, *2008 Strategic Plan and Report to the CARB on Meeting AB32 Forestry Sector Targets* (October, 2008), at p. 2.)

Human activities, such as motor vehicle use, energy production and land development, also result in both direct and indirect emissions that contribute to highly elevated concentrations of GHGs in the atmosphere. (California Energy Commission, *Inventory of California Emissions and Sinks: 1990 to 2004* (2006).)[1] Transportation

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[1] Multiple statewide emission inventories covering the same period of time may vary. This is largely due to inventories characterizing an emission source by sectors (e.g. agriculture, cement, transportation, etc.) which may not be treated the same depending on the methodology used and access to information. Thus,

alone is estimated to account for nearly 40 percent of California's GHG emissions. (California Air Resources Board, *Climate Change Proposed Scoping Plan* (2008), at p. 11 ("Scoping Plan"); California Energy Commission 2007, *2007 Integrated Energy Policy Report*, CEC-100-2007-008-CMF ("2007 IEPR") at p. 18, Figure 1-2.) Emissions attributable to transportation result largely from development that increases, rather than decreases, vehicle miles traveled: low density, unbalanced land uses separating jobs and housing, and a focus on single-occupancy vehicle travel. (California Energy Commission, The Role of Land Use In Meeting California's Energy and Climate Change Goals. (2007) at p. 9.) In approaching regulation of GHG emissions in California, for example, the California Air Resources Board ("ARB") proposes to regulate various economic sectors that are known to emit GHGs, including electric power, transportation, industrial sources, landfills, commercial and residential sectors, agriculture and forestry. (Scoping Plan, Appendix F.) With a growing population and economy, California's total GHG emissions continue to increase. As explained below, this rapid rate of increase in GHG emissions is causing a change in the composition of atmospheric gases that may cause life threatening adverse environmental consequences.

<u>What Effects May Result from Increased Greenhouse Gas Emissions?</u>

Several measurable effects, including, among others, an increase in global average temperatures have been attributed to increases in GHG emissions resulting from human activity. (Intergovernmental Panel on Climate Change, *Working Group 1 Report: The Physical Science Basis* (2001), at p. 101.) Evidence further indicates that a warmer planet may in turn lead to changes in rainfall patterns, a retreat of polar icecaps, a rise in sea level, and changes in ecosystems supporting human, animal and plant life. (U.S. Environmental Protection Agency, *Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act,* April 17, 2009 ("Technical Support Document"), at pp. ES-1 to ES-3.) Climate change is not the only effect of increased GHG emissions. Impacts to human health and ocean acidification are also attributed to increasing concentrations of GHGs in the Earth's atmosphere. (*Id*. at p. 57.)

Globally elevated concentrations of GHGs have been observed to induce a range of associated effects. For example, the effects of atmospheric warming include, but are not limited to, increased likelihood of more frequent and intense natural disasters, increased drought, and harm to agriculture, wildlife, and ecological systems. (Technical Support Document at pp. ES-1, ES-6.) According to a report prepared for the California Climate Change Center:

> Climate change is likely to affect the abundance, production, distribution, and quality of ecosystem services throughout the State of California

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two statewide emissions inventories may be different depending on the agency that created them or its intended application. The CARB is in the process of updating its statewide data and methodologies to be consistent with international and national guidelines. The typical emissions inventory covers 1990 to 2004.

> including the delivery of abundant and clean water supplies to support human consumption and wildlife, climate stabilization through carbon sequestration, the supply of fish for commercial and recreational sport fishing. For example, as described in this report, areas of the state suitable for forage production to support cattle grazing in natural areas could shift as some parts of the state become too dry to support forage and others become wetter. The ability of the State's forests to sequester carbon and support climate stabilization could be hindered as productivity decreases and fires increase. And increased water temperatures in streams due to a decrease in provision of fresh water could seriously reduce salmon reproduction and subsequently reduce the number of salmon available for commercial and recreational harvest. Also, areas of the state suitable for forage production to support cattle grazing in natural areas could shift as some parts of the state become too dry to support forage and others become wetter. All of these ecosystem services have economic value and that value and its distribution is likely to changes under a changing climate.

(Rebecca Shaw, et al., for the California Climate Change Center, *The Impact of Climate Change on California's Ecosystem Services*, March 2009, CEC-500-2009-025-D, at p. 1.)

The effects of increased GHG concentrations are already being felt in California. For example, global atmospheric changes are causing sea levels to rise. An increase of approximately 8 inches has been recorded at the Golden Gate Bridge over the past 100 years. Such sea level rise threatens low coastal areas with inundation and increased erosion. (Scoping Plan, at p. 10.)

While sea levels continue to rise, the Sierra snowpack has been shrinking. Average annual runoff from spring snowmelt has decreased 10% in the last 100 years. Because snow in the Sierra acts as a reservoir, holding winter water for use later in the year, reduced snowpack creates greater potential for summer droughts and reduced hydroelectricity generation. (Office of Environmental Health and Hazard Assessment, April, 2009, Indicators of Climate Change in California, at p. 76.) Climate change is also thought to account for changes in the timing of California's major precipitation events. As explained in a report prepared for the California Climate Change Center:

> reservoirs were designed to store only a fraction of the state's entire yearly precipitation, under the assumption that the annual mountain snowpack would melt at roughly the same time every year. During anomalously high rain or snowmelt events, reservoirs must not only store water, but also discharge excess water to avoid flooding. Water must sometimes be discharged in anticipation of large events to reduce flood risk. The dual functions of storage and flood management require reservoir managers to carefully balance factors such as precipitation, snowmelt timing, reservoir storage capacity, and demand. Even if future precipitation remains

> unchanged, shifts in snowmelt timing can affect California's water supply during the warm season due to reservoir storage capacity constraints.

(Sarah Kapnick and Alex Hall, for the California Climate Change Center, *Observed Changes in the Sierra Nevada Snowpack: Potential Causes and Concerns*, March 2009, CEC-500-2009-016-D, at p. 1.)

Climate change is also expected to increase the number and intensity of forest fires. (Technical Support Document, at p. 91; *see also* Indicators of Climate Change (2009) at p. 131.) A generally warmer climate is associated with a longer summer season, which in turn dries vegetation and fuels making ignition easier and hastens wildfire spread. (*Ibid*; see also A. L. Westerling, for the California Climate Change Center*, Climate Change, Growth and California Wildfire*, March 2009, CEC-500-2009-046-D, at pp. 1-2.) Not only do wildfires release additional carbon and increase air pollutants, but they also cause indirect effects. For example, wildfires reduce vegetative cover leading to increased water runoff, which has affected watersheds and dampens the effectiveness of California's water works infrastructure. This will degrade California's water quality and challenge water treatment operations to provide safe drinking water. Adverse health impacts from heat-related illnesses are expected with hotter temperatures, and, due to poorer air quality, lung disease, asthma, and other respiratory and circulatory problems will be exacerbated. (California Climate Action Team, Executive Summary Report to Governor Schwarzenegger and the California Legislature (2006) at pp. xii to xiii, 27.); see also Technical Support Document, at pp. ES-4, 69-71.)

<u>Why is California Involved in Greenhouse Gas Regulation?</u>

California is vulnerable to the effects of global warming, and, despite its global nature, action to curb GHG emissions is needed on a statewide level. The legislative findings in Assembly Bill 32 (Chapter 448, Statutes 2006) ("AB32"), for example, state:

> … Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California. The potential adverse impacts of global warming include the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other human health-related problems.
>
> … Global warming will have detrimental effects on some of California's largest industries, including agriculture, wine, tourism, skiing, recreational and commercial fishing, and forestry. It will also increase the strain on electricity supplies necessary to meet the demand for summer air-conditioning in the hottest parts of the state.

(Health & Safety Code, § 38501(a), (b).) The Legislature further declared: "action taken by California to reduce emissions of greenhouse gases will have far-reaching effects by encouraging other states, the federal government, and other countries to act." (*Id*. at subd. (d).) As the world's fifteenth largest emitter of GHGs from human activity and natural sources, California is uniquely positioned to act to reduce GHGs. (Scoping Plan, at pp. 11.)

Reducing greenhouse gas emissions is a necessary response to the threats posed by climate change. Efforts to reduce emissions may result in other significant benefits as well. Governor Schwarzenegger laid out the case for action to reduce greenhouse gas emissions in Executive Order S-3-05:

> … California-based companies and companies with significant activities in California have taken leadership roles by reducing greenhouse gas (GHG) emissions, including carbon dioxide, methane, nitrous oxide and hydrofluorocarbons, related to their operations and developing products that will reduce GHG emissions; …
>
> … [C]ompanies that have reduced GHG emissions by 25 percent to 70 percent have lowered operating costs and increased profits by billions of dollars; …
>
> … [T]echnologies that reduce greenhouse gas emissions are increasingly in demand in the worldwide marketplace, and California companies investing in these technologies are well-positioned to profit from this demand, thereby boosting California's economy, creating more jobs and providing increased tax revenue; …
>
> … [M]any of the technologies that reduce greenhouse gas emissions also generate operating cost savings to consumers who spend a portion of the savings across a variety of sectors of the economy; this increased spending creates jobs and an overall benefit to the statewide economy.

Thus, the Governor, Legislature and private sector have concluded that action to reduce greenhouse gas emissions is necessary and beneficial for the State.

<u>What is California Doing to Reduce its Greenhouse Gas Emissions?</u>

Action to curb greenhouse gas emissions is taking place on many fronts. As described above, the private sector has already taken important steps to increase efficiency and lower costs associated with such emissions. Many local governments have also adopted, or are currently developing, various plans and programs designed to reduce community-wide GHG emissions. (Office of Planning and Research, *The California Planner's Book of Lists* (January 2009) ("Book of Lists"), at pp. 92-100; see also Scoping Plan, at p. 26.) Due to its potential vulnerability to the effects of GHG emissions, and the wide variety of GHG emissions sources within its borders, California has enacted several laws and programs designed to reduce the State's GHG emissions. Several major legislative initiatives are described below.

AB32 – The Global Warming Solutions Act

Assembly Bill 32 (Chapter 448, Statutes 2006) is a key piece of California's effort to reduce its GHG emissions. AB32 requires the California Air Resources Board ("ARB") to establish regulations designed to reduce California's GHG emissions to 1990 levels by 2020. (Health & Safety Code, § 38550.) On December 11, 2008, ARB adopted its Scoping Plan, setting forth a framework for future regulatory action on how California will achieve that goal through sector-by-sector regulation. (ARB, Resolution No. 08-47; see also Health & Safety Code, § 38561.) ARB must adopt, no later than January 1, 2012, rules and regulations to implement the GHG emissions reductions envisioned in the Scoping Plan. (Health & Safety Code, § 38562.)

The AB32 Scoping Plan outlines a set of actions designed to reduce overall GHG emissions in California to 1990 levels by 2020. The Scoping Plan presents GHG emission reduction strategies that combine regulatory approaches, voluntary measures, fees, policies, and programs. Reduction strategies are expected to evolve as technologies develop and progress toward the State's goal is monitored. Thus, the Scoping Plan sets forth the outline of California's strategy to reduce GHG emissions on a statewide basis.

SB375

As noted above, nearly 40 percent of California's GHG emissions come from the State's transportation sector. (Chapter 728, Statutes 2007, § 1(a).) Technology innovation and lower-carbon fuels alone will not reduce transportation-related emissions sufficiently for California to reach the reduction goals set out in AB32. (*Id*. at § 1(c).) Therefore, in SB375, California enacted several measures to reduce vehicular emissions through land-use planning.

Specifically, SB375 requires ARB to develop "greenhouse gas emission reduction targets for the automobile and light truck sector" for each metropolitan planning organization (MPO). (Gov. Code, § 65080(b)(2)(A).) Once that target is set, each MPO must develop a sustainable communities strategy (SCS), as part of its regional transportation plan, that will set forth a development pattern that will achieve the reduction target approved by the ARB. (*Id*. at subd. (b)(2)(B).) The MPO's transportation planning activities must be consistent with the adopted SCS. (*Id*. at subd. (b).) While an SCS does not supersede a local government's land use authority, SB375 created an exemption from CEQA for local transit-oriented residential projects that are consistent with the applicable SCS as an incentive. (*Id*. at subd. (b)(2)(J); Pub. Resources Code, § 21155.1.)

CEQA and SB97

While AB32 and SB375 target specific types of emissions from specific sectors, the California Environmental Quality Act ("CEQA") regulates nearly all governmental activities and approvals. CEQA generally requires that a lead agency analyze the potential adverse environmental impacts of their decisions, and, if those impacts are determined to be significant, to avoid those impacts through mitigation or project alternatives. As awareness of the causes and effects of GHG emissions has increased, those effects began to be addressed in environmental analyses on a project-level basis. Federal courts, moreover, have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Uncertainty developed, however, among public agencies regarding how GHG emissions should be analyzed in environmental documents prepared pursuant to CEQA.

To provide greater certainty to lead agencies, Governor Schwarzenegger signed Senate Bill 97 (Chapter 148, Statutes 2007). (Governor Schwarzenegger's Signing Message, SB 97.) That statute, among other things, constitutes the Legislature's recognition that GHG emissions and the effects of GHG emissions are appropriate subjects for CEQA analysis. Pursuant to SB97, OPR developed, and the Resources Agency will adopt, amendments to the State CEQA Guidelines to address analysis and mitigation of the potential effects of GHG emissions in CEQA documents and processes. As new information or criteria established by ARB in the AB 32 process becomes available, OPR and the Resources Agency will periodically update the CEQA Guidelines to account for that new information. This rulemaking package responds to the Legislature's directive in SB97.

Questions concerning the relationship between AB32, SB375 and CEQA were raised in public comments on the Proposed Amendments. The Resources Agency developed responses to those questions in the Responses to Comments, which are appended to this Final Statement of Reasons. Further discussion of the relationship between AB32, SB375 and CEQA is provided in the Thematic Responses at the end of this Final Statement of Reasons.

BACKGROUND ON THE DEVELOPMENT OF THE PROPOSED AMENDMENTS

OPR developed the Proposed Amendments pursuant to Public Resources Code section 21083.05, which states in part:

> On or before July 1, 2009, the Office of Planning and Research shall prepare, develop, and transmit to the Resources Agency guidelines for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions as required by this division, including, but not limited to, effects associated with transportation or energy consumption.

In developing the Proposed Amendments, OPR actively sought the input, advice, and assistance of numerous interested parties and stakeholder groups. (Letter from OPR Director, Cynthia Bryant, to Secretary for the Natural Resources Agency, Mike Chrisman, April 13, 2009.) Specifically, OPR met with representatives of numerous agencies and organizations to discuss the perspectives of the business community, the environmental community, local governments, non-governmental organizations, state agencies, public health officials, CEQA practitioners and legal experts. In addition, OPR took advantage of numerous regional and statewide conferences to raise awareness about CEQA and GHG emissions among diverse audiences and to seek their input. These activities satisfy the provisions of Government Code section 11346.45 which require early public involvement in complex proposals.

After publishing a preliminary draft, on January 8, 2009, OPR continued to conduct extensive public outreach, including two public workshops, to receive input on the Preliminary Amendments. Both public workshops were well attended, drawing over two hundred participants representing various California business interests, environmental organizations, local governments, attorneys and consultants. In addition to oral comments at its workshops, OPR received over eighty written comment letters.

Some comments suggested additional amendments to the CEQA Guidelines. Other comments sought clarification of the language in the preliminary amendments. OPR incorporated those suggestions and clarifications to the extent possible and appropriate into its April 13, 2009, submittal to the Resources Agency. Some suggestions were not appropriate for inclusion, however, due to conflict with existing statutory authority and/or case law. For example, some comments submitted to OPR during its public workshops indicated that the Guidelines should be addressed to "Climate Change" rather than just the effects of GHG emissions. The focus in the Guidelines on GHG emissions is appropriate for at least three reasons.

First, the Legislative authorization for the Proposed Amendments refers specifically to guidelines on the "mitigation of greenhouse gas emissions and the effects of greenhouse gas emissions." (Pub. Resources Code, § 21083.05.) Had the Legislature intended the Guidelines to address climate change or global warming specifically, it presumably would have so indicated. Second, the precise "effect" of GHG emissions from a project is a factual matter for the lead agency to determine. Such effects may include "climate change," "global warming" and other changes in the physical environment (increased ocean acidity or sea-level rise, for example). (EPA, Draft Endangerment Finding, 74 Fed. Reg. 18886 (April 24, 2009), Technical Support Document, at pp. ES-2 to ES-3; see further discussion at pages 4-5, above.) Thus, rather than limit analysis to a particular effect, the proposed Guidelines on GHG emissions are consistent with the treatment of air pollutants in the existing Appendix G, which focus largely on the concentration of pollutants. (See, e.g., existing State CEQA Guidelines, Appendix G, III.d.) Third, the focus in a cumulative impacts analysis is "whether any additional effect caused by the proposed project should be considered significant given the existing cumulative effect." (*CBE*, *supra*, 103 Cal. App. 4th at 118.)

Thus, the Proposed Amendments appropriately focus on a project's potential incremental contribution of GHGs rather than on the potential effect itself (i.e., climate change). Notably, however, the Proposed Amendments expressly incorporate the fair argument standard. (See, e.g., proposed Section 15064.4(b)(3).) Thus, if there is any substantial evidence supporting a fair argument that a project's GHG emissions may result in any adverse impacts, including climate change, the lead agency must resolve that concern in an EIR.

THE NATURAL RESOURCES AGENCY'S RULEMAKING PROCESS

The Natural Resources Agency commenced the rulemaking process on the Amendments on July 3, 2009, by publishing its Notice of Proposed Action in the California Regulatory Notice Register. (2009 No. 27-Z.) In addition, the Notice of Proposed Action was mailed to over 640 interested parties, and notices were e-mailed to those parties that requested electronic notification. The Natural Resources Agency also posted the Notice, Proposed Text and Initial Statement of Reasons on its website, and invited public comments on the proposed amendments between July 3, 2009, and August 20, 2009. Public hearings were held on August 18, 2009, and August 20, 2009, in Los Angeles and Sacramento, respectively, at which verbal and written comments and presentations were accepted. To ensure that all interested parties were able to provide written comments if they so chose, the Natural Resources Agency extended the public comment period to August 27, 2009. The Natural Resources Agency received over 80 comment letters on the proposed amendments.

Following review of all public comments received during the public review period and at the public hearings, the Natural Resources Agency determined that further revisions to the proposed text were appropriate. It, therefore, mailed a Notice of Proposed Changes to all hearing attendees and all persons that requested notice. Electronic notices were e-mailed to those requesting such notification. The Notice of Proposed Changes, Revised Text of the proposed amendments, comment letters, and all prior rulemaking documents were posted on the Natural Resources Agency's website. Since all revisions to the proposed amendments were sufficiently related to the originally noticed text, public comment was invited between October 23, 2009, and November 10, 2009. The Natural Resources Agency received over 20 comment letters on the revisions to the proposed amendments.

Following the close of the second public comment period, the Natural Resources Agency reviewed and considered all written comments. The Secretary for Natural Resources determined that, other than two non-substantive, clarifying changes in sections 15126.2(a) and 15126.4(c), described below, no further revisions to the proposed amendments was necessary. Secretary Mike Chrisman adopted the amendments described in this Final Statement of Reasons in December 2009.

Throughout the rulemaking process, staff of the Natural Resources Agency met with all interested parties requesting in person meetings. It also attended and presented at various conferences hosted by, among others, the California Chapter of the American Planning Association, the California State Bar's Environmental Law Conference, County Counsels Association of California, several county bar association meetings and local government forums to provide updates on the proposed amendments and to ensure widespread participation in the Natural Resources Agency's rulemaking process.

Copies of all relevant rulemaking documents, including hearing transcripts, notices, and agendas, are included in the record of proceedings.

ADOPTED AMENDMENTS

Analysis of GHG emissions in a CEQA document presents unique challenges to lead agencies. Such analysis must be consistent with existing CEQA principles, however. Therefore, the Amendments comprise relatively modest changes to various portions of the existing CEQA Guidelines. Modifications address those issues where analysis of GHG emissions may differ in some respects from more traditional CEQA analysis. Other modifications clarify existing law that may apply both to analysis of GHG emissions as well as more traditional CEQA analyses. The incremental approach in the Amendments is consistent with Public Resources Code section 21083(f), which directs OPR and the Resources Agency to regularly review the Guidelines and propose amendments as necessary.

The Legislature expressly left development of the Guidelines to the discretion of OPR and the Resources Agency. That discretion is governed by the Government Code, which requires that any administrative regulations be consistent, and not conflict, with existing statutory authority. (Gov. Code, § 11342.2.) Thus, the Resources Agency intends, as did OPR, the Amendments to incorporate existing law, and where necessary "to implement, interpret, make specific or otherwise carry out the provisions of the statute." (*Ibid*.) In addition, the Guidelines must be "reasonably necessary" to carry out a legislative directive. (*Ibid*.) Because the determination of "reasonable necessity" implicates an agency's expertise, courts will defer to an agency's findings of necessity unless the action is arbitrary, capricious or without reasonable basis. (*Communities for a Better Environment v. California Resources Agency* (2002) 103 Cal.App.4th 98, 109 ("*CBE*").)

The Amendments include changes to or additions of fourteen sections of the existing Guidelines, as well as changes to Appendices F (Energy Conservation) and G (Environmental Checklist Form). The Amendments are discussed below.

SECTION 15064. DETERMINING THE SIGNIFICANCE OF THE ENVIRONMENTAL EFFECTS CAUSED BY A PROJECT.

Specific Purposes of the Amendment

Amendments are proposed to two subdivisions of the existing section 15064. The first, to subdivision (f)(5), is a grammatical correction that qualifies as a "change without regulatory effect" pursuant to section 100(a)(4) of the Office of Administrative Law's regulations governing the rulemaking process. (Cal. Code Regs., tit. 1, § 100(a)(4).) The second set of amendments is to subdivision (h)(3). The latter amendments are described in detail below.

Cumulative Impacts

Existing subdivision (h)(3) allows an agency to find that a project's potential cumulative impacts are less than significant due to compliance with requirements in a plan or mitigation program. (*CBE, supra,* 103 Cal.App.4th at 111 ("a lead agency's use of existing environmental standards in determining the significance of a project's environmental impacts is an effective means of promoting consistency in significance determinations and integrating CEQA environmental review activities with other environmental program planning and regulation").) In effect, that section creates a rebuttable presumption that compliance with certain plans and regulations reduces a project's potential incremental contribution to a cumulative effect to a level that is not cumulatively considerable.

The existing Guidelines text includes several criteria that define which plans or programs may create such a presumption. To satisfy those criteria, a plan or program must: (1) have been previously approved, (2) contain specific requirements that avoid or substantially lessen the cumulative problem within a defined geographic area, and (3) be either specified in law or approved by a public agency with jurisdiction over affected resources. These criteria ensure that the presumption applies only where plans or programs have undergone public scrutiny and include binding requirements to address a cumulative problem. The existing text lists three types of plans as examples that may be relied upon for a cumulative analysis. The word "e.g." in the existing text indicates, however, that the list is not exclusive. The Third District Court of Appeal upheld what is now section 15064(h)(3) in the *CBE* decision. (*CBE*, *supra*, 103 Cal.App.4th at 115-116.)

Use of Plans and Regulations in a Cumulative Impacts Analysis

The Proposed Amendments include two changes to subdivision (h)(3). First, the Amendments would add several plans and regulations to the list of examples. The Proposed Amendments would add "habitat conservation plan, natural community conservation plan, [and] plans or regulations for the reduction of greenhouse gas emissions" to the list of plans and programs that may be considered in a cumulative impacts analysis. As explained below, the Resources Agency finds that the added plans and regulations satisfy the criteria in the existing text.

"Habitat conservation plans" are defined in the federal Endangered Species Act, and typically include specific requirements to protect listed species within a defined geographic area. (16 U.S.C. § 1539.) Though a habitat conservation plan ("HCP") may be prepared to address the impacts of one particular project, HCPs may also be, and often have been, prepared to address the impacts of cumulative development within a defined area. (Fish and Wildlife Service and National Marine Fisheries Service, Habitat Conservation Planning and Incidental Take Permit Processing Handbook (November 4, 1996), at pp. 1-6 to 1-7, 1-14 to 1-15.) Most HCPs, other than "low effect HCPs," will also likely need to undergo environmental review under the National Environmental Policy Act. (*Id*. at Ch. 5.) In such cases, an applicable HCP may appropriately be used in a cumulative impacts analysis as described in subdivision (h)(3).

"Natural community conservation plans" ("NCCPs") are defined in the California Natural Community Conservation Planning Act. (Fish & G. Code, §§ 2800 et seq.) The purpose of an NCCP is to conserve natural communities at the ecosystem scale while accommodating compatible land uses. An NCCP includes, among others, measures to avoid or minimize impacts to natural communities, conservation obligations, and compliance monitoring. An NCCP is adopted by the Department of Fish and Game as well as local agencies with land use authority in a defined area. As discretionary acts of public agencies, NCCPs must undergo environmental review pursuant to CEQA. Thus, NCCPs satisfy the criteria in existing subdivision (h)(3).

The Legislature recognized local GHG planning efforts in Health & Safety Code section 38561(c) by directing the California Air Resources Board (ARB) to consider such programs in developing its Scoping Plan. Greenhouse gas emission reduction plans are not currently specified in law. However, the ARB's Climate Change Scoping Plan includes a recommended reduction target for local governments and community-level emissions of 15 percent by 2020. (California Air Resources Board, *Climate Change Proposed Scoping Plan* (2008), at p. 27 ("Scoping Plan").) The Scoping Plan also recognized the important role local greenhouse gas reduction plans would play in achieving statewide reductions. The Scoping Plan itself suggests elements that such plans should include. (Scoping Plan, Appendix C, at p. C-49.)

Independent of the Scoping Plan, many local governments have adopted, or are currently developing, various plans and programs designed to curb GHG emissions. (Office of Planning and Research, *The California Planner's Book of Lists* (January 2009) ("Book of Lists"), at pp. 92-100; see also Scoping Plan, at p. 26.) Other public agencies, such as school districts and public universities, may also adopt greenhouse gas reduction plans to govern their own activities. Provided that such plans contain specific requirements with respect to resources that are within the agency's jurisdiction to avoid or substantially lessen the agency's contributions to GHG emissions, both from its own projects and from private projects it has approved or will approve, such plans may be appropriately relied on in a cumulative impacts analysis. Additional guidance regarding the characteristics of greenhouse gas reduction plans that may be used in this context is provided in the proposed Section 15183.5, and is explained in greater detail below. Thus, greenhouse gas reduction plans satisfying such criteria would satisfy the criteria in existing subdivision (h)(3).

Finally, requirements addressing a cumulative problem may also take the form of regulations. AB 32, for example, requires ARB to adopt regulations that achieve the maximum technologically feasible and cost effective GHG reductions to reach the adopted state-wide emissions limit. (Health & Safety Code, § 38560.) Pursuant to Health and Safety Code section 38560(b), ARB will adopt a first set of regulations by January 1, 2010. Thus, a lead agency may consider whether ARB's GHG reduction regulations satisfy the criteria in existing subdivision (h)(3).

While section 15064(h)(3) creates a presumption that, where a plan, program or regulation governs a project's GHG emissions, and the project complies with those requirements, those emissions are not cumulatively considerable. That presumption is rebuttable, however. The Proposed Amendments do not alter the standard, reflected in the existing Guidelines, that if substantial evidence supports a fair argument that, despite compliance with the requirements in a plan or program, a project may have a significant effect on the environment, then an EIR must be prepared.

<u>Demonstrating How the Plan, Program or Regulation Addresses Cumulative Impacts</u>

In addition to augmenting the list of plans, programs and regulations that give rise to the presumption that a project's contribution is not cumulatively considerable, the Amendments also contain explanatory language designed to ensure that the plan or regulation relied on in a cumulative impacts analysis actually addresses the cumulative effect of concern for the particular project under consideration. This language is necessary to avoid misapplication of subdivision (h)(3). For example, shortly after ARB identified early action items, some lead agencies determined that a project's contribution of GHG emissions was not cumulatively considerable because the project was not inconsistent with the early action items. (See, e.g., Tentative Ruling, San Bernardino County Superior Court Case Nos. 810232, 800607 (ruling that consistency with CAT Strategies alone does not provide sufficient information about the potential impacts of a project); see also California Environmental Protection Agency, *Climate Action Team Report to Governor Schwarzenegger and the Legislature*, March 2006, at pp. 39-63.) Such an analysis, however, would fail to account for emissions that are not addressed by the early action items. Because those early action items largely addressed industrial-type emissions, consistency with the early action items would have little relevance for a residential subdivision project. Likewise, consistency with plans that are purely aspirational (i.e., those that include only unenforceable goals without mandatory reduction measures), and provide no assurance that emissions within the area governed by the plan will actually address the cumulative problem, may not achieve the level of protection necessary to give rise to this subdivision's presumption. Thus, by requiring that lead agencies draw a link between the project and the specific provisions of a binding plan or regulation, section 15064(h)(3) would ensure that cumulative effects of the project are actually addressed by the plan or regulation in question.

Demonstrating that compliance with a plan addresses a cumulative problem is already impliedly required by CEQA. For example, an initial study must include sufficient information to support its conclusions. (State CEQA Guidelines, § 15063(d)(3).) Similarly, section 15128 requires a lead agency to explain briefly the reasons that an impact is determined to be less than significant and therefore was not analyzed in an EIR. The added sentence, therefore, reflects existing law and is necessary to ensure that plans are not misapplied in a CEQA analysis.

<u>Policy Goals</u>

Inclusion of additional plans and programs to the list of examples supports two policy goals. First, an expanded list promotes integration of various regulatory mechanisms to reduce duplication. (See, e.g., Pub. Resources Code, § 21003(a) (state policy is that "[l]ocal agencies integrate the requirements of [CEQA] with planning and environmental review procedures otherwise required by law or by local practice …"), (f) ("[a]ll persons and public agencies involved in the environmental review process be responsible for carrying out the process in the most efficient, expeditious manner in order to conserve the available financial, governmental, physical, and social resources with the objective that those resources may be better applied toward the mitigation of actual significant effects on the environment").) Second, the addition of GHG emissions reduction plans and regulations for the reduction of GHG emissions reflects the view of both the OPR and the Resources Agency that the effects of GHG emissions resulting from individual projects are best addressed and mitigated at a programmatic level.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) The Guidelines must address the determination of whether the "possible effects of a project are individually limited but cumulatively considerable." (*Id*. at § 21083(b)(2).) Due to the global nature of GHG emissions and their potential effects, GHG emissions will typically be addressed in a cumulative impacts analysis. (See, e.g., EPA, Draft Endangerment Finding, 74 Fed. Reg. 18886, 18904 (April 24, 2009) ("cumulative emissions are responsible for the cumulative change in the stock of concentrations in the atmosphere"); California Air Pollution Control Officers Association, *CEQA and Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act* (January 2008) ("CAPCOA White Paper"), at p. 35 ("GHG impacts are exclusively cumulative impacts; there are no non-cumulative GHG emission impacts from a climate change perspective").) Existing section 15064(h) governs the analysis of cumulative effects in an initial study. The proposed amendments to section 15064(h)(3), on determining the significance of cumulative impacts in an initial study, are therefore necessary to carry out this legislative directive.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and that the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and case law interpreting CEQA for determining the significance of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans.*, Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).)[2] Thus, the Amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

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[2] Federal court decisions interpreting NEPA is persuasive authority in CEQA cases. (*Western Placer Citizens for an Ag. & Rur. Env. v. County of Placer* (2006) 144 Cal.App. 4th 890, 902.)

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the amendments to this section are intended to reduce the costs of environmental review on lead agencies and project applicants by encouraging the use of existing environmental analysis where available. (Pub. Resources Code, § 21003(d) (use information in existing EIRs in order to reduce duplication), (f) (environmental review should proceed in the most efficient manner possible).)

SECTION 15064.4. DETERMINING THE SIGNIFICANCE OF IMPACTS FROM GREENHOUSE GAS EMISSIONS

Specific Purposes of the Amendment

A key component of environmental analysis under CEQA is the determination of significance. (Pub. Resources Code § 21002; *Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1106-07.) Guidelines on the analysis of GHG emissions must, therefore, include provisions on the determination of significance of those emissions.

New section 15064.4, on the determination of significance of GHG emissions, reflects the existing CEQA principle that there is no iron-clad definition of "significance." (State CEQA Guidelines, § 15064(b); *Berkeley Keep Jets Over the Bay Com. v. Board of Port Comm*. (2001) 91 Cal.App.4th 1344, 1380-81 ("*Berkeley Jets*").) Accordingly, lead agencies must use their best efforts to investigate and disclose all that they reasonably can regarding a project's potential adverse impacts. (*Ibid*; *see also* State CEQA Guidelines, § 15144.) Section 15064.4 is designed to assist lead agencies in performing that required investigation. In particular, it provides that lead agencies should quantify GHG emissions where quantification is possible and will assist in the determination of significance, or perform a qualitative analysis, or both as appropriate in the context of the particular project, in order to determine the amount, types and sources of GHG emissions resulting from the project. Regardless of the type of analysis performed, the analysis must be based "to the extent possible on scientific and factual data." In addition, lead agencies should also consider several factors. The specific provisions of section 15064.4 are discussed below.

<u>Quantitative Analysis</u>

Subdivision (a) of section 15064.4 states that lead agencies should calculate or estimate the GHG emissions resulting from the proposed project. This directive reflects the holding in the *Berkeley Jets* case, which required a Port Commission to quantify emissions of toxic air contaminants even in the absence of a universally accepted methodology for doing so. (*Berkeley Jets*, *supra*, 91 Cal.App.4th at p. 1370 ("The fact that a single methodology does not currently exist that would provide the Port with a precise, or 'universally accepted,' quantification of the human health risk from TAC exposure does not excuse the preparation of any health risk assessment--it requires the Port to do the necessary work to educate itself about the different methodologies that <u>are</u> available") (emphasis in original).) That case also required quantitative analysis of single-event noise, even though the applicable thresholds were expressed as cumulative noise levels. (*Id*. at 1382.) Quantification was required in that context in order to identify existing noise levels, the number of additional flights, the frequency of those flights, the degree to which the increased flights would cause increased noise levels at a given location, and ultimately, the community's reaction to that noise. (*Ibid*.) In other words, quantification would assist the lead agency in determining whether the increased noise would be potentially significant. (*Ibid*. ("CEQA requires that the Port and the inquiring public obtain the technical information needed to assess whether the ADP will merely inconvenience the Airport's nearby residents or damn them to a somnambulate-like existence"); see also *Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1109 ("in preparing an EIR, the agency must consider and resolve every fair argument that can be made about the possible significant environmental effects of a project, irrespective of whether an established threshold of significance has been met with respect to any given effect").)

With the foregoing principles in mind, the quantification called for in proposed section 15064.4(a)(1) is reasonably necessary to ensure an adequate analysis of GHG emissions using available data and tools, in accordance with Public Resources Code Section 21083.05. Even where a lead agency finds that no numeric threshold of significance applies to a proposed project, the holdings in the *Berkeley Jets* and *Protect the Historic Amador Waterways* cases, described above, require quantification of emissions if such quantification will assist in determining the significance of those emissions. OPR and the Resources Agency find that quantification will, in many cases, assist in the determination of significance, as explained below. (State CEQA Guidelines, § 15142 ("An EIR shall be prepared using an interdisciplinary approach which will ensure the integrated use of the natural and social sciences and the consideration of qualitative as well as quantitative factors").)

First, quantification of GHG emissions is possible for a wide range of projects using currently available tools. Modeling capabilities have improved to allow quantification of emissions from various sources and at various geographic scales. (Office of Planning and Research, *CEQA and Climate Change: Addressing Climate Change Through the California Environmental Quality Act Review*, Attachment 2: Technical Resources/Modeling Tools to Estimate GHG Emissions (June 2008); CAPCOA White Paper, at pp. 59-78.) Moreover, one of the models that can be used in a GHG analysis, URBEMIS, is already widely used in CEQA air quality analyses. (CAPCOA White Paper, at p. 59.) Second, quantification informs the qualitative factors listed in proposed section 15064.4(b). Third, quantification indicates to the lead agency, and the public, whether emissions reductions are possible, and if so, from which sources. Thus, if quantification reveals that a substantial portion of a project's emissions result from energy use, a lead agency may consider whether design changes could reduce the project's energy demand.

Proposed section 15064.4(a)(1) also reflects existing case law that reserves for lead agencies the precise methodology to be used in a CEQA analysis. (*See*, *e.g.*, *Eureka Citizens for Responsible Gov't v. City of Eureka* (2007) 147 Cal.App.4th 357, 371-373.) As indicated above, a wide variety of models exist that could be used in a GHG analysis. (CAPCOA White Paper, at pp. 59-78.) Further, not every model will be appropriate for every project. For example, URBEMIS may be an appropriate tool to analyze a typical residential subdivision or commercial use project, but some public utilities projects, such as waste-water treatment plants, may require more specialized models to accurately estimate emissions. (*Id*. at pp. 60-65.) The requirement to disclose any limitations in the model or methodology chosen also reflects the standard for adequacy of EIRs in existing State CEQA Guidelines section 15151.

Qualitative and Performance Standard Based Analysis

As explained in greater detail below in the Thematic Responses, CEQA does not require quantification of emissions in every instance. If the lead agency determines that quantification is not possible, would not yield information that would assist in analyzing the project's impacts and determining the significance of the GHG emissions, or is not appropriate in the context of the particular project, section 15064.4(a) would allow the lead agency to consider qualitative factors or performance standards. Consideration of qualitative factors is appropriate for several reasons. First, CEQA directs lead agencies to consider qualitative factors. (Pub. Resources Code, § 21001(g) (CEQA's purpose includes to: "require governmental agencies at all levels to consider qualitative factors as well as economic and technical factors and long-term benefits and costs, in addition to short-term benefits and costs and to consider alternatives to proposed actions affecting the environment").) Second, existing section 15064.7 of the State CEQA Guidelines indicate that thresholds of significance may be qualitative, which implies that a determination of significance without a threshold could also evaluate qualitative factors. Third, the existing CEQA Guidelines state that the determination of significance requires a lead agency to use its judgment based on *all* relevant information. (State CEQA Guidelines, § 15064(b); see also *id*. at §§ 15064.7 (thresholds may be qualitative), 15142 (analysis should be interdisciplinary and both qualitative and quantitative).)

Subdivision (a) would also allow a lead agency to rely on performance-based standards to assist in the determination of significance. Just as with quantification, the purpose of engaging in a qualitative or performance standard based analysis is to develop information relevant to a significance determination. Several examples exist of the types of performance standards that might appropriately be used in determining the significance of greenhouse gas emissions. Proposed section 15183.5(b)(1)(D), for example, contemplates that a plan for the reduction of greenhouse gas emissions may contain performance based standards. Where such standards are developed as part of such a plan, a lead agency would have evidence indicating that compliance with such standards would indicate that the impact of greenhouse gas emissions would be less than significant. Further, in adopting SB375, the Legislature acknowledged that regional transportation plans, and the environmental impact reports prepared to analyze those plans, may contain performance standards that would apply to transit priority projects. (See, e.g., Public Resources Code, § 21155.2.) Other potential examples include the Bay Area Air Quality Management District's proposed Best Management Practices for Construction Greenhouse Gas Emissions (calling for use of alternative fuels, local building materials and recycling), and the California Public Utilities Commission's Performance Standard for Power Plans (requiring emissions no greater than a combined cycle gas turbine plant). Compliance with such standards may be relevant to the significance determination, when considered in conjunction with the project's total projected emissions. Section 15064.4(a) was revised in response to comments to clarify that lead agencies may rely on quantitative or qualitative analyses, or both, in part to emphasize that qualitative analyses and performance standards may be useful supplements to a quantitative analysis.

Similar to use of a significance threshold, a lead agency must exercise care to ensure that performance standards do not replace a full analysis of all potential emissions. (*Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1109 ("in preparing an EIR, the agency must consider and resolve every fair argument that can be made about the possible significant environmental effects of a project, irrespective of whether an established threshold of significance has been met with respect to any given effect").) For example, while a Platinum LEED® rating could assist a lead agency in determining whether emissions related to a building's energy use may be significant, that performance standard may not reveal sufficient information to evaluate transportation-related emissions associated with that proposed project.

As indicated above, even a qualitative analysis must be based to the extent possible on scientific and factual data. Further, the type of analysis that is required will depend on the context of a particular project. Given the multitude of different project types and sizes, and different agencies subject to CEQA, the CEQA Guidelines, which are general by necessity, cannot specify precisely when a quantitative analysis may be required or a qualitative analysis may be appropriate. The following hypothetical examples may illustrate, however, how section 15064.4(a) could operate:

> **Project 1**: a small habitat restoration project is proposed in a remote part of California. Workers would drive to the site where they would camp for the duration of the project. Some gas-powered tools and machinery may be required. Cleared brush would either be burned or would decay naturally.
>
> **Project 2**: a large commercial development is proposed in an suburban context. Heavy-duty machinery would be required in various construction phases spanning many months. Following construction, the development would rely on electricity, water and wastewater services from the local utilities. Natural gas burners would be used on site. The development would employ several hundred workers and attract thousands of customers daily. A traffic study has been prepared for the project. The local air quality management district's guidance document recommends that projects of similar size and character should use of URBEMIS, or another similar model, to estimate the air quality impacts of the development.

In the context of Project 2 a quantitative analysis would likely be appropriate. The URBEMIS model, which would likely be used to analyze other emissions, could also be used to estimate emissions from both project-related transportation and on-site indirect emissions (landscaping, hot-water heaters, etc.) Modeling is typically done for projects of like size and character. Other models are readily available to estimate emissions associated with utility use. In the context of Project 2, a lead agency may find it difficult to demonstrate a good faith effort through a purely qualitative analysis. (See, e.g., *Berkeley Keep Jets Over the Bay Com. v. Board of Port Comm*. (2001) 91 Cal.App.4th 1344, 1370.)

In the context of Project 1, however, a qualitative analysis would likely be appropriate. Project 1's emissions are not easily modeled, and the Project is small in scale. While it may be technically possible, quantification of the emissions may not reveal any additional information that indicates the significance of those emissions or how they may be reduced that could not be provided in a qualitative assessment of emissions sources. (See, e.g., Public Resources Code, § 21003(f) ("public agencies involved in the environmental review process be responsible for carrying out the process in the most efficient, expeditious manner in order to conserve the available financial, governmental, physical, and social resources with the objective that those resources may be better applied toward the mitigation of actual significant effects on the environment").)

<u>Factors Potentially Indicating Significance</u>

The qualitative factors listed in the proposed section 15064.4(b) are intended to assist lead agencies in collecting and considering information relevant to a project's incremental contribution of GHG emissions and the overall context of such emissions. Notably, while subdivision (b) provides a list of factors that should be considered by public agencies in determining the significance of a project's GHG emissions, other factors can and should be considered as appropriate.

<u>Determine Whether Emissions Will Increase or Decrease</u>

The first factor in subdivision (b), for example, asks lead agencies to consider whether the project will result in an increase or decrease in different types of GHG emissions relative to the existing environmental setting. All project components, including construction and operation, equipment and energy use, and development phases must be considered in this analysis. (State CEQA Guidelines, § 15378 (project includes "the whole of the action").) For example, a mass transit project may involve GHG emissions during its construction phase, but substantial evidence may also indicate that it will cause existing commuters to switch from single-occupant vehicles to mass transit use. Operation of such a project may ultimately result in a decrease in GHG emissions. Such analysis, provided that it is supported with substantial evidence and fully accounts for all project emissions, may support a lead agency's determination that GHG emissions associated with a project are not cumulatively considerable.

This section's reference to the "existing environmental setting" reflects existing law requiring that impacts be compared to the environment as it currently exists. (State CEQA Guidelines, § 15125.) This clarification is necessary to avoid a comparison of the project against a "business as usual" scenario as defined by ARB in the Scoping Plan. Such an approach would confuse "business as usual" projections used in ARB's Scoping Plan with CEQA's separate requirement of analyzing project effects in comparison to the environmental baseline. (*Compare* Scoping Plan, at p. 9 ("The foundation of the Proposed Scoping Plan's strategy is a set of measures that will cut greenhouse gas emissions by nearly 30 percent by the year 2020 as compared to business as usual") *with Fat v. County of Sacramento* (2002) 97 Cal.App.4th 1270, 1278 (existing environmental conditions normally constitute the baseline for environmental analysis); see also *Center for Bio. Diversity v. City of Desert Hot Springs*, Riverside Sup. Ct. Case No. RIC464585 (August 6, 2008) (rejecting argument that a large subdivision project would have a "beneficial impact on CO2 emissions" because the homes would be more energy efficient and located near relatively uncongested freeways).) Business as usual may be relevant, however, in the discussion of the "no project alternative" in an EIR. (State CEQA Guidelines, § 15126.6(e)(2) (no project alternative should describe what would reasonably be expected to occur in the future in the absence of the project).)

Notably, section 15064.4(b)(1) is not intended to imply a zero net emissions threshold of significance. As case law makes clear, there is no "one molecule rule" in CEQA. (CBE, *supra*, 103 Cal.App.4th at 120.)

<u>Thresholds of Significance</u>

The second factor in subdivision (b) asks whether a project exceeds a threshold of significance for GHG emissions. Section 21000(d) of the Public Resources Code expressly directs public agencies to identify whether there are any critical thresholds for health and safety to identify those areas where the capacity of the environment is limited. A threshold is an "identifiable quantitative, qualitative or performance level" at which impacts are normally less than significant. (State CEQA Guidelines, § 15064.7(a); *see also Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1107.) Lead agencies may rely on thresholds developed by other agencies that have particular expertise in the subject matter under consideration. (*See*, *e.g.*, State CEQA Guidelines, Appendix G, Sample Question III ("[w]here available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make" a significance determination).) For example, a lead agency may look to standards included in a Basin Plan to assist in the determination of whether water quality impacts are significant. (*Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1107 ("[s]uch thresholds can be drawn from existing environmental standards, such as other statutes or regulations").)

Several agencies have developed, or are in the process of developing, thresholds of significance for GHG emissions.[3] For example, thresholds are currently being developed, or have already been adopted by the Bay Area Air Quality Management District for operations and construction,[4] the City of Davis for residential

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[3] Reference to these thresholds and proposed thresholds does not reflect an endorsement of those thresholds; rather, they are cited solely for the purpose of demonstrating that agencies are developing such thresholds.
[4] BAAQMD CEQA Guidelines Update: work in progress - http://www.baaqmd.gov/pln/ ceqa/index.htm.

developments,[5] and the South Coast Air Quality Management District for industrial projects.[6] Regardless of the threshold chosen, however, this section does not alter the pre-existing rule under CEQA that if substantial evidence supports a fair argument that a project may result in significant impacts, despite compliance with a threshold, an EIR must be prepared. (*Mejia v. City of Los Angeles* (2005) 130 Cal.App.4th 322, 342.) Further, "in preparing an EIR, the agency must consider and resolve every fair argument that can be made about the possible significant environmental effects of a project, irrespective of whether an established threshold of significance has been met with respect to any given effect." (*Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1109.)

Consistent with the above, if relying on a threshold developed by another agency, lead agencies must exercise caution in selecting a threshold to ensure that the threshold is appropriately applied. For CEQA purposes, a threshold identifies a level below which an environmental impact will normally be less than significant. (State CEQA Guidelines, § 15064.7(a).) Some agencies have adopted "thresholds" pursuant to other laws that may not be applicable in the CEQA context. ARB has adopted several thresholds pursuant to AB32, for example, to address specific purposes that are unrelated to CEQA. For example, the *de minimis* threshold governs the level at which emissions will be regulated by ARB's AB32 regulations. (Health & Safety Code, § 38561(e); Scoping Plan, at pp. 96-97.) CEQA does not permit use of a *de minimis* threshold, however. (*CBE*, *supra*, 103 Cal.App.4th at p. 121.) Additionally, the Reporting Threshold is the level at which emissions from large industrial sources are required to be reported. (Scoping Plan, at pp. 108-109; *see also* CARB Board Resolution 07-54 (2007).) Again, this reporting threshold reflects a policy decision regarding regulation by the ARB, but does not address the level at which environmental harm may occur, and does not satisfy a lead agency's duties under CEQA related to review of projects which may result in significant adverse environmental impacts.

<u>Consistency with a Plan or Regulation</u>

Finally, the third factor in subdivision (b) directs consideration of the extent to which a project complies with a plan or regulation to reduce GHG emissions. That section further states, however, that to be used for the purpose of determining significance, a plan must contain specific requirements that result in reductions of GHG emissions to a less than significant level. This clarification is necessary because of the wide variety of climate action plans and GHG reduction plans that are currently being adopted by public agencies. ARB, for example, recently adopted its statewide Scoping Plan. That plan may not be appropriate for use in determining the significance of individual projects, however, because it is conceptual at this stage and relies on the future development of regulations to implement the strategies identified in the Scoping

[5] City of Davis (2009) Greenhouse Gas Emission Threshold and Standards for New Residential Development; Accessed 5/27/09, http://cityofdavis.org/pgs/sustainability/pdfs/15_4.21.09_GHG%20Standards.pdf
[6] SCAQMD (2008) Interim CEQA GHG Significance Threshold for Stationary Sources, Rules and Plans, Accessed 5/27/09 http://www.aqmd.gov/hb/2008/December/081231a.htm.

Plan. (Scoping Plan, at p. 9.) Regulations that will require actual reductions of GHG emissions may not be adopted until 2012. (*Ibid.*) Once those regulations are adopted and being implemented, they may, if appropriate, be used to assist in the determination of significance, similar to the current use of air quality, water quality and other similar environmental regulations. (*CBE*, *supra*, 103 Cal. App. 4th at 111 ("a lead agency's use of existing environmental standards in determining the significance of a project's environmental impacts is an effective means of promoting consistency in significance determinations and integrating CEQA environmental review activities with other environmental program planning and regulation").)

In addition to the regulations that will be developed to implement the Scoping Plan, this factor would also allow lead agencies to consider plans that are developed to reduce GHG emissions on a regional or local level. (Scoping Plan, at p. 26.) The proposed section 15064.4(b)(3) is intended to be read in conjunction with the section 15064(h)(3), as proposed to be amended, and proposed section 15183.5. Those sections each indicate that local and regional plans may be developed to reduce GHG emissions. If such plans reduce community-wide emissions to a level that is less than significant, a later project that complies with the requirements in such a plan may be found to have a less than significant impact.

Notably, CEQA does not provide a specific definition of "comply" in the context of determining a project's consistency with a particular plan. Some guidance may be gleaned, however, from case law interpreting the requirement that a local government's activities be consistent with its General Plan. In that context, a "zoning ordinance [for example] is consistent with the city's general plan where, considering all of its aspects, the ordinance furthers the objectives and policies of the general plan and does not obstruct their attainment." (*City of Irvine v. Irvine Citizens Against Overdevelopment* (1994) 25 Cal. App. 4th 868, 879.) Reading section 15064.4 together with 15064(h)(3), however, to demonstrate consistency with an existing GHG reduction plan, a lead agency would have to show that the plan actually addresses the emissions that would result from the project. Thus, for example, a subdivision project could not demonstrate "consistency" with the ARB's Early Action Measures because those measures do not address emissions resulting from a typical housing subdivision. (ARB, Expanded List of Early Action Measures to Reduce Greenhouse Gas Emissions in California Recommended for Board Consideration, October 2007; see also State CEQA Guidelines, §§ 15063(d)(3) (initial study must be supported with information to support conclusions), 15128 (determination in an EIR that an impact is less than significant must be briefly explained).)

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) A key component of environmental analysis under CEQA is the determination of significance. (*Id*. at § 21002; *Protect the Historic Amador Waterways, supra,* 116 Cal.App.4th at

1106-07.) The new section 15064.4, on determining the significance of impacts of GHG emissions, is therefore necessary to carry out this legislative directive.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the Amendments were proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for determining the significance of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans.*, Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).)[7] Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, by providing greater certainty to lead agencies regarding the determination of significance of GHG emissions, the cost of environmental analysis, and potential litigation, may be reduced.

[7] Federal court decisions interpreting NEPA is persuasive authority in CEQA cases. (*Western Placer Citizens for an Ag. & Rur. Env. v. County of Placer* (2006) 144 Cal.App. 4th 890, 902.)

SECTION 15064.7. THRESHOLDS OF SIGNIFICANCE

Specific Purposes of the Amendment

Proposed subdivision (c) of section 15064.7 would allow a lead agency to adopt a threshold developed by another agency, or recommended by experts, provided that such threshold is supported with substantial evidence. This proposed regulation is reasonably necessary because many lead agencies perform general governmental functions, and may lack the specific expertise necessary to develop their own thresholds of significance for GHG emissions. Such agencies may rely on thresholds developed by other agencies with specialized expertise (such as an air quality management district) in conducting their CEQA analyses. (OPR, Thresholds of Significance: Criteria for Defining Environmental Significance, September 1994, at p. 7.) In fact, Appendix G of the State CEQA Guidelines expressly encourages lead agencies to rely on thresholds established by local air quality management districts. (State CEQA Guidelines, Appendix G, Question III.)

Several local and regional air districts are in the process of developing thresholds for GHG emissions. As noted above, for example, thresholds are currently being developed, or have already been adopted by the Bay Area Air Quality Management District for operations and construction, the City of Davis for residential developments, and the South Coast Air Quality Management District for industrial projects. Lead agencies within the jurisdiction of an air district, or other agency, that adopts a GHG emissions threshold may adopt such a threshold as its own. In adopting any threshold of significance, including one developed by an expert or agency with specialized expertise, the lead agency must support the threshold with substantial evidence in the administrative record. (State CEQA Guidelines, § 15064.7(b).)

Independent experts may also develop such thresholds for use by public agencies. For example, the California Air Pollution Control Officers Association has published a White Paper on developing thresholds of significance for GHG emissions. (CAPCOA White Paper, at pp. 31-58.) A lead agency could potentially use CAPCOA's suggestions in developing its own thresholds. Because any threshold must be supported with substantial evidence, and must be adopted through a public process, any threshold recommended by an expert that is ultimately adopted will undergo sufficient scrutiny to ensure its legitimacy. (State CEQA Guidelines, § 15064.7(b).)

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) Defining "significance" is a critical step in the lead agency's impact analysis and therefore needs to be addressed as part of the Proposed Action. Section 21000(d) of the Public Resources Code encourages the development of thresholds. These sections together require OPR and the Resources Agency to develop and adopt regulations governing the adoption of thresholds of significance for GHG emissions.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for determining the significance of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, by providing greater certainty to lead agencies regarding the determination of significance of GHG emissions, the cost of environmental analysis, and potential litigation, may be reduced.

SECTION 15065. MANDATORY FINDINGS OF SIGNIFICANCE

Specific Purposes of the Amendment

The amendment to section 15065(b)(1) would change the word “preliminary” to “public.” The purpose of this amendment is to make section 15065 consistent with section 21064.5 of the Public Resources Code. The latter provision defines a mitigated negative declaration to be a negative declaration where mitigation measures are added to a project “before the proposed negative declaration and initial study are released for *public* review[.]” (State CEQA Guidelines, § 15070(b)(1).) In contrast, existing CEQA Guidelines section 15065(b)(1), dealing with mandatory findings of significance, would require a commitment to mitigation prior to “preliminary” review. “Preliminary Review,” as that term is used in section 15060, refers to a period following receipt of an application during which a lead agency determines whether an exemption applies to the project or whether an EIR would clearly be prepared. Read literally, existing section 15065 would require a commitment to mitigation before an initial study is even conducted. Because the statutory definition of mitigated negative declaration contemplates that mitigation measures may be developed during the preparation of the initial study prior to public review, the change in 15065 from “preliminary” to “public” is appropriate.

Necessity

Section 21083 of the Public Resources Code directs OPR to develop, and the Resources Agency to adopt, guidelines on the implementation of CEQA. The Amendment is necessary to ensure that those guidelines are consistent with relevant statutory definitions.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency’s Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency’s determination that the Amendmentswould make the existing Guidelines easier to follow as a result of greater internal consistency. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific existing statutory CEQA provisions and/or case law interpreting CEQA. Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, by providing greater consistency within the Guidelines, the cost of environmental analysis, and potential litigation, may be reduced.

SECTION 15086. CONSULTATION CONCERNING DRAFT EIR

The revision to this section is a non-substantive correction to this section's reference to the California Air Resources Board. This revision, therefore, qualifies as a "change without regulatory effect" pursuant to section 100(a)(4) of the Office of Administrative Law's regulations governing the rulemaking process. (Cal. Code Regs., tit. 1, § 100(a)(4).)

SECTION 15093. STATEMENT OF OVERRIDING CONSIDERATIONS

Specific Purposes of the Amendment

Section 21081(b) of the Public Resources Code provides that a lead agency may approve or carry out a project with significant and unavoidable impacts only after the lead agency makes a finding that "specific overriding economic, legal, social, technical or other benefits of the project outweigh the significant effects on the environment." The State CEQA Guidelines describes the factors that a lead agency must weigh in determining whether to approve a project with adverse environmental effects:

> CEQA recognizes that in determining whether and how a project should be approved, a public agency has an obligation to balance a variety of public objectives, including economic, environmental, and social factors and in particular the goal of providing a decent home and satisfying living environment for every Californian. An agency shall prepare a statement of overriding considerations as described in Section 15093 to reflect the ultimate balancing of competing public objectives when the agency decides to approve a project that will cause one or more significant effects on the environment.

(State CEQA Guidelines, § 15021(d).) The California Supreme Court has further observed that "an agency's decision that the specific benefits a project offers outweigh any environmental effects that cannot feasibly be mitigated … lies at the core of the lead agency's discretionary responsibility under CEQA…." (*City of Marina v. Board of Trustees of Cal. State Univ* (2006) 39 Cal.4th 341, 368.)

In the context of GHG emissions, some projects may cause adverse environmental impacts but still provide an overall benefit of reducing GHG emissions on a statewide or regional level. For example, a city may make a policy choice to allow increased housing density within a jobs-rich region in order to reduce region-wide GHG emissions from vehicles and transportation. (See, e.g., 2007 IEPR, at p. 210.) Though the introduction of new housing within the jurisdiction may result in near-term or local adverse impacts related to GHG emissions, doing so may assist the region as a whole in meeting region-wide reduction targets. Thus, subdivision (a) of section 15093 was revised to expressly allow a lead agency to consider this type of environmental benefit of a project in making a statement of overriding considerations.

The revision to section 15093(a) accomplishes two objectives. First, it reminds lead agencies and the public that even a project that appears environmentally beneficial may itself cause adverse environmental impacts, and such impacts must undergo full CEQA review, and, if applicable, a statement of overriding considerations. Second, it discourages purely local interests from dominating consideration of a project by expressly allowing a lead agency to consider region- and statewide benefits of a project. Further, "economic, legal, social, technical and other benefits" could be interpreted to refer to local benefits. This addition would ensure that lead agencies may consider regional and statewide benefits in considering a project's adverse impacts. Finally, the proposed addition makes clear, consistent with section 15021(d) of the existing State CEQA Guidelines, that the lead agency may consider environmental benefits to balance a project's significant adverse environmental effects that remain even after the adoption of all available feasible mitigation measures.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) If a lead agency determines that a project's GHG emissions will result in significant and unavoidable impacts, a lead agency may only approve the project if it makes specified findings. (*Id*. at § 21081(b).) This amendment is necessary to ensure that a lead agency considers state-wide and regional benefits of a project in addition to purely local benefits. Because consideration of state-wide and region-wide benefits may also apply to impacts unrelated to GHG emissions, the amendment was worded broadly to address any significant environmental impact.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the proposed revisions. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and/or make specific statutory CEQA provisions and case law interpreting CEQA for making statements of overriding considerations. Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California.

SECTION 15125. ENVIRONMENTAL SETTING

Specific Purposes of the Amendment

Section 15125 reflects existing law requiring examination of project impacts in relation to the existing environment. Subsection (d) states that lead agencies should consider whether the proposed project is inconsistent with applicable local and regional plans. That subsection provides a non-exclusive list of plans for potential consideration. The Amendments would add specific plans, regional blueprint plans and greenhouse gas reduction plans to subdivision (d). The added plans are necessary to ensure that GHG emissions analyses in such plans are addressed.

Specific Plans

Specific Plans address a defined geographic area within the area covered by a General Plan. (Gov. Code, § 65450 ("After the legislative body has adopted a general plan, the planning agency may, or if so directed by the legislative body, shall, prepare specific plans for the systematic implementation of the general plan for all or part of the area covered by the general plan").) Specific Plans must contain "[s]tandards and criteria by which development will proceed, and standards for the conservation, development, and utilization of natural resources, where applicable." (*Id*. at § 65451(a)(3).) Thus, given that so many local governments are addressing GHG emissions in their policy documents, and that Specific Plans must contain standards and criteria, it is likely that Specific Plans may address GHG emissions, and consistency with adopted Specific Plans should be considered in EIRs.

Regional Blueprint Plans

Regional Blueprint Plans are being developed in many of California's Metropolitan Planning Organizations through grants provided by the California Department of Transportation. While originally designed to address transportation efficiencies, Regional Blueprint Plans typically involve smart growth planning with an aim to reducing vehicle miles traveled at a regional level. As a result, Regional Blueprint Plans can provide information regarding the region's existing transportation setting and identify methods to reduce region-wide transportation-related impacts. (Scoping Plan, Appendix C, at pp. C-74-C-84.) Land use decisions impact many sectors responsible for GHG emissions, including transportation, electricity, water, waste, and others. However, the primary impact of land use development on GHG emissions relates to vehicle use. (Land Use Subcommittee of the Climate Action Team, *LUSCAT Submission to CARB Scoping Plan on Local Government, Land Use, and Transportation* (2008), at p. 13.) Blueprint Plans highlight this relationship between land use and transportation and how this relationship may impact a local community's and region's GHG emissions. Analysis of GHG reduction is not required by Blueprint grants but it is recommended. Therefore, Blueprint Plans provide an indication of the GHG emissions potentially created or reduced by the plan. (LUSCAT (2009), at p. 30.) Given the large percentage of GHG emissions that result from transportation in

California, a project's consistency with a Regional Blueprint Plan can provide information indicating whether the project could have significant environmental impacts related to GHG emissions. (*Ibid.*) Regional Blueprint Plans may, therefore, provide evidence to assist the lead agency in determining whether a project may tend to increase or decrease GHG emissions relative to the existing baseline. Thus, where such a plan has been developed and adopted by an MPO, lead agencies may find it useful to evaluate the project's consistency with that Blueprint Plan.

<u>Plans for the Reduction of Greenhouse Gas Emissions</u>

The Amendments would add plans for the reduction of greenhouse gas emissions to the list of plans in section 15125(d). Many local and regional plans now include policies relating to, and analyses of, GHG emissions. (OPR, Book of Lists, at pp. 92-100; Scoping Plan, at p. 26.) Many such plans include detailed information on the jurisdiction's inventory of GHG emissions and measures to reduce such emissions. (*Ibid.*) Such plans may also include prescriptions for specific mitigation measures to address GHG emissions. (Scoping Plan, Appendix C, at p. C-49.) Where such a plan has been developed and adopted within the relevant jurisdiction, a project's inconsistency with that plan could be an indication of potential adverse environmental impacts.

Notably, while section 15125(d) requires an EIR to discuss any inconsistencies of a project with the listed plans, it does not mandate a finding of significance resulting from any identified inconsistencies. The plans simply provide information regarding the project's existing setting and inconsistency may be an indication of potentially significant impacts. The determination of significance is to be made by the lead agency.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines addressing the mitigation of GHG emissions and the effects of the GHG emissions. (Pub. Resources Code, § 21083.05.) As indicated above, one potential indicator of a project's potential GHG emissions impacts is whether the project is consistent with applicable plans that have addressed that impact. Thus, the addition of plans that may address GHG emissions to the list of plans in the existing section 15125 is reasonably necessary to ensure that such analysis occurs.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analyzing the effects of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the amendments to this section are intended to reduce the costs of environmental review on lead agencies and project applicants by encouraging the use of existing environmental information where available. (Pub. Resources Code, § 21003(d) (use information in existing EIRs in order to reduce duplication), (f) (environmental review should proceed in the most efficient manner possible).)

SECTION 15126.2. CONSIDERATION AND DISCUSSION OF SIGNIFICANT ENVIRONMENTAL EFFECTS.

Amendments are proposed to two subdivisions of the existing section 15126.2. The first, to subdivision (c), adds a cross-reference to the Public Resources Code and another section of the State CEQA Guidelines. This revision, therefore, qualifies as a "change without regulatory effect" pursuant to section 100(a)(4) of the Office of Administrative Law's regulations governing the rulemaking process. (Cal. Code Regs., tit. 1, § 100(a)(4).) The second change, made in response to public comments, adds a sentence to the end of existing subdivision (a). That change is described in greater detail below.

Specific Purposes of the Amendment

Several comments submitted as part of the Natural Resources Agency's SB97 rulemaking process urged it to develop guidance addressing the analysis of the impacts of climate change on a project. These comments similarly suggested that such guidance was appropriate in light of the release of the draft California Climate Adaptation Strategy (Adaptation Strategy), developed pursuant to Executive Order S-13-2008. In considering such comments, it is important to understand several key differences between the Adaptation Strategy and the California Environmental Quality Act. First, the Adaptation Strategy is a policy statement that contains recommendations; it is not a binding regulatory document. Second, the Adaptation Strategy focuses on how the State can plan for the effects of climate change. CEQA's focus, on the other hand, is the analysis of a particular project's greenhouse gas emissions on the environment, and mitigation of those emissions if impacts from those emissions are significant. Given these differences, CEQA should not be viewed as the tool to implement the Adaptation Strategy; rather, as indicated in the Strategy's key recommendations, advanced programmatic planning is the primary method to implement the Adaptation Strategies.

There is some overlap between CEQA and the Adaptation Strategy, however. As explained in both the Initial Statement of Reasons and in the Adaptation Strategy, section 15126.2 may require the analysis of the effects of a changing climate under certain circumstances. (Initial Statement of Reasons, at pp. 68-69.) In particular, Section 15126.2 already requires an analysis of placing a project in a potentially hazardous location. Further, several questions in the Appendix G checklist already ask about wildfire and flooding risks. Many comments on the proposed amendments asked for additional guidance, however.

Having reviewed all of the comments addressing the effects of climate change, the Natural Resources Agency revised the proposed amendments to include a new sentence in Section 15126.2 clarifying the type of analysis that would be required. Existing section 15126.2(a) provides an example of a potential hazard requiring analysis: placing a subdivision on a fault line. The new sentence adds further examples, as follows:

> Similarly, the EIR should evaluate any potentially significant impacts of locating development in other areas susceptible to hazardous conditions (e.g., floodplains, coastlines, wildfire risk areas) as identified in authoritative hazard maps, risk assessments or in land use plans addressing such hazards areas.

According to the Office of Planning and Research, at least sixty lead agencies already require this type of analysis. (California Governor's Office of Planning and Research, State Clearinghouse, The California Planners' Book of Lists (January, 2009), at p. 109.) This addition is reasonably necessary to guide lead agencies as to the scope of analysis of a changing climate that is appropriate under CEQA.

As revised, section 15126.2 would provide that a lead agency should analyze the effects of bringing development to an area that is susceptible to hazards such as flooding and wildfire, both as such hazards currently exist or may occur in the future. Several limitations apply to the analysis of future hazards, however. For example, such an analysis may not be relevant if the potential hazard would likely occur sometime after the projected life of the project (i.e., if sea-level projections only project changes 50 years in the future, a five-year project may not be affected by such changes). Additionally, the degree of analysis should correspond to the probability of the potential hazard. (State CEQA Guidelines, § 15143 ("significant effects should be discussed with emphasis in proportion to their severity and probability of occurrence").) Thus, for example, where there is a great degree of certainty that sea-levels may rise between 3 and 6 feet at a specific location within 30 years, and the project would involve placing a wastewater treatment plant with a 50 year life at 2 feet above current sea level, the potential effects that may result from inundation of that plant should be addressed. On the other extreme, while there may be consensus that temperatures may rise, but the magnitude of the increase is not known with any degree of certainty, effects associated with temperature rise would not need to be examined. (State CEQA Guidelines, § 15145 ("If, after thorough investigation, a lead agency finds that a particular impact is too speculative for evaluation, the agency should note its conclusion and terminate the discussion of the impact").) Lead agencies are not required to generate their own original research on potential future changes; however, where specific information is currently available, the analysis should address that information. (State CEQA Guidelines, § 15144 (environmental analysis "necessarily involves some degree of forecasting. While seeing the unforeseeable is not possible, an agency must use its best efforts to find out and disclose all that it reasonably can").)

The decision in *Baird v. County of Contra Costa* (1995) 32 Cal.App.4th 1464, does not preclude this analysis. In that case, the First District Court of Appeal held that a county was not required to prepare an EIR due solely to pre-existing soil contamination that the project would not change in any way. (Id. at 1468.) No evidence supported the petitioner's claim that the project would "expose or exacerbate" the pre-existing contamination, which was located several hundred to several thousand feet from the project site. (Id. at n. 1.) Moreover, the project would have no other significant effects on the environment, and other statutes exist to protect residents from contaminated soils. Thus, the question confronting that court was whether pre-existing contamination near the project was, by itself, enough to require preparation of an EIR. It held that, in those circumstances, an EIR was not required. That court also acknowledged, however, that where there is a potential for ultimately changing the environment, an EIR could be required. (Id. at p. 1469.) Thus, unlike the circumstances in the *Baird* case, the analysis required in section 15126.2(a) would occur if an EIR was otherwise required. Similarly, the addition to that section contemplates hazards which the presence of a project could exacerbate (i.e., potential upset of hazardous materials in a flood, increased need for firefighting services, etc.).

This revision was described in the Natural Resources Agency's Notice of Proposed Changes and the public was invited to present comments on that change. The Natural Resources Agency determined that the change was sufficiently related to the original proposal described in the Notice of Proposed Action, so a fifteen day comment period was appropriate. It is sufficiently related because the Notice of Proposed Action explained that the rulemaking activity was intended to address the directive in SB97 to provide guidelines on the analysis of the "effects of greenhouse gas emissions." As explained in the Initial Statement of Reasons, the Natural Resources Agency initially chose not to provide specific guidance on the analysis of the effects of placing development in an area subject to the effects of climate change because the Agency interpreted existing section 15126.2(a) to already require that analysis under certain circumstances. As indicated above, however, many comments on the proposed amendments suggested revisions to section 15126.2(a) to provide additional guidance. The areas susceptible to hazards include those that may result from a changing climate. Thus, the change is sufficiently related that a reasonable person would be put on notice that such a change could occur as a result of the rulemaking activity described in the Notice of Proposed Action.

Finally, following review of comments on this revision, the Natural Resources Agency clarified that this analysis applies only to "potentially significant" effects of locating developing in areas susceptible to hazards. Because this revision clarifies the last sentence in section 15126.2(a), consistent with the Public Resources Code, and does not alter the requirements, rights, responsibilities, conditions, or prescriptions contained in the originally proposed text, this revision is nonsubstantial and need not be circulated for additional public review. (Government Code, § 11346.8(c); Cal. Code Regs., tit. 1, § 40.)

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines addressing the analysis of the effects of GHG emissions. (Pub. Resources Code, § 21083.05.) As explained above, the effects of GHG emissions include flooding, sea-level rise and wildfires. Thus, the addition of a clarifying sentence to existing section 15126.2(a), requiring analysis of the effects of placing developing in hazardous locations, is reasonably necessary to ensure that such analysis occurs with respect to areas subject to potential hazards resulting from climate change.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analyzing the effects of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans.*, Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, by providing greater certainty to lead agencies regarding the analysis that may be required of the potential effects of climate change on a project, the cost of environmental analysis, and potential litigation, may be reduced.

SECTION 15126.4. CONSIDERATION AND DISCUSSION OF MITIGATION MEASURES PROPOSED TO MINIMIZE SIGNIFICANT EFFECTS.

Specific Purposes of the Amendment

Section 21083.05 of the Public Resources Code expressly requires OPR and the Resources Agency to develop regulations on the "mitigation of greenhouse gas emissions." The goals of this legislative mandate are to (1) reduce GHG emissions and (2) to provide consistency in the development of GHG emissions reduction measures. There is no indication, however, that the Legislature intended to alter any existing laws governing mitigation under CEQA. The Amendments, therefore, interpret and make specific existing CEQA law and regulations for mitigation of significant impacts resulting from GHG emissions.

Existing section 15126.4 provides guidance on CEQA's general mitigation requirements. To emphasize that mitigation of GHG emissions is subject to those existing CEQA requirements, OPR and the Natural Resources Agency added a new subdivision (c) to the existing section 15126.4. The Amendments identify five general methods of mitigation that may be tailored to the specific circumstances surrounding a specific project. In response to public comments, the Natural Resources Agency provided additional guidance, described below, in the lead-in sentences introducing those five broad categories of mitigation.

Mitigation of Greenhouse Gas Emissions

Comments submitted on the Amendments indicated general concerns that mitigation for GHG emissions may not be effective or reliable. To further clarify the existing mitigation requirements that would apply to measures to reduce greenhouse gas emissions, the Natural Resources Agency revised the lead-in sentences in subdivision (c). Specifically, the Natural Resources Agency added that all mitigation must be supported with substantial evidence and be capable of monitoring or reporting. This addition reflects the requirement in Public Resources Code that a lead agency's findings on mitigation be supported with substantial evidence and that it must adopt a mitigation monitoring and reporting program along with the project if mitigation measures are required. (Public Resources Code, §§ 21081(a)(1), 21081.6.)

In response to comments, the Natural Resources Agency had originally also proposed to add a sentence indicating that only emissions reductions that were not required by some other law or contract could qualify as mitigation. In response to comments on that proposed revision, that sentence is no longer proposed to be added to the lead-in section; rather, subdivision (c)(3) will be clarified, as described below.

Mitigation Identified in an Existing Plan

The first type of mitigation of GHG emissions that may be considered includes measures identified in an existing plan. As indicated above, many agencies are beginning to address GHG emissions at a planning level. (OPR, Book of Lists, at pp. 92-100.) Some of those GHG reduction plans include specific measures that may be applied on a project-by-project basis. (*Ibid*; *see also* Scoping Plan, Appendix C, at p. C-49.) Proposed subdivision (c)(1), therefore, would encourage lead agencies to look to adopted plans for sources of mitigation measures that could be applied to specific projects.

Project Design Features

The second type of measure that a lead agency should consider is project design features that will reduce project emissions. Various project design features could be used to reduce GHG emissions from a wide variety of projects. The CAPCOA White Paper provides examples of various project design features that may reduce emissions from commercial and residential buildings. (CAPCOA White Paper, at pp. B-13 to B-18.) For example, according to the California Energy Commission, "[r]esearch shows that increasing a community's density and its accessibility to jobs centers are the two most significant factors for reducing vehicle miles traveled," which is an important component of reducing statewide emissions. (California Energy Commission 2007, *2007 Integrated Energy Policy Report*, CEC-100-2007-008-CMF ("2007 IEPR"), at p. 12; see also CEC, *The Role of Land Use in Meeting California's Energy and Climate Goals* (2007) at p. 20.) This subdivision also refers specifically to measures identified in Appendix F, which include a variety of measures designed to reduce energy use. By encouraging lead agencies to consider changes to the project itself, this subdivision further encourages the realization of co-benefits such as reduced energy costs for project occupants, increased amenities for non-vehicular transportation, and others. Thus, project design can reduce GHG emissions directly through efficiency and indirectly through resource conservation and recycling. (Green Building Sector Subgroup of the Climate Action Team, Scoping Plan Measure Development and Cost Analysis (2008) at p. 6 to 9.)

Off-Site Measures

The third type of measures addressing GHG emissions is off-site measures including offsets. Proposed subdivision (c)(3) recognizes the availability of various off-site mitigation measures. Such measures could include, among others, the purchase of carbon offsets, community energy conservation projects, and off-site forestry projects. (*See*, *e.g.*, South Coast Air Quality Management District, SoCal Climate Solutions Exchange (June 2008), at pp.1; Rodeo Refinery Settlement Agreement, BAAQMD Carbon Offset Fund; Recommendations of the ETAAC, Final Report (February 2008) at pp. 9-5; ARB, Staff Report: Proposed Adoption of California Climate Action Registry Forestry Greenhouse Gas Protocols for Voluntary Purposes (October 17, 2007), at p. 15 ("[t]he three protocols together – the sector, project, and certification protocols – are a cohesive and comprehensive set of methodologies for forest carbon accounting, and furthermore contain all the elements necessary to generate high quality carbon credits"); see also Scoping Plan, Appendix C, at pp. C-21 to C-23.) Off-site mitigation may be appropriate under various circumstances. For example, such mitigation may be appropriate where a project is incapable of design modifications that would sufficiently reduce GHG emissions within the project boundaries. In that case, a lead agency could consider whether emissions reductions may be achieved through such measures as energy-efficiency upgrades within the community or reforestation programs.

The reference to “offsets” in subdivision(c)(3) generated several comments during the public review period. The offsets concept is familiar in other aspects of air quality regulation. The Federal Clean Air Act, for example, provides that increases in emissions from new or modified sources in a nonattainment area must be offset by reductions in existing emissions within the nonattainment area. (See, e.g., 42 U.S.C. § 7503(a)(1)(A).) California laws also apply to offsets and emissions credits. (See, e.g., Health & Saf. Code, § 39607.5.) Those other laws generally require that emissions offsets must be “surplus” or “additional”. Comments on the proposed amendments suggested that to be used for CEQA mitigation purposes, offsets should also be “additional.” Thus, the Natural Resources Agency further refined the revisions it publicized on October 23, 2009, by deleting the lead-in sentence stating that “Reductions in emissions that are not otherwise required may constitute mitigation pursuant to this subdivision,” and amending subdivision (c)(3) to state that mitigation may include “Off-site measures, including offsets <u>that are not otherwise required</u>, to mitigate a project’s emissions[.]”

Moving this concept from the general provisions on mitigation of greenhouse gas emissions to the provision on offsets does not materially alter the rights or conditions in the originally proposed text because the “not otherwise required” concept would only make sense in the context of offsets. Because this revision clarifies section 15126.4(c)(3), consistent with the Public Resources Code and cases interpreting it, and does not alter the requirements, rights, responsibilities, conditions, or prescriptions contained in the originally proposed text, this revision is nonsubstantial and need not be circulated for additional public review. (Government Code, § 11346.8(c); Cal. Code Regs., tit. 1, § 40.)

<u>Sequestration</u>

The fourth type of GHG emissions mitigation measure is sequestration. Indeed, one way to reduce a project’s GHG emissions is to sequester project-related GHG emissions and thereby prevent them from being released into the atmosphere. At present, the most readily available, and accountable, way to sequester GHGs is forest management. California forests have a “unique capacity to remove [carbon dioxide, a GHG,] from the air and store it long-term as carbon.” (Scoping Plan, Appendix C, at p. C-165.) Forest sequestration functions are, therefore, a key part of the ARB’s Scoping Plan and reduction effort. (Scoping Plan, at pp. 64-65.)

The California Climate Action Team has also identified several forest-related sequestration strategies, including, reforestation, conservation forest management, conservation (i.e., avoided development), urban forestry, and fuels management and biomass. (ARB, Staff Report: Proposed Adoption of California Climate Action Registry

Forestry Greenhouse Gas Protocols for Voluntary Purposes (October 17, 2007), at pp. 6-7.) ARB has adopted Forest Protocols for large forestry projects. (ARB, Resolution 07-44 (adopting California Climate Action Registry Forestry Sector Protocol (September 2007), Forest Project Protocol (September 2007) and Forest Verification Protocol (May 2007).) ARB has also adopted Urban Forest Protocols for urban forestry projects. (California Climate Action Registry, Urban Forest Project Reporting Protocol and Verification Protocol (August 2008) (ARB adopted on September 25, 2008).) Such projects could be located on the project site or off-site. (Urban Forest Project Reporting Protocol, at pp. 4-5.) The protocols include methods of measuring the ability of various forestry projects to store capture and store carbon.

Consistent with section 15126.4(a), a lead agency must support its choice of, and its determination of the effectiveness of, any reduction measures with substantial evidence. Substantial evidence in the record must demonstrate that any mitigation program or measure is will result in actual emissions reductions. As a practical matter, where a mitigation program or measure is consistent with protocols adopted or approved by an agency with regulatory authority to develop such a program, a lead agency will more easily be able to demonstrate that off-site mitigation will actually result in emissions reductions. Examples of such protocols include the forestry protocols described above. Where a mitigation proposal cannot be verified with an existing protocol, a greater evidentiary showing may be required.

Measures to be Implemented on a Project-by-Project Basis

Finally, the fifth type of measure that could reduce GHG emissions at a planning level is the development of binding measures to be implemented on a project-specific basis. As explained in greater detail in the discussion of proposed section 15183.5, below, ARB's Scoping Plan strongly encourages local agencies to develop plans to reduce GHG emissions throughout the community. In addition, the CEC's Power Plant Siting Committee is assessing the impacts of GHG emission from proposed new power plants and how they can be mitigated. Comments received during the CEC's informational proceedings warranted a lengthy discussion on the practical application of a programmatic approach to mitigating GHG emissions from new power plants. (CEC, *Committee Guidance on Fulfilling California Environmental Quality Act Responsibilities for Greenhouse Gas Impacts in Power Plant Siting Applications* (2009) at p. 26 to 28.) Existing State CEQA Guidelines sections 15168(b)(4) and 15168(c)(3) recognize that programmatic documents provide an opportunity to develop mitigation plans that will apply on a project-specific basis. Proposed subdivision (c)(5) recognizes that, for a planning level decision, appropriate mitigation of GHG emissions may include the development of a program to be implemented on a project-by-project basis. (State CEQA Guidelines, § 15126.4(a)(2) ("[i]n the case of the adoption of a plan, policy, regulation, or other public project, mitigation measures can be incorporated into the plan, policy, regulation or project design").)

This type of mitigation is subject to the limits of existing law, however. Thus, proposed subdivision (c)(5) should not be interpreted to allow deferral of mitigation.

Rather, it is subject to the rule in existing section 15126.4(a)(1)(B) that such measures "may specify performance standards which would mitigate the significant effect of the project and which may be accomplished in more than one specified way." (*See also San Joaquin Raptor Rescue Center v. County of Merced* (2007) 149 Cal. App. 4th 645, 670-71.)

Suggestions Rejected

During its public involvement process, OPR received comments on its preliminary draft of the proposed amendments related to mitigation. Some comments suggested provisions that were not included in these Proposed Amendments. Several comments, for example, suggested that the Guidelines provide a specific "hierarchy" of mitigation requiring lead agencies to mitigate GHG emissions on-site where possible, and to allow consideration and use of off-site mitigation only if on-site mitigation is impossible or insufficient. OPR and the Resources Agency recognize that there may be circumstances in which requiring on-site mitigation may result in various co-benefits for the project and local community, and that monitoring the implementation of such measures may be easier. However, CEQA leaves the determination of the precise method of mitigation to the discretion of lead agencies. (State CEQA Guidelines, § 15126.4(a)(1)(B); *see also San Franciscans Upholding the Downtown Plan v. City & Co. of San Francisco* (2002) 102 Cal. App. 4th 656, 697.)

Several comments also suggested that mitigation for GHG emissions must be "real, permanent, quantifiable, verifiable, and enforceable." The Proposed Amendments do not include such standards, however, for several reasons. The proposed standard appears to have been derived from section 38562(d) of the Health and Safety Code, which prescribes requirements for regulations to be promulgated to implement AB32. AB32 is a separate statutory scheme, and, as noted above, there is no indication that the legislature intended to alter standards for mitigation under CEQA. Similarly, standards for mitigation under CEQA already exist and are set out in section 15126.4(a). Specifically, mitigation must be fully enforceable, which implies that the measure is also real and verifiable. Additionally, substantial evidence in the record must support an agency's conclusion that mitigation will be effective, and in the context of an EIR, courts will defer to an agency's determination of a measure's effectiveness. (*Environmental Council of Sacramento v. City of Sacramento* (2006) 147 Cal.App.4th 1018, 1041 (mitigation ratio is supportable even at less than 1:1 given the project's circumstances); *Ass'n of Irritated Residents v. County of Madera* (2003) 107 Cal.App.4th 1383, 1398 (lead agency has discretion to resolve dispute regarding the effectiveness of an EIR's mitigation measures).) No existing law requires CEQA mitigation to be quantifiable. Rather, mitigation need only be "roughly proportional" to the impact being mitigated. (State CEQA Guidelines, § 15126.4(a)(4)(B); see also id. at § 15142.)

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the mitigation of GHG emissions. (Pub. Resources Code, § 21083.05.) The proposed subdivision (c) sets out types of mitigation of GHG emissions that a lead agency may consider. Thus, that subdivision is reasonably necessary to implement the Legislature's directive.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the proposed action and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the proposed action. This conclusion is based on the Resources Agency's determination that the proposed action is necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the proposed action adds no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the proposed revisions. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The proposed action interprets and makes specific statutory CEQA provisions and/or case law interpreting CEQA for mitigating the impacts of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans.*, Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th

Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the proposed action does not add any substantive requirements, it will not result in an adverse impact on businesses in California. On the contrary, by providing greater certainty to lead agencies regarding the determination of significance of GHG emissions, the cost of environmental analysis, and potential litigation, may be reduced.

SECTION 15130. DISCUSSION OF CUMULATIVE IMPACTS

Specific Purposes of the Amendment

The Proposed Amendments include two revisions to the existing section 15130 of the State CEQA Guidelines. The two proposed amendments are described below.

Section 15130(b)(1)(B)

Section 21083(b) of the Public Resources Code requires that an EIR be prepared if the "possible effects of a project are individually limited but cumulatively considerable." That section further defines "cumulatively considerable" to mean that "the incremental effects of an individual project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects."

In determining whether a project may have significant cumulative impacts, a lead agency must engage in a two-step process. First, it must determine the extent of the cumulative problem. To do so, a lead agency must examine the "effects of past projects, the effects of other current projects, and the effects of probable future projects." Once it does so, the lead agency then determines whether the project's incremental contribution to that problem is cumulatively considerable. Section 21100(e) further provides that "[p]reviously approved land use documents, including but not limited to, general plans, specific plans, and local coastal plans, may be used in a cumulative impact analysis."

The existing Guideline section 15130(b) addresses the first step of the process. It offers two options for estimating the effects resulting from past, present and reasonably foreseeable projects. A lead agency may either rely on a list of such projects, or a summary of projections to estimate cumulative impacts. Existing section 15130(b)(1)(B) allows a lead agency to rely on projections in a land use document or certified environmental document that addresses the cumulative impact under consideration.

The proposed amendments would clarify that plans providing such projections need not be limited to land use plans, so long as the plan evaluates the relevant cumulative effect. The proposed amendments would also allow a lead agency to rely on information provided in regional modeling programs. The best projections of the cumulative effect of GHG emissions may be available in up-to-date models such as the International Council for Local Environmental Initiative's Local Government GHG Protocol[8] and the California Climate Action Reserve's Registry general,[9] industry[10] and

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[8] ICLEI (2008) Local Government Operations Protocol; Accessed 6/08/09, http://www.icleiusa.org/action-center/tools/lgo-protocol-1
[9] California Climate Action Registry (2009) General Reporting Protocol: Accessed 6/08/09, http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

project type protocols.[11] Such projections may also be supplied in plans that are not strictly "land use" plans. For example, regional transportation plans in certain areas will ultimately include sustainable community strategies which will include projections a region's GHG emissions and related cumulative effects. (Gov Code, § 65080(b)(2).) Finally, some agencies are beginning to develop GHG reduction plans or climate action plans that may also include such projections. (ARB, Scoping Plan, Appendix C, at p. C-49; OPR, Book of Lists, at pp. 92-100.)

The proposed amendments are consistent with section 21083 of the Public Resources Code and CEQA case law. Section 21083 requires consideration of "the effects of past projects, the effects of other current projects, and the effects of probable future projects." Projections in the listed types of plans and models may include inventories of existing emissions and projected future emissions. Section 21100 of the Public Resources Code provides that land use plans "may" be used in a cumulative impacts analysis, but that section does not purport to limit the types of plans that can be used in a cumulative impacts analysis to land use plans. Finally, case law has supported reliance on projections provided by industry, for example, to satisfy the requirement for a discussion of impacts caused by closely related projects. (*Ass'n of Irritated Residents*, *supra*, 107 Cal. App. 4th at 1404.)

While models may provide the most up to date information, lead agencies should still look first to information provided in adopted or certified environmental documents. First, such information has already gone through a public and agency review process. Second, to the extent the model provides information that is not provided in the prior environmental document, the relationship of the model and applicable plans must be explained, along with any changes in circumstances.

Section 15130(d)

The Office of Planning and Research had originally proposed the addition of certain plans to section 15130(d). That section states that previously approved land use plans may be used in a cumulative impacts analysis. Those additions were inadvertently excluded from the proposed amendments that were made available for public review on July 3, 2009. Therefore, the revisions were added to revisions that were made publicly available on October 23, 2009.

The added plans include regional transportation plans and plans for the reduction of greenhouse gas emissions. This change is sufficiently related to the proposal that was originally published. Those plans were proposed for addition to other sections of the proposed amendments, for example, and comments were submitted regarding the use of such plans in cumulative impacts analysis. Plans for the reduction of greenhouse gas emissions were described under section 15064(h)(3), above. Regional

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[10] California Climate Action Registry (2005) Industry Specific Protocols: Accessed 06/08/09, http://www.climateregistry.org/tools/protocols/industry-specific-protocols.html
[11] California Climate Action Registry (2007) Project Protocols: Accessed 06/08/09, http://www.climateregistry.org/tools/protocols/project-protocols.html

transportation plans may contain information regarding transportation-related greenhouse gas emissions that may be useful in a cumulative impacts analysis. As explained above, regional transportation plans in certain areas will ultimately include sustainable community strategies which will include projections a region's GHG emissions and related cumulative effects. (Gov Code, § 65080(b)(2).) Thus, these additions are reasonably necessary to ensure that public agencies perform a cumulative impacts analysis of greenhouse gas emissions as required by Public Resources Code section 21083.05. The additions are also consistent with Public Resources Code section 21100(e) which provides that previously adopted land use plans may be used in a cumulative impacts analysis.

<u>Section 15130(f)</u>

The Natural Resources Agency originally proposed to add subdivision (f) to section 15130 to clarify that sections 21083 and 21083.05 of the Public Resources Code do not require a detailed analysis of GHG emissions solely due to the emissions of other projects. (State CEQA Guidelines, § 15130(a)(1); *Santa Monica Chamber of Commerce v. City of Santa Monica* (2002) 101 Cal.App.4th 786, 799.) Rather, proposed subdivision (f) would have provided that a detailed analysis is required when evidence shows that the incremental contribution of the project's GHG emissions is cumulatively considerable when added to other cumulative projects. (*CBE*, *supra*, 103 Cal.App.4th at 119-120.) In essence, the proposed addition would be a restatement of law as applied to GHG emissions. Analysis of GHG emissions as a cumulative impact is consistent with case law arising under the National Environmental Policy Act. (*See, e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Other portions of these proposed Guidelines address how lead agencies may determine whether a project's emissions are cumulatively considerable. (See, e.g., Proposed Sections 1506(h)(3) and 15064.4.)

Public comments noted, however, that the new subdivision merely restated the law, and was capable of misinterpretation. The Natural Resources Agency, therefore, determined that because other provisions of the Amendments address the analysis of greenhouse gas emissions as a cumulative impact, and because the reasoning of those is fully explained in the Initial Statement of Reasons, subdivision (f) should not be added to the CEQA Guidelines. The deletion was reflected in the revisions that were made available for further public review and comment on October 23, 2009.

Necessity

Sections 21083 and 21083.05 of the Public Resources Code respectively require that an EIR analyze cumulative impacts and that the effects of GHG emissions be analyzed in CEQA documents. The Amendments include guidance to assist lead agencies to evaluate the cumulative impacts of GHG emissions where an EIR is required. Thus, the Amendments are reasonably necessary to implement the Legislature's directive.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analysis and mitigation of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans.*, Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the

amendments to this section are intended to reduce the costs of environmental review on lead agencies and project applicants by encouraging the use of existing environmental analysis where available. (Pub. Resources Code, § 21003(d) (use information in existing EIRs in order to reduce duplication), (f) (environmental review should proceed in the most efficient manner possible).)

SECTION 15150. INCORPORATION BY REFERENCE

Specific Purposes of the Amendment

The existing CEQA Guidelines allow lead agencies to incorporate information from other documents by reference. (State CEQA Guidelines, § 15150.) Doing so permits a lead agency to avoid repetitious analysis of general matters and to reduce paperwork. (Pub. Resources Code § 21003 (it is state policy that "persons and public agencies involved in the environmental review process be responsible for carrying out the process in the most efficient, expeditious manner in order to conserve the available financial, governmental, physical, and social resources with the objective that those resources may be better applied toward the mitigation of actual significant effects on the environment").) Existing Guidelines section 15150(f) provides that "[i]ncorporation by reference is most appropriate for including long, descriptive, or technical materials that provide general background but do not contribute directly to the analysis of the problem at hand."

The key requirements for documents that may be incorporation by reference are set forth in the statutory definition of "EIR." (Pub. Resources Code, § 21061.) Those requirements include:

- The incorporated information is a matter of public record or is generally available to the public; and
- The incorporated information is reasonably available for inspection at a public place or public building.

Descriptions of global, statewide and regional GHG emissions are particularly well-suited to incorporation by reference. Such descriptions can be technical and lengthy. (Public Policy Institute of California, Climate Policy at the Local Level: A Survey of California's Cities and Counties (November 2008), at pp. 24-32 (describing barriers and constraints to adoption of climate action plans and policies).) General descriptions may also remain current enough to be used in several successive environmental documents. In fact, OPR has found that many agencies are addressing GHG emissions in programmatic documents that could be incorporated by reference into later documents. (OPR, Book of Lists, at pp. 92-100.) Thus, the Resources Agency and OPR find that addition of subdivision (e)(4) is reasonably necessary to effectuate the legislative directive that public agencies conduct environmental review in the most efficient manner possible.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) The Legislature has further directed that resources be conserved wherever possible in the analysis of environment impacts. (*Id*. at § 21003.) Thus, the amendment to add GHG analyses to the list of documents that may be incorporated by reference is reasonably necessary to implement the Legislature's directive.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the proposed action adds no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the proposed revisions. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analysis and mitigation of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the amendments to this section are intended to reduce the costs of environmental review on lead agencies and project applicants by encouraging the use of existing environmental analysis where available. (Pub. Resources Code, § 21003(d) (use information in existing EIRs in order to reduce duplication), (f) (environmental review should proceed in the most efficient manner possible).)

SECTION 15183. PROJECTS CONSISTENT WITH A COMMUNITY PLAN OR ZONING

Specific Purposes of the Amendment

Section 21083.3 of the Public Resources Code provides that projects that are consistent with a General Plan, Community Plan or Zoning may not need to analyze cumulative effects that have already been analyzed in an EIR on the prior planning or zoning action. The exemption may apply, for example, where "uniformly applied development policies or standards" will substantially mitigate a cumulative effect. (Pub. Resources Code, § 21083.3(d).) The statute does not define what types of development policies or standards may be used in this context. It does provide, however, that such standards or policies must have been adopted by the lead agency with a finding, supported with substantial evidence, that the policy or standard will substantially mitigate the environmental effect under consideration. (*Ibid*.) Existing Guidelines section 15183 provides several non-exclusive examples of policies and standards that might apply in the context of section 21083.3, including grading ordinances and floodplain protection ordinances.

The inclusion of "[r]equirements for reducing greenhouse gas emissions, as set forth in adopted land use plans, policies or regulations" among the list of examples of "uniformly applied development policies or standards" is consistent with the direction in section 21083.3. First, the text provides that such requirements would be "adopted" by the lead agency. Second, they would be "development policies or standards" because the requirements would be contained in an adopted "land use plan, policy or regulation." Finally, such requirements could substantially mitigate the effects of GHG emissions by "reducing greenhouse gas emissions" in the adopting jurisdiction. (Proposed Section 15183.5(b) would provide elements that may be included in a GHG emissions reduction plan that might be used in the context of section 15183.)

One comment submitted during OPR's public involvement process questioned whether such requirements relating to reductions in GHG emissions would be kept current. (See, e.g., Letter from Joyce Dillard to OPR, January 26, 2009.) Section 21083.3 specifically provides, however, that such requirements would not apply in this context if "substantial new information shows that the policies or standards will not substantially mitigate the environmental effect." (Pub. Resources Code, § 21083.3(d).) Therefore, lead agencies have an incentive to ensure that their policies remain current.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) The addition to section 15183 is reasonably necessary to carry out the legislature's intent that projects that are consistent with General Plans, Community Plans and Zoning benefit from streamlined CEQA review. Several jurisdictions are beginning to include requirements for reducing GHG emissions in their general plans. (OPR, Book of Lists, at pp. 92-100; Scoping Plan, Appendix C, at p. C-49.) The addition is also reasonably necessary to effectuate the legislature's intent that OPR and the Resources Agency provide guidance on how to analyze GHG emissions.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Resources Agency rejected the no action alternative because it would not achieve the objectives of the proposed revisions. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analysis and mitigation of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to

SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the amendments to this section are intended to reduce the costs of environmental review on lead agencies and project applicants by encouraging the use of existing environmental analysis where available. (Pub. Resources Code, § 21003(d) (use information in existing EIRs in order to reduce duplication), (f) (environmental review should proceed in the most efficient manner possible).)

SECTION 15183.5. TIERING AND STREAMLINING THE ANALYSIS OF GREENHOUSE GAS EMISSIONS

Specific Purposes of the Amendment

In adopting SB375, the Legislature found that "[n]ew provisions of CEQA should be enacted so that the statute encourages … local governments to make land use decisions that will help the state achieve its climate goals under AB 32[.]" (Statutes 2008, Ch. 728, § 1(f).) ARB's Scoping Plan similarly recognizes the important role that local governments play in reducing the State's GHG emissions. (ARB, Scoping Plan, at p. 26.) In particular, local government "[d]ecisions on how land is used will have large impacts on the GHG emissions that will result from the transportation, housing, industry, forestry, water, agriculture, electricity, and natural gas sectors." (*Ibid.*) Decision-making on urban growth and land use planning begins with local general plans. (Gov. Code, § 65030.1 ("The Legislature … finds that decisions involving the future growth of the state, most of which are made and will continue to be made at the local level, should be guided by an effective planning process, including the local general plan, and should proceed within the framework of officially approved statewide goals and policies directed to land use, population growth and distribution, development, open space, resource preservation and utilization, air and water quality, and other related physical, social and economic development factors").)

GHG emissions may be best analyzed and mitigated at a programmatic level. "For local government lead agencies, adoption of general plan policies and certification of general plan EIRs that analyze broad jurisdiction-wide impacts of GHG emissions can be part of an effective strategy for addressing cumulative impacts and for streamlining later project-specific CEQA reviews." (OPR, Technical Advisory: CEQA and Climate Change: Addressing Climate Change Through California Environmental Quality Act (CEQA) Review, June 19, 2008, at p. 8.) Other lead agencies may also address GHG emissions programmatically in long range development plans, facilities master plans, and other long-range planning documents.

This emphasis on long-range planning is consistent with state policy expressed in CEQA. The Legislature has clearly stated its preference that lead agencies tier environmental documents wherever feasible. (Pub. Resources Code, § 21093(b).) Specifically:

> The Legislature finds and declares that tiering of environmental impact reports will promote construction of needed housing and other development projects by (1) streamlining regulatory procedures, (2) avoiding repetitive discussions of the same issues in successive environmental impact reports, and (3) ensuring that environmental impact reports prepared for later projects which are consistent with a previously approved policy, plan, program, or ordinance concentrate upon environmental effects which may be mitigated or avoided in connection with the decision on each later project. The Legislature further finds and

> declares that tiering is appropriate when it helps a public agency to focus upon the issues ripe for decision at each level of environmental review and in order to exclude duplicative analysis of environmental effects examined in previous environmental impact reports.

(Pub. Resources Code, § 21093(a).) The Amendments, therefore, include the addition of a new section 15183.5 to address both tiering and streamlining of GHG analyses, as well as the proper use of GHG reduction plans in CEQA analyses. Explanation of the rationale of each new subdivision is provided below.

Existing Methods of Streamlining and Tiering

Because GHG emissions raise a cumulative concern, analysis of such emissions in a long-range planning document lends itself to tiering and use in later project-specific environmental review. (Pub. Resources Code, § 21093.) The Legislature has created several tiering and streamlining methods, reflected in various provisions of the existing State CEQA Guidelines, that can reduce duplication in the analysis of GHG emissions. Subdivision (a) clarifies that existing provisions in the State CEQA Guidelines regarding tiering and streamlining may be applied to the analysis of GHG emissions.

Greenhouse Gas Emissions Reduction Plans

Many jurisdictions are beginning to address GHG emissions reductions in "climate action plans" and "gas emissions reduction plans." (OPR, Book of Lists, at pp. 92-100; see also, Scoping Plan, Appendix C, at p. C-49.) ARB's Scoping Plan specifically encourages local governments to develop such plans, and has created a local government operations protocol to assist in that effort. (Scoping Plan, at p. 26.) A community-wide emissions protocol is also under development.

Some comments raised during OPR's public involvement process expressed concern that due to a lack of legislative criteria for such plans, existing provisions in the CEQA Guidelines regarding cumulative impacts may be misused. (See, e.g., Letter from Center for Biological Diversity, et al., to OPR, February 2, 2009, at p. 2.) For example, without specific guidance, a lead agency could erroneously rely on a plan with purely aspirational intent to determine that a later project's cumulative impact is less than significant pursuant to section 15064(h)(3). The proposed subdivision (b) provides criteria to assist lead agencies in determining whether an existing greenhouse gas reduction plan is an appropriate document to use in a cumulative impacts analysis under CEQA.

The existing CEQA Guidelines allow lead agencies to rely on plans for cumulative analysis where the plan has been adopted in a public review process and contains specific requirements to avoid or substantially lessen a cumulative problem. (State CEQA Guidelines, § 15064(h)(3).) The criteria set out in proposed subdivision (b)(1) are designed to ensure that a greenhouse gas reduction plan would satisfy the requirements described in sections 15064(h)(3) and 15130(d), for the reasons described below.

Criteria (A) and (C) are necessary to define the scope of GHG emissions within the defined geographic area and the incremental contribution of activities that will occur within that area to those emissions. (State CEQA Guidelines, § 15064(h)(3) (plan addresses cumulative impacts "within the geographic area in which the project is located").) Criterion (B) establishes a benchmark to assist the lead agency in determining whether the plan provisions will avoid or substantially lessen cumulative effects of the area's GHG emissions. (*Ibid*. (plan "provides specific requirements that will avoid or substantially lessen the cumulative problem").) Criteria (D) and (E) are necessary to demonstrate that the plan will actually avoid or substantially lessen the cumulative effects of those emissions. (*Ibid*.) Finally, criterion (F) reflects the requirement in sections 15064(h)(3) and 15130(d) that the plan be adopted through a public review process, as well as case law requiring that mitigation plans themselves undergo environmental review. (*California Native Plant Society v. County of El Dorado* (2009) 170 Cal. App. 4th 1026, 1053 (mitigation "programs may offer the best solution to environmental planning challenges, by providing some certainty to developers while adequately protecting the environment" but "in order to provide a lawful substitute for the 'traditional' method of mitigating CEQA impacts, that is, a project-by-project analysis, the fee program must be evaluated under CEQA").) Notably, the criteria provided in subdivision (b) are largely consistent with the elements that ARB recommends be included in a greenhouse gas reduction plan. (ARB, Scoping Plan, Appendix C, at p. C-49.)

Subdivision (b)(2) describes the uses and limitations of plans for the reduction of greenhouse gas emissions in a cumulative impacts analysis for later projects. Specifically, it provides a safeguard to ensure that the later activity was actually addressed in the plan for the reduction of greenhouse gas emissions, and that any applicable requirements of the plan are incorporated into the later project. This requirement is similar the requirement in case law that a lead agency determine that a particular threshold appropriately addresses the impact of concern. (*Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1109 ("in preparing an EIR, the agency must consider and resolve every fair argument that can be made about the possible significant environmental effects of a project, irrespective of whether an established threshold of significance has been met with respect to any given effect").) Finally, subdivision (b)(2) makes specific the requirement that, while the existence of an applicable plan for the reduction of greenhouse gas emissions may create a presumption that compliance with that plan will reduce the incremental contribution of later activities to a less than cumulatively considerable level, the existence of substantial evidence supporting a fair argument to the contrary may still require preparation of an EIR.

<u>Special Situations</u>

Subdivision (c) provides necessary clarification of the partial exemption provided in sections 21155.2 and 21159.28 of the Public Resources Code, enacted as part of SB375 (see description above). The limitation on analysis of global warming applies only to the effects caused by GHG emissions from cars and light duty trucks. That limitation should be read in conjunction with section 21083.05 of the Public Resources Code and State CEQA Guideline sections 15064.4 and 15126.4 which require analysis of all sources of GHG emissions and mitigation if those emissions are significant. Thus, projects that qualify for the limitation in sections 21155.2 and 21159.28 must still analyze emissions resulting from, as applicable, energy use, land conversion, and other direct and indirect sources of emissions. This clarification is reasonably necessary to effectuate the legislative directive in section 21083.3 that OPR and Resources develop guidelines on the analysis of GHG emissions and to avoid confusion regarding the streamlining provisions provided by SB375.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) The Legislature has also directed that EIRs be tiered wherever possible, and that duplication be minimized. (*Id*. at §§ 21003, 21093, 21094.) Section 15183.5, which provides guidance on tiering and streamlining of GHG emissions analyses, is therefore reasonably necessary to carry out these directives.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Natural Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the Amendments are proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Natural Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Natural Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analysis and mitigation of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the Amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the amendments to this section are intended to reduce the costs of environmental review on lead agencies and project applicants by encouraging the use of existing environmental analysis where available. (Pub. Resources Code, § 21003(d) (use information in existing EIRs in order to reduce duplication), (f) (environmental review should proceed in the most efficient manner possible).)

SECTION 15364.5. GREENHOUSE GAS

Specific Purposes of the Amendment

The Legislature has not included a definition of "greenhouse gases" in CEQA, though it did include a definition in AB32. (Health & Saf. Code, § 38505(g).) Thus, new section 15364.5 adds a definition of greenhouse gases. The specified gases are consistent with existing law as they are defined to include those identified by the Legislature in section 38505(g) of the Health and Safety Code.

Notably, the definition in AB32 states that GHG "includes all of the following…." In so stating, the Legislature implies that other gases may also be considered GHGs. The ARB's Scoping Plan also acknowledges that other gases contribute to climate change. (Scoping Plan, at p. 11.) In fact, the EPA's Endangerment Finding explained that several other gases share attributes with GHGs but would not be appropriate for regulation under the Clean Air Act at this time. (EPA Endangerment Finding, at pp. 18896-98.) Therefore, similar to the statutory definition of GHGs in AB32, the definition in the Amendments is not exclusive to the six primary GHGs. The purpose of a more expansive definition is to ensure that lead agencies do not exclude from consideration GHGs that are not listed, so long as substantial evidence indicates that such non-listed gases may result in significant adverse effects. This approach is consistent with the Supreme Court's directive that CEQA be interpreted to provide the fullest possible protection to the environment. (*Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal. 3d 376, 390.)

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) Section 15364.5 is necessary to make specific the instruction to analyze GHG emissions because it states which gases are considered to be "greenhouse gases" and should be included in the analysis.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Natural Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Natural Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Natural Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analysis and mitigation of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans*., Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the Amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the addition of this section is intended to reduce the costs of environmental review on lead agencies and project applicants by assisting lead agencies in determining which gases should be included in an analysis.

APPENDIX F. ENERGY CONSERVATION

Specific Purposes of the Amendment

CEQA's requirement to analyze and mitigate energy impacts of a project is substantive, and is not merely procedural. (*People v. County of Kern* (1976) 62 Cal.App.3d 761, 774.) Despite the requirement, lead agencies have not consistently included such analysis in their EIRs. (Remy et al., Guide to CEQA, 11th Ed. 2007, at pp. 1007-1008, n. 34.) The following revisions to Appendix F are, therefore, reasonably necessary to ensure that lead agencies comply with the substantive directive in section 21100(b)(3).

<u>Introduction</u>

The revisions to the introduction section include a cross-reference to section 21100(b)(3) of the Public Resources Code to direct lead agencies to the statutory directive underlying Appendix F. This section also includes an addition to make clear that energy impacts that have already been analyzed may not need to be repeated in later EIRs. This sentence is consistent with the Legislative intent in CEQA that information in existing environmental review be used to "reduce delay and duplication in preparation of subsequent environmental impact reports." (Pub. Resources Code, § 21003(d).)

<u>EIR Contents</u>

The amendments to Appendix F revise the section on EIR Contents to clarify that lead agencies "shall" analyze energy conservation in their EIRs. The word "shall" indicates that the duty is mandatory, and makes Appendix F consistent with Public Resources Code section 21100(b)(3). While Appendix F is revised to make clear that an energy analysis is mandatory, the amendments to this section would also make clear that the energy analysis is limited to effects that are applicable to the project.

<u>"Lifecycle"</u>

The amendments to Appendix F remove the term "lifecycle." No existing regulatory definition of "lifecycle" exists. In fact, comments received during OPR's public workshop process indicate a wide variety of interpretations of that term. (Letter from Terry Rivasplata et al. to OPR, February 2, 2009, at pp. 5, 12 and Attachment; Letter from Center for Biological Diversity et al. to OPR, February 2, 2009, at pp. 17.) Thus, retention of the term "lifecycle" in Appendix F could create confusion among lead agencies regarding what Appendix F requires.

Moreover, even if a standard definition of the term "lifecycle" existed, requiring such an analysis may not be consistent with CEQA. As a general matter, the term could refer to emissions beyond those that could be considered "indirect effects" of a project as that term is defined in section 15358 of the State CEQA Guidelines.

Depending on the circumstances of a particular project, an example of such emissions could be those resulting from the manufacture of building materials. (CAPCOA White Paper, at pp. 50-51.) CEQA only requires analysis of impacts that are directly or indirectly attributable to the project under consideration. (State CEQA Guidelines, § 15064(d).) In some instances, materials may be manufactured for many different projects as a result of general market demand, regardless of whether one particular project proceeds. Thus, such emissions may not be "caused by" the project under consideration. Similarly, in this scenario, a lead agency may not be able to require mitigation for emissions that result from the manufacturing process. Mitigation can only be required for emissions that are actually caused by the project. (State CEQA Guidelines, § 15126.4(a)(4).) Conversely, other projects may spur the manufacture of certain materials, and in such cases, consideration of the indirect effects of a project resulting from the manufacture of its components may be appropriate. A lead agency must determine whether certain effects are indirect effects of a project, and where substantial evidence supports a fair argument that such effects are attributable to a project, that evidence must be considered. However, to avoid potential confusion regarding the scope of indirect effects that must be analyzed, the term "lifecycle" has been removed from Appendix F.

Types of Energy Use

The amendments to Appendix F clarify that project design may achieve energy savings through measures related to water use and solid waste disposal. (California Energy Commission, Water Supply-Related Electricity Demand in California, CEC 500-2007-114 (November 2007), at p. 3 (reporting that water related energy use, including water movement, treatment and heating, annually accounts for approximately 20 percent of California's electricity consumption); Scoping Plan, Appendix C, at pp. C-158 to C-160.) The addition of these potential sources of energy reductions is consistent with the direction in section 21100(b)(3) to identify mitigation measures to reduce inefficient consumption of energy.

Grammar and Syntax

Finally, several minor revisions to Appendix F were made to improve grammar and syntax. Such revisions qualify as a "change without regulatory effect" pursuant to section 100(a)(4) of the Office of Administrative Law's regulations governing the rulemaking process. (Cal. Code Regs., tit. 1, § 100(a)(4).)

Necessity

The Legislature directed OPR and the Natural Resources Agency to develop guidelines on the analysis and mitigation of GHG emissions. (Pub. Resources Code, § 21083.05.) Since a significant source of GHG emissions results from energy use (consumption), these Amendments appropriately addressed energy use and conservation as a subject for CEQA analysis. Additionally, the legislature requires that lead agencies analyze energy use in their EIRs. (*Id*. at § 21100(b)(3).) The amendments to Appendix F are, therefore, necessary to ensure that lead agencies implement these directives.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Natural Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Natural Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Natural Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA's requirements for analysis and mitigation of energy use. Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California.

APPENDIX G. INITIAL STUDY CHECKLIST

Specific Purposes of the Amendment

The Amendments include revisions to several portions of Appendix G, which contains a sample environmental checklist that lead agencies may use to satisfy the requirement to prepare an initial study. The amendments and their necessity are described below.

Note Regarding Use of the Checklist

The amendments would add a note to the beginning of Appendix G to clarify the checklist contained therein is only a sample that may be modified as necessary to suit the lead agency and to address the particular circumstances of the project under consideration. The addition is necessary for two reasons. First, several lead agencies have expressed concern that the checklist does not reflect the circumstances existing in that particular agency. (See, e.g., Letter from Napa County – Department of Conservation, Development, and Planning to OPR, January 26, 2009; Letter from County of San Bernardino - Land Use Services Department to OPR, February 2, 2009.) Second, the Third District Court of Appeal recently issued an opinion that clarified that all substantial evidence regarding potential impacts of a project must be considered, even if the particular potential impact is not listed in Appendix G. (*Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at 1109.) Thus, the note emphasizes that Appendix G does not mandate a particular form that must be used for an Initial Study; rather, it provides merely an example.

Forest Resources

The amendments would add several questions addressing forest resources in the section on Agricultural Resources. Forestry questions are appropriately addressed in the Appendix G checklist for several reasons. First, forests and forest resources are directly linked to both GHG emissions and efforts to reduce those emissions. For example, conversion of forests to non-forest uses may result in direct emissions of GHG emissions. (See, e.g., California Energy Commission Baseline GHG Emissions for Forest, Range, and Agricultural Lands in California (March, 2004) at p. 19.) Such conversion would also remove existing carbon stock (i.e., carbon stored in vegetation), as well as a significant carbon sink (i.e., rather than emitting GHGs, forests remove GHGs from the atmosphere). (Scoping Plan, Appendix C, at p. C-168.) Thus, such conversions are an indication of potential GHG emissions. Changes in forest land or timberland zoning may also ultimately lead to conversions, which could result in GHG emissions, aesthetic impacts, impacts to biological resources and water quality impacts, among others. Thus, these additions are reasonably necessary to ensure that lead agencies consider the full range of potential impacts in their initial studies. In the same way that an EIR must address conversion of prime agricultural land or wetlands as part of a project (addressing the whole of the action requires analyzing land clearance in advance of project development), so should it analyze forest removal.

During OPR's public involvement process, some commenters suggested that conversion of forest or timber lands to agricultural uses should not be addressed in the Initial Study checklist. (Letter from California Farm Bureau Federation to OPR, February 2, 2009; Letter from County of Napa, Conservation, Development and Planning Department, to OPR, January 26, 2009.) As explained above, the purpose of the Amendments is to implement the Legislative directive to develop Guidelines on the analysis and mitigation of GHG emissions. Although some agricultural uses also provide carbon sequestration values, most agricultural uses do not provide as much sequestration as forest resources. (Climate Action Team, *Carbon Sequestration* (2009), Chapter 3.3.8 at p. 3.21; California Energy Commission, *Baseline GHG Emissions for Forest, Range, and Agricultural Lands in California* (2004), at p. 2.) Therefore, such a project could result in a net increase in GHG emissions, among other potential impacts. Thus, such potential impacts are appropriately addressed in the Initial Study checklist. See the Thematic Responses, below, for additional discussion of this issue.

<u>Greenhouse Gas Emissions</u>

The additions also include two questions related to GHG emissions. These questions are necessary to satisfy the Legislative directive in section 21083.05 that the effects of GHG emissions be analyzed under CEQA. The questions are intended to provoke a full analysis of such emissions where appropriate. More detailed guidance on the context of such an analysis is provided in other sections throughout the Guidelines. Despite the detailed provisions in the Guidelines themselves, questions related to GHG emissions should also appear in the checklist because some lead agencies will not seriously consider an environmental issue unless it is specifically mentioned in the checklist. (*Protect the Historic Amador Waterways*, *supra*, 116 Cal. App. 4th at 1110.)

<u>Transportation</u>

The Amendments make four primary changes to the questions involving transportation and traffic.

First, question (a) changes the focus from an increase in traffic at a given location to the effect of a project on the overall circulation system in the project area. This change is appropriate because an increase in traffic, by itself, is not necessarily an indicator of a potentially significant *environmental* impact. (Ronald Miliam, AICP, *Transportation Impact Analysis Gets a Failing Grade When it Comes to Climate Change and Smart Growth*; *see also* Land Use Subcommittee of the Climate Action Team LUSCAT Submission to CARB Scoping Plan on Local Government, Land Use, and Transportation Report (May, 2008) at pp. 31, 36.) Similarly, even if some projects may result in a deterioration of vehicular level of service – that is, delay experienced by drivers – the overall effectiveness of the circulation system as a whole may be improved. (*Ibid*.) Such projects could include restriping to provide bicycle lanes or creating dedicated bus lanes. Even in such cases, however, any potential adverse air quality or other impacts would still have to be addressed as provided in other sections of the checklist. Finally, the change to question (a) also recognizes that the lead agency has discretion to choose its own metric of analysis of impacts to intersections, streets, highways and freeways. (Pub. Resources Code, § 21081.2(e); *Eureka Citizens for Responsible Gov't v. City of Eureka, supra,* 147 Cal.App.4th at 371-373 (lead agency has discretion to choose its methodology).) Thus, "level of service" may or may not be the applicable measure of effectiveness of the circulation system.

Second, the revision to question (b) clarifies the role of a congestion management program in a CEQA analysis. Specifically, it clarifies that a congestion management program contains many elements in addition to a level of service designation. (Gov. Code § 65088 et seq.) The clarification is also necessary to address any projects within an "in-fill opportunity zone" that may be exempted from level of service requirements. (*Id*. at § 65088.4.)

Third, the amendments eliminate the existing question (f) regarding parking capacity. Case law recognizes that parking impacts are not necessarily environmental impacts. (*San Franciscans Upholding the Downtown Plan v. City and County of San Francisco, supra,* 102 Cal.App.4th at 697.) The focus of the Initial Study checklist should be on direct impacts of a project. Therefore, the question related to parking is not relevant in the initial study checklist. As noted above, however, if there is substantial evidence indicating adverse indirect environmental impacts from a project related to parking capacity, the lead agency must address such potential impacts regardless of whether the checklist contains parking questions. (*Ibid*.) Additional discussion of this issue is included in the Thematic Responses, below.

Finally, the amendments revise existing question (g), now question (f), to address the performance and safety of certain modes of alternative transportation. These revisions were made in response to comments received on the Amendments. While the primary objective of the Amendments is to provide guidance on the analysis and mitigation of greenhouse gas emissions, this revision was determined to be necessary to support the use of alternative transportation.

Necessity

The Legislature directed OPR and the Resources Agency to develop guidelines on the analysis of GHG emissions. (Pub. Resources Code, § 21083.05.) An initial study may be used to assist in the determination of whether a project may have a significant effect on the environment. (*Protect the Historic Amador Waterways*, *supra*, 116 Cal. App. 4th at 1110.) Appendix G of the State CEQA Guidelines is intended to provide a sample of an initial study that lead agencies may use. (*Ibid*.) Amendment of Appendix G to include questions that will assist a lead agency in determining whether a project may result in significant impacts related to GHG emissions is, therefore, necessary to carry out the Legislature's directive in section 21083.05 of the Public Resources Code.

Reasonable Alternatives to the Regulation, Including Alternatives that Would Lessen Any Adverse Impact on Small Business, and the Resources Agency's Reasons for Rejecting Those Alternatives

The Natural Resources Agency considered reasonable alternatives to the Amendments and determined that no reasonable alternative would be more effective in carrying out the purpose for which the action is proposed or would be as effective as, and less burdensome to affected private persons than, the Amendments. This conclusion is based on the Natural Resources Agency's determination that the Amendments are necessary to implement the Legislature's directive in SB97 in a manner consistent with existing statutes and case law, and the Amendments add no new substantive requirements. The Natural Resources Agency rejected the no action alternative because it would not achieve the objectives of the Amendments. There are no alternatives available that would lessen any adverse impacts on small businesses, as any impacts would result from the implementation of existing law.

Evidence Supporting an Initial Determination That the Action Will Not Have a Significant Adverse Economic Impact on Business

The Amendments interpret and make specific statutory CEQA provisions and/or case law interpreting CEQA for analysis and mitigation of GHG emissions that may result from proposed projects. Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating GHG emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al.*, Riverside Co. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans.*, Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (*See*, *e.g.*, *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad*., 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Because the Amendments do not add any substantive requirements, they will not result in an adverse impact on businesses in California. On the contrary, the

amendments to Appendix G are intended to reduce the costs of environmental review on lead agencies and project applicants by assisting lead agencies in determining which topics should be addressed in an Initial Study.

NON-SUBSTANTIAL CHANGES

On October 23, 2009, the Natural Resources Agency made available for public review certain changes to its originally proposed amendments. Those changes were described in the Notice of Proposed Changes. In response to comments on those changes, the Natural Resources Agency has made two non-substantial changes. Because those changes clarify the text that was made available for public review, and do not alter the requirements, rights, responsibilities, conditions, or prescriptions contained in the originally proposed text, the revisions are nonsubstantial and need not be circulated for additional public review. (Government Code, § 11346.8(c); Cal. Code Regs., tit. 1, § 40.) Those revisions are described below.

Section 15126.2(a)

As explained in the Notice of Proposed Changes, the revisions to the proposed text included a clarifying sentence in section 15126.2 indicating that an environmental impact report should analyze the effect of placing a project in areas susceptible to hazardous conditions. That revision specifically lists types of areas (including floodplains, coastlines and wildfire risk areas) that may be most impacted by the effects of a changing climate. The revision would also clarify that analysis of such hazards is appropriate where such areas are specified in authoritative hazard maps, risk assessments or land use plans.

The Natural Resources Agency further revised section 15126.2(a) in response to comments. That section was revised as follows:

> Similarly, the EIR should evaluate **~~the~~** **<u>any potentially significant</u>** impacts of locating development in other areas susceptible to hazardous conditions (e.g., floodplains, coastlines, wildfire risk areas) as identified in authoritative hazard maps, risk assessments or in land use plans addressing such hazards areas.

This change does not alter the rights, responsibilities, conditions, or prescriptions contained in the originally proposed text because the Public Resources Code already provides that an EIR is only required for those impacts that are potentially significant. (Public Resources Code, § 21002.1(a).) Because this revision clarifies the last sentence in section 15126.2(a), consistent with the Public Resources Code, this revision is nonsubstantial and need not be circulated for additional public review. (Government Code, § 11346.8(c); Cal. Code Regs., tit. 1, § 40.)

Section 15126.4(c)

The Natural Resources Agency also further revised text related to mitigation that was made publicly available as described in the October 23, 2009, Notice of Proposed Changes in response to comments on that text. The revision clarifies that the qualification that measures to mitigate greenhouse gas emissions must not otherwise be required applies in the context of offsets and is not intended to contradict case law recognizing that changes in a project that are required to comply with existing environmental standards may qualify as mitigation. Thus, section 15126.4(c) was revised as follows:

> (c) Mitigation Measures Related to Greenhouse Gas Emissions.
>
> Consistent with section 15126.4(a), lead agencies shall consider feasible means, supported by substantial evidence and subject to monitoring or reporting, of mitigating the significant effects of greenhouse gas emissions**.** ~~**Reductions in emissions that are not otherwise required may constitute mitigation pursuant to this subdivision.**~~ Measures to mitigate the significant effects of greenhouse gas emissions may include, among others:
>
> (1) Measures in an existing plan or mitigation program for the reduction of emissions that are required as part of the lead agency's decision;
>
> (2) Reductions in emissions resulting from a project through implementation of project features, project design, or other measures, such as those described in Appendix F;
>
> (3) Off-site measures, including offsets **that are not otherwise required**, to mitigate a project's emissions;
>
> (4) Measures that sequester greenhouse gases;
>
> (5) In the case of the adoption of a plan, such as a general plan, long range development plan, or plans for the reduction of greenhouse gas emissions, mitigation may include the identification of specific measures that may be implemented on a project-by-project basis. Mitigation may also include the incorporation of specific measures or policies found in an adopted ordinance or regulation that reduces the cumulative effect of emissions.

This change does not alter the rights, responsibilities, conditions, or prescriptions contained in the originally proposed text because the Public Resources Code already provides that to be considered mitigation, a measure must be tied to impacts resulting from the project. Section 21002 of the Public Resources Code, the source of the requirement to mitigate, states that "public agencies should not approve projects as proposed if there are … feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects[.]" Similarly, section 21081(a)(1) specifies a finding by the lead agency in adopting a project that "[c]hanges or alterations have been required in, or incorporated into, the project which mitigate or avoid the significant effects on the environment." Both statutory provisions expressly link the changes to be made (i.e., the "mitigation measures") to the significant effects of the project. Because this revision clarifies section 15126.4(c), consistent with the Public Resources Code, this revision is nonsubstantial and need not be circulated for additional public review. (Government Code, § 11346.8(c); Cal. Code Regs., tit. 1, § 40.)

THEMATIC RESPONSES

Several themes emerged in the comments submitted on the Natural Resources Agency's proposed amendments to the CEQA Guidelines addressing greenhouse gas emissions. While the Natural Resources Agency has responded individually to each comment it received, the following provides general responses to several issues that were raised repeated in the comments.

Quantitative versus Qualitative Analysis

Many comments focused on section 15064.4's recognition of lead agency discretion in determining whether to analyze a project's greenhouse gas emissions using either qualitative or quantitative methods, or both. Some comments suggested that a qualitative analysis would not satisfy CEQA's informational mandates. Other comments indicated that qualitative analysis is consistent with CEQA, and may be particularly appropriate in the context of a negative declaration. Other comments asked for examples of how performance standards could be used in such an analysis. As explained in the Initial Statement of Reasons, the Natural Resources Agency finds that CEQA leaves to lead agencies the choice of the most appropriate methodology to analyze a project's impacts, and that rule should continue to apply in the context of greenhouse gas emissions. The reasoning supporting this determination is set forth below.

First, nothing in CEQA prohibits use of a qualitative analysis or requires the use of a quantitative analysis. As explained in the Initial Statement of Reasons, CEQA directs lead agencies to consider qualitative factors. (Initial Statement of Reasons, at p. 19; Public Resources Code, § 21001(f).) Further, the existing CEQA Guidelines recognize that thresholds of significance, which are used in the determination of significance, may be expressed as quantitative, qualitative or performance-based standards. (State CEQA Guidelines, § 15064.7.) Moreover, even where quantification is technically or theoretically possible, "CEQA does not require a lead agency to conduct every test or perform all research, study, and experimentation recommended or demanded by commentors." (State CEQA Guidelines, § 15204(a); see also *Ass'n of*

Irritated Residents v. County of Madera (2003) 107 Cal.App.4th 1383, 1396-1398; *San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1996) 27 Cal.App.4th 713, 728.)[12]

Second, the comments do not appropriately distinguish between the determination of significance and the informational standards governing the preparation of environmental documents. The purpose of section 15064.4 is to assist the lead agency in determining whether a project's greenhouse gas emissions may be significant, which would require preparation of an EIR, and if an EIR is prepared, to determine whether such emissions are significant, which would require the imposition of feasible mitigation or alternatives. The existing CEQA Guidelines contain several provisions governing the informational standards that apply to various environmental documents. Conclusions in an initial study, for example, must be "briefly explained to indicate that there is <u>some evidence</u> to support" the conclusion. (State CEQA Guidelines, § 15063(d) (emphasis added).) Similarly, if an EIR is prepared, a determination that an impact is not significant must be explained in a "statement <u>briefly</u> indicating the reasons that various possible significant effects of a project" are in fact not significant. (State CEQA Guidelines, § 15128 (emphasis added).) If the impact is determined to be significant, the impact "should be discussed with emphasis in proportion to their severity and probability of occurrence." (State CEQA Guidelines, § 15143.) The explanation of significance in an EIR must be "prepared with a sufficient degree of analysis to provide decisionmakers with information which enables them to make a decision which intelligently takes account of environmental consequences" and must demonstrate "adequacy, completeness, and a good faith effort at full disclosure." (State CEQA Guidelines, § 15151.) In sum, while proposed section 15064.4(a) reflects the requirement that a lead agency base its significance determination on substantial evidence, whether quantitative, qualitative or both, it does not, as some comments appear to fear, alter the rules governing the sufficiency of information in an environmental document.

Third, the discretion recognized in section 15064.4 is not unfettered. A lead agency's analysis, whether quantitative or qualitative, would be governed by the standards in the first portion of section 15064.4. The first sentence applies to the context of greenhouse gas emissions the general CEQA rule that the determination of significance calls for a careful judgment by the lead agency. (Proposed § 15064.4(a) ("[t]he determination of the significance of greenhouse gas emissions calls for a careful judgment by the lead agency consistent with the provisions in section 15064").) The second sentence sets forth the requirement that the lead agency make a good-faith effort to describe, calculate or estimate the amount of greenhouse gas emissions

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[12] Notably, as administrative regulations, the development of the proposed regulations is governed by the Administrative Procedures Act. Government Code section 11340.1(a) states the Legislature's intent that administrative regulations substitute "performance standards for prescriptive standards wherever performance standards can be reasonably expected to be as effective and less burdensome, and that this substitution shall be considered during the course of the agency rulemaking process." Thus, absent authority in CEQA that would prohibit a qualitative analysis, section 15064.4 appropriately recognizes a lead agency's discretion to determine what type of analysis is most appropriate to determine the significance of a project's greenhouse gas emissions.

resulting from a project. That sentence has been further revised, as explained in greater detail below, to provide that the description, calculation or estimation is to be based "to the extent possible on scientific and factual data." The third sentence advises that the exercise of discretion must be made "in the context of a particular project." Thus, as provided in existing section 15146, the degree of specificity required in the analysis will correspond to the degree of specificity involved in the underlying project. In other words, even a qualitative analysis must demonstrate a good-faith effort to disclose the amount and significance of greenhouse gas emissions resulting from a project.

Fourth, the discretion recognized in proposed section 15064.4 would not enable a lead agency to ignore evidence submitted to it as part of the environmental review process. For example, if a lead agency proposes to adopt a negative declaration based on a qualitative analysis of the project's greenhouse gas emissions, and a quantitative analysis is submitted to that lead agency supporting a fair argument that the project's emissions may be significant, an EIR would have to be prepared. The same holds true if a lead agency proposes to adopt a negative declaration based on a quantitative analysis, and qualitative evidence supports a fair argument that the project's emissions may be significant. (*Berkeley Keep Jets Over the Bay Com. v. Board of Port Comm*. (2001) 91 Cal.App.4th 1344, 1382; *Oro Fino Gold Mining Corp. v. County of El Dorado* (1990) 225 Cal. App. 3d 872, 881-882 (citizens' personal observations about the significance of noise impacts on their community constituted substantial evidence that the impact may be significant and should be assessed in an EIR, even though the noise levels did not exceed general planning standards).) Similarly, even if an EIR is prepared, a lead agency would have to consider and resolve conflicts in the evidence in the record. (State CEQA Guidelines, § 15151 ("EIR should summarize the main points of disagreement among the experts"); *Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1109.)

Finally, regarding performance standards, several examples exist of the types of performance standards that might appropriately be used in determining the significance of greenhouse gas emissions. Proposed section 15183.5(b)(1)(D), for example, contemplates that a plan for the reduction of greenhouse gas emissions may contain performance based standards. Where such standards are developed as part of such a plan, a lead agency would have evidence indicating that compliance with such standards would indicate that the impact of greenhouse gas emissions would be less than significant. Further, in adopting SB375, the Legislature acknowledged that regional transportation plans, and the environmental impact reports prepared to analyze those plans, may contain performance standards that would apply to transit priority projects. (See, e.g., Public Resources Code, § 21155.2.) Other potential examples[13] include the Bay Area Air Quality Management District's proposed Best Management Practices for Construction Greenhouse Gas Emissions (calling for use of alternative fuels, local building materials and recycling), and the California Public Utilities Commission's Performance Standard for Power Plans (requiring emissions no greater

[13] The Natural Resources Agency does not necessarily endorse the use of these performance standards. Lead agencies must determine whether a particular standard is appropriate based on the substantial evidence supporting it and the context of the particular project.

than a combined cycle gas turbine plant). As with either a qualitative or quantitative analysis, reliance on performance standards must be supported with "scientific or factual data" indicating that compliance with the standard will ensure that impacts of greenhouse gas emissions are less than significant.

In sum, the proposed section 15064.4(a) appropriately reflects the standards in CEQA governing the determination of significance and the discretion CEQA leaves to lead agencies to determine how to analyze impacts. Mandating that lead agencies must quantify emissions whenever quantification is possible would be a departure from the CEQA statute.

Existing Environmental Setting

Several comments focused on the phrase "existing environmental setting" in section 15064.4(b)(1). Some comments urged, for example, that only "net" emissions should be considered. Comments from energy producers suggested that the phrase "existing environmental system" should encompass the entire energy system, which extends beyond California's borders. Some comments suggested that section 15064.4 should include a lifecycle analysis.

Section 15064.4(b)(1) advises lead agencies to consider the extent to which a project would increase or decrease greenhouse gas emissions compared to the existing environmental setting. In performing this analysis, a lead agency must account for all project phases, including construction and operation, as well as indirect and cumulative impacts. (State CEQA Guidelines, §§ 15063(a) ("[a]ll phases of project planning, implementation, and operation must be considered in the initial study…"), 15064(h) (addressing cumulative impacts), 15126 ("[a]ll phases of a project must be considered when evaluating its impact on the environment: planning, acquisition, development, and operation"), 15358(a)(2) (defining "effects" to include indirect effects), 15378.) The "setting" to be described varies depending on the project and the potential environmental resources that it may affect. In *Friends of the Eel River v. Sonoma County Water Agency* (2003) 108 Cal. App. 4th 859, for example, the lead agency failed to adequately describe the environmental setting by limiting its discussion primarily to the southern portions of its water system. Framing the setting narrowly resulted in impacts to the northern portion of the water system being ignored. Finding that section 15125 is to be construed broadly to ensure the fullest protection to the environment, the court in that case held that the lead agency was required to disclose that increased use of the southern portion of the water system would require greater diversions from the northern portion, and to analyze the impacts on species in the northern portion of the system. (*Id*. at pp. 873-875.) In the context of power generation, to the extent that a project may cause changes in greenhouse gas emissions in an existing power system, and substantial evidence substantiates such changes, those changes may be considered pursuant to section 15064.4(b)(1).

Similarly, if an agency has performed an analysis that demonstrates that a particular process for waste treatment does not result in an increase in greenhouse gas emissions compared to biogenic emissions that already occurs in the atmosphere, that evidence may support a conclusion that the project would not cause an increase in greenhouse gas emissions. Thus, to the extent a lead agency does not consider biogenic emissions to be new emissions, and its analysis is supported with substantial evidence, the text in section 15064.4(b)(1) would be broad enough to encompass those emissions, subject to the limitation that such analysis could not be used in a way that would mask the effects of emissions associated with the project. For example, if the emissions occurring in the short-term will have impacts that differ from emissions occurring in the future, those differences may need to be analyzed.

Finally, some comments suggested that the Guidelines should authorize a "net" or "lifecycle" analysis for projects that operate within a closed system. Nothing in section 15064.4 precludes such analysis where such analysis complies with the provision of section 15064, and where substantial evidence supports the ultimate conclusions and findings. However, since a "net" analysis may only be appropriate or possible in limited cases, the Natural Resources Agency deliberately chose to draft section 15064.4 broadly. Additionally, in some situations, a true "net" analysis may not be technically feasible or scientifically possible, and determination of an appropriate baseline for determining a "net" effect may be difficult.

As explained below, the Natural Resources Agency has deliberately avoided the term "lifecycle," however, to the extent an agency equates "lifecycle" with what occurs in the existing environmental setting, section 15064.4 authorizes lead agencies to consider such evidence.

Thresholds of Significance

Some comments expressed concern that the proposed amendments did not establish a statewide threshold of significance. Others suggested that most lead agencies are not qualified to establish their own thresholds, and if they do adopt thresholds, they should be required to adopt the most stringent threshold possible.

The CEQA Guidelines do not establish thresholds of significance for other potential environmental impacts, and SB97 did not authorize the development of a statewide threshold as part of this CEQA Guidelines update. Rather, the proposed amendments recognize a lead agency's existing authority to develop, adopt and apply their own thresholds of significance or those developed by other agencies or experts. As set forth in the existing section 15064.7, a threshold is "an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which means the effect normally will be determined to be less than significant." Because a threshold would be used in the determination of significance, the threshold would need to be supported with substantial evidence. (State CEQA Guidelines, § 15064.7(b).)

As explained in a recent decision of the Third District Court of Appeal, “[p]ublic agencies are … encouraged to develop thresholds of significance for use in determining whether a project may have significant environmental effects.” (*Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1108.) Nothing in CEQA requires that thresholds be developed by experts or expert agencies; however, “thresholds can be drawn from existing environmental standards, such as other statutes or regulations.” (*Id*. at p. 1107.) Regardless of who develops the threshold, if an agency adopts a threshold, it must be supported with substantial evidence. (State CEQA Guidelines, § 15064.7(b).) Additionally, “thresholds cannot be used to determine automatically whether a given effect will or will not be significant[;]” “[i]nstead, thresholds of significance can be used only as a measure of whether a certain environmental effect "will *normally* be determined to be significant" or "*normally* will be determined to be less than significant" by the agency. (Guidelines, § 15064.7, subd. (a), italics added.)” (*Protect the Historic Amador Waterways*, *supra*, 116 Cal.App.4th at pp. 1108-1109.) Proposed subdivision (c) of section 15064.7 recognizes the principles described above by expressly recognizing that experts and expert agencies may be developing thresholds that other public agencies may find useful in their own CEQA analyses, but requiring, as a safeguard, that any such threshold be supported with substantial evidence.

Notably, nothing in either AB32 or SB97 requires a finding of significance for any particular level of increase in greenhouse gas emissions. AB32, and regulations implementing that statute, will require reductions in emissions from certain sectors in the economy, but do not preclude new emissions. Moreover, as explained in the Initial Statement of Reasons, the proposed amendments do not establish a zero emissions threshold of significance because “there is no ‘one molecule rule’ in CEQA. (*CBE*, *supra*, 103 Cal.App.4th at 120.)” (Initial Statement of Reasons, at p. 20.)

Some comments suggested that any numeric thresholds that are developed should not be set at such a low level that adverse economic impacts would result. While economic issues are appropriate in the determination of feasibility of mitigation and alternatives, it is not appropriate in the determination of significance (see, e.g., Public Resources Code, § 21002), so a threshold should not be designed with economic impacts in mind. Moreover, even a “high” threshold would not relieve agencies of the requirement to consider any evidence indicating that a project may have a significant effect despite falling below a threshold. (*Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1109; *Mejia v. City of Los Angeles* (2005) 130 Cal.App.4th 322, 342.)

Mitigation Hierarchy

CEQA's substantive mandate requires that "public agencies should not approve projects as proposed if there are … feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects[.]" (Public Resources Code, § 21002.) The statute defines feasible to mean "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors." (Public Resources Code, § 21061.1.) The Legislature further provided that a lead agency may use its lawful discretion to mitigate significant impacts to the extent provided by other laws:

> In mitigating or avoiding a significant effect of a project on the environment, a public agency may exercise only those express or implied powers provided by law other than this division. However, a public agency may use discretionary powers provided by such other law for the purpose of mitigating or avoiding a significant effect on the environment subject to the express or implied constraints or limitations that may be provided by law.

(Public Resources Code, § 21004.) Cities and counties may rely on their constitutional police powers, for example, while the ability of other agencies to require mitigation may be limited by the scope of their statutory authority. Mitigation is also subject to constitutional limitations; i.e., there must be a nexus between the mitigation measure and the impact it addresses, and the mitigation must be roughly proportional to the impact of the project. (*Nollan v. California Coastal Comm'n* (1987) 483 U.S. 825; *Dolan v. City of Tigard* (1994) 512 U.S. 374; State CEQA Guidelines, § 15126.4(a)(4).)

CEQA itself imposes very few limitations on a lead agency's discretion to impose mitigation. For example, agencies may not mitigate the effects of a housing project by reducing the proposed number of units if other feasible mitigation measures are available. (Public Resources Code, § 21159.26.) Similarly, the Legislature has prescribed specific types of mitigation in only very limited circumstances; i.e., impacts to archeological resources and oak woodlands. (Public Resources Code, §§ 21083.2, 21083.4.)

SB 97 specifically called for guidelines addressing the mitigation of greenhouse gas emissions. In doing so, however, the Legislature did not alter a lead agency's discretion, authority or limitations on the imposition of mitigation where the impacts of a project's greenhouse gas emissions are significant. Thus, as explained in the Initial Statement of Reasons, the existing CEQA rules apply to the mitigation of greenhouse gas emissions.

Within the scope of a lead agency's existing authority, the CEQA Guidelines already contain provisions that recognize a lead agency's obligation to balance various factors in determining how or whether to carry out a project. (State CEQA Guidelines, § 15021(d).) Further, the Guidelines already require that "[w]here several measures are available to mitigate an impact, each should be discussed and the basis for selecting a particular measure should be identified." (State CEQA Guidelines, § 15126.4(a)(1)(B).)

Additionally, public agencies are directed to adopt their own implementing procedures, consistent with CEQA and the State CEQA Guidelines, which could set forth the types of mitigation that a particular agency finds to be most appropriate for projects subject to its approval. (State CEQA Guidelines, § 15022.) The Natural Resources Agency cannot, however, state in the State CEQA Guidelines that all lead agencies have the authority to prioritize types of mitigation measures, or to establish any particular priority order for them. Each lead agency must determine the scope of its own authority based on its own statutory or constitutional authorization.

Reliability and Effectiveness of Mitigation

Some comments expressed concern about the reliability and efficacy of some mitigation strategies. In response to such comments, the Natural Resources Agency further revised section 15126.4(c) to expressly require that any measures, in addition to being feasible, must be supported with substantial evidence and be capable of monitoring or reporting. (See Revised Section 15126.4(c) (October 23, 2009).) This addition reflects the requirements in Public Resources Code section 21081.5 that findings regarding mitigation be supported with substantial evidence and the monitoring or reporting requirement in section 21081.6.

The text of proposed section 15126.4(c), addressing mitigation of greenhouse gas emissions, also requires that mitigation measures be effective. The first sentence of that section requires that mitigation be "feasible." Further, the statue defines "feasible" to mean "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors." (Public Resources Code, § 21061.1 (emphasis added); see also State CEQA Guidelines § 15364 (adding "legal" factors to the definition of feasibility.) A recent decision of the Third District Court of Appeal confronting questions regarding the effectiveness of a mitigation measure explained: "concerns about whether a specific mitigation measure 'will actually work as advertised,' whether it 'can … be carried out,' and whether its 'success … is uncertain' go to the feasibility of the mitigation measure[.]" (*California Native Plant Society v. City of Rancho Cordova* (2009) 172 Cal. App. 4th 603, 622-623.) Thus, by requiring that lead agencies consider feasible mitigation of greenhouse gas emissions, section 15126.4(c) already requires that such measures be effective.

Off-site Mitigation and Offsets

Relatively little authority addresses the question of how close of a causal connection must exist between off-site emissions reductions and project implementation in order to be adequate mitigation under CEQA. CEQA requires lead agencies to mitigate or avoid the significant effects of proposed projects where it is feasible to do so. While the CEQA statute does not define mitigation, the State CEQA Guidelines define mitigation to include:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

(c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

(State CEQA Guidelines, § 15370.) As subdivision (e) implies, off-site measures may constitute mitigation under CEQA, and such measures have been upheld as adequate mitigation in CEQA case law. (See, e.g., *California Native Plant Society v. City of Rancho Cordova* (2009) 172 Cal. App. 4th 603, 619-626.)

Whether on-site or off-site, to be considered mitigation, the measure must be tied to impacts resulting from the project. Section 21002 of the Public Resources Code, the source of the requirement to mitigate, states that "public agencies should not approve projects as proposed if there are … feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects[.]" Similarly, section 21081(a)(1) specifies a finding by the lead agency in adopting a project that "[c]hanges or alterations have been required in, or incorporated into, the project which mitigate or avoid the significant effects on the environment." Both statutory provisions expressly link the changes to be made (i.e., the "mitigation measures") to the significant effects of the project. Courts have similarly required a link between the mitigation measure and the adverse impacts of the project. (*Save Our Peninsula Comm. v. Monterey County Bd. of Supervisors* (2001) 87 Cal. App. 4th 99, 128-131 (EIR must discuss "the history of water pumping on [the off-site mitigation] property and its feasibility for providing an actual offset for increased pumping on the [project] property").) The text of sections 21002 and 21081, and case law requiring a "nexus" between a measure and a project impact, together indicate that "but for" causation is a necessary element of mitigation. In other words, mitigation should normally be an activity that occurs in order to minimize a particular significant effect. Or, stated another way and in the context of greenhouse gas emissions, emissions reductions that would occur without a project would not normally qualify as mitigation.

Notably, this interpretation of the CEQA statute and case law is consistent with the Legislature's directive in AB32 that reductions relied on as part of a market-based compliance mechanism must be "in addition to any greenhouse gas emission reduction otherwise required by law or regulation, and any other greenhouse gas emission reduction that otherwise would occur." (Health and Safety Code, § 38562(d)(2).) While AB32 and CEQA are separate statutes, the additionality concept may be applied analytically in the latter as follows: greenhouse gas emission reductions that are otherwise required by law or regulation would appropriately be considered part of the existing baseline. Pursuant to section 15064.4(b)(1), a new project's emissions should be compared against that existing baseline.

Thus, in light of the above, and in response to concerns raised in the comments, the Natural Resources Agency has revised section 15126.4(c)(3) to state that mitigation includes: "Off-site measures, including offsets that are not otherwise required, to mitigate a project's emissions[.]" This provision is intended to be read in conjunction with the statutory mandate in Public Resources Code sections 21002 and 21081 that mitigation be tied to the effects of a project.

This provision would not limit the ability of a lead agency to create, or rely on the creation of, a mechanism, such as an offset bank, created prospectively in anticipation of future projects that will later rely on offsets created by those emissions reductions. The Initial Statement of Reasons referred, for example, to community energy conservation projects. (Initial Statement of Reasons, at p. 38.) Such a program could, for example, identify voluntary energy efficiency retrofits that would not occur absent implementation of the program, and then fund the retrofits through the sale of offsets that would occur as a result of the retrofit. Emissions reductions that occur as a result of a regulation requiring such reduction, on the other hand, would not constitute mitigation.

Some comments opined that offsets are highly uncertain and of questionable legitimacy. The Initial Statement of Reasons, however, cites several sources discussing examples of offsets being used in a CEQA context. Further, the ARB Scoping Plan describes offsets as way to "provide regulated entities a source of low-cost emission reductions, and … encourage the spread of clean, efficient technology within and outside California." (Scoping Plan, Appendix C, at p. C-21.) The Natural Resources Agency finds that the offset concept is consistent with the existing CEQA Guidelines' definition of "mitigation," which includes "[r]ectifying the impact by repairing, rehabilitating, or restoring the impacted environment" and "[c]ompensating for the impact by replacing or providing substitute resources or environments." (State CEQA Guidelines, §§ 15370(c), (e).)

While the proposed amendments recognize offsets as a potential mitigation strategy, they do not imply that offsets are appropriate in every instance. The efficacy of any proposed mitigation measure is a matter for the lead agency to determine based on the substantial evidence before it. Use of the word "feasible" in proposed Section 15126.4(c) requires the lead agency to find that any measure, including offsets, would be "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors." (State CEQA Guidelines, § 15364.)

Thus, the Natural Resources Agency finds that by expressly requiring that any mitigation measure be feasible, supported with substantial evidence, and capable of monitoring or reporting, section 15126.4(c) adequately addresses the concern stated in the comment that offsets may be of questionable legitimacy.

Use of Plans for the Reduction of Greenhouse Gas Emissions in a Cumulative Impacts Analysis

Section 15183.5 was developed to address tiering and streamlining the analysis of greenhouse gas emissions. Subdivision (a) highlights existing tiering and streamlining mechanisms in CEQA that may be used to address the analysis and mitigation of greenhouse gas emissions. Those mechanisms are often used for general plans and other long range planning documents. Subdivision (a) therefore recognizes that lead agencies may choose to include a programmatic analysis of greenhouse gas emissions in those long range plans. That subdivision did not create any new tiering or streamlining provisions; rather, it cross-references existing mechanisms. Each mechanism has its own benefits and drawbacks, and the use of any analysis of greenhouse gas emissions contained in such a document would be governed by the specific provisions cited in subdivision (a).

Subdivision (b), on the other hand, acknowledges that, in addition to the long range documents mentioned in subdivision (a), some agencies are voluntarily developing stand-alone plans focused specifically on the reduction of greenhouse gas emissions. Subdivision (b) is not a tiering mechanism. Tiering is governed by section 15152 of the existing CEQA Guidelines. The purpose of section 15183.5(b) is much narrower. Because climate action plans and greenhouse gas reduction plans are voluntary, and not subject to any legislative criteria or requirements, subdivision (b) was developed "to assist lead agencies in determining whether an existing greenhouse gas reduction plan is an appropriate document to use in a cumulative impacts analysis under CEQA." (Initial Statement of Reasons, at p. 54.) Specifically, a project that is consistent with a plan that satisfies the criteria in subdivision (b) may benefit from the presumption created in sections 15064(h)(3) and 15130(d) that the project's cumulative impacts are less than significant due to compliance with the plan. Subdivision (b) does not create or authorize any plans; rather, it provides a tool to determine whether a plan for the reduction of greenhouse gas emissions may be used in a cumulative impacts analysis as provided in section 15064(h)(3) or 15130(d). Section 15183.5(b) does not require that public agencies develop plans for the reduction of greenhouse gas emissions, nor does it prohibit public agencies from developing individual ordinances and regulations to address individual sources of greenhouse gas emissions.

As an example, if a general plan EIR analyzed and mitigated greenhouse gas emissions, a lead agency would likely use the specific streamlining provision applicable to general plan EIRs in section 15183, and not the more general provision in 15183.5(b). A stand alone "climate action plan" that was not analyzed in a program EIR, master EIR, or other mechanism identified in 15183.5(a) may still be used in a cumulative impacts analysis pursuant to sections 15064(h)(3) or 15130(d), but only if that climate action plan contains the elements listed in section 15183.5(b)(1).

Some comments suggested that section 15183.5(b) should identify specific types of plans to which it would apply. That section was developed precisely because plans for the reduction of greenhouse gas emissions are not specified in law and are so varied. They have been variously titled “climate action plans”, “sustainability plans”, “greenhouse gas reduction plans”, etc. Contents of such plans also vary widely. Thus, the Natural Resources Agency cannot specifically identify which plans satisfy the criteria in subdivision (b). That determination must be made by the individual lead agency based on whether the specific plan under consideration satisfies each of the criteria in subdivision (b)(1).

Notably, public agencies are required to develop their own procedures to implement CEQA. (State CEQA Guidelines, § 15022.) If a lead agency determines that it does not have a plan for the reduction of greenhouse gas emissions that contains the criteria set forth in section 15183.5(b), but its collective policies, ordinances and other requirements nevertheless ensure that the incremental contribution of individual projects is not cumulatively considerable, and substantial evidence supports that determination, it could include such an explanation and support in its own implementing procedures.

Some comments questioned how a Sustainable Communities Strategy or Alternative Planning Strategy should be treated in light of section 15183.5. SB375 encourages programmatic analysis and planning for greenhouse gas emissions from cars and light-duty trucks, and provides specific CEQA streamlining benefits for certain types of projects that are consistent with a Sustainable Communities Strategy (SCS) or an Alternative Planning Strategy (APS). Given the specificity of those statutory provisions, sections 21155 through 21155.3 and 21159.28 of the Public Resources Code in particular, the Office of Planning and Research and the Natural Resources Agency did not find that additional guidance on those provisions was necessary at this time. Proposed section 15183.5(c), however, clarifies that while certain projects consistent with an SCS or APS may not need to analyze greenhouse gas emissions from cars and light-duty trucks, emissions from other sources still may require analysis and mitigation. As SB97 requires the CEQA Guidelines to be updated every two years to incorporate new information, additional guidance regarding the relationship between CEQA and SB375 may be developed as necessary. (See also the discussion of AB32, SB375 and CEQA, above.)

Definition of Greenhouse Gas Emissions

Several comments objected to the definition of greenhouse gas emissions in the Guidelines. Some suggested that it should be strictly limited to the gases identified in AB32. Other thought it should include all potential greenhouse gas emissions. Still others wanted to exclude biogenic emissions from the definition.

As explained in the Initial Statement of Reasons, the definition of greenhouse gases in AB32 states that GHG "includes all of the following…." (Health and Safety Code, § 38505(g).) The Legislature thus implied that other gases may also be considered GHGs. Further, the ARB Scoping Plan also acknowledged that other gases contribute to climate change. (Scoping Plan, at p. 11.) Consistent with the definition in the Health and Safety Code, the proposed definition in the Proposed Amendments is not exclusive to the six primary GHGs. The purpose of a more expansive definition is to ensure that lead agencies do not exclude from consideration GHGs that are not listed, so long as substantial evidence indicates that such non-listed gases may result in significant adverse effects. This approach is consistent with the Supreme Court's directive that CEQA be interpreted to provide the fullest possible protection to the environment. (*Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal. 3d 376, 390.)

While the definition could not be strictly limited to the six gases identified in AB32, the Natural Resources Agency concluded that specific mention of other potential greenhouse gases was also not appropriate. Notably, the federal Environmental Protection Agency limited its proposed endangerment finding to those same six listed gases. It did so because the six gases are well studied, and have been the focus of climate change research. (Federal Register, v. 74, 18886, 18895 (April 24, 2009).) It is not necessary to list each of the known potential greenhouse gases because the proposed definition in section 15364.5 is written broadly, stating that the greenhouse gas emissions "are not limited to" the listed examples. As further explained in the Initial Statement of Reasons, the "purpose of a more expansive definition is to ensure that lead agencies do not exclude from consideration GHGs that are not listed, so long as substantial evidence indicates that such non-listed gases may result in significant adverse effects." (Initial Statement of Reasons, at p. 58.) Because the CEQA Guidelines must be updated periodically to reflect developments relating to greenhouse gas emissions, the Natural Resources Agency may expand the definition of greenhouse gas emissions if necessary to reflect the most current science and practice.

The Natural Resources Agency also concluded that the definition of greenhouse gas emissions should not differentiate between biogenic and anthropogenic emissions. SB97 does not distinguish between the sources of greenhouse gas emissions. Notably, neither AB32 nor the Air Resources Board's Scoping Plan distinguishes between biogenic and anthropogenic sources of greenhouse gas emissions. On the contrary, the Scoping Plan identifies methane from, among other sources, organic wastes decomposing in landfills as a source of emissions that should be controlled. (Scoping Plan, at pp. 62-63.)

Forestry

Some comments objected to the inclusion of questions related to forest resources in the Appendix G questions in the section on agricultural resources.

SB97 called for guidance on the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions. (Public Resources Code, § 21083.05.) As explained in the Initial Statement of Reasons, forest conversions may result in direct greenhouse gas emissions. Further, such conversions remove existing forest stock and the potential for further carbon sequestration. (Initial Statement of Reasons, at p. 63.) Sequestration is recognized as a key mitigation strategy in the Air Resources Board's Scoping Plan. (Scoping Plan, Appendix C, at p. C-168.)

The addition of questions related to forestry does not target the establishment of agricultural operations. The questions ask about *any* conversion of forests, not just conversions to other agricultural operations. Moreover, analysis of impacts to forestry resources is already required. The Legislature has declared that "forest resources and timberlands of the state are among the most valuable of the natural resources of the state" and that such resources "furnish high-quality timber, recreational opportunities, and aesthetic enjoyment while providing watershed protection and maintaining fisheries and wildlife." (Public Resources Code, § 4512(a)-(b).) Because CEQA defines "environment" to include "land, air, water, minerals, flora, fauna, noise, [and] objects of historic or aesthetic significance" (Public Resources Code, section 21060.5), and because forest resources have been declared to be "the most valuable of the natural resources of the state," projects affecting such resources must be analyzed, whether or not specific questions relating to forestry resources appear in Appendix G. (*Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1109.) In effect, suggestions that the Appendix G questions be limited to conversions to "non-agricultural uses" ask the Natural Resources Agency to adopt changes that are inconsistent with CEQA, which it cannot do.

Questions related to greenhouse gas emissions in Appendix G are not sufficient to address impacts related to forestry resources. As explained in the Initial Statement of Reasons, not only do forest conversions result in greenhouse gas emissions, but may also "remove existing carbon stock (i.e., carbon stored in vegetation), as well as a significant carbon sink (i.e., rather than emitting GHGs, forests remove GHGs from the atmosphere)." (Initial Statement of Reasons, at p. 63.) Further, conversions may lead to "aesthetic impacts, impacts to biological resources and water quality impacts, among others." The questions related to greenhouse gas emissions would not address such impacts. Thus, the addition of forestry questions to Appendix G is appropriate both pursuant to SB97 and the Natural Resources Agency's general authority to update the CEQA Guidelines pursuant to Public Resources Code section 21083(f).

"Level of Service" and Transportation Impact Analysis

The Natural Resources Agency acknowledges the concern expressed by some comments that the use of level of service metrics in CEQA analysis has led to an auto-centric focus. The Office of Planning and Research and the Natural Resources Agency have participated in extensive outreach with stakeholder groups to revise question (a) in the transportation section of Appendix G to accomplish the following goals:

- Assess traffic impacts on intersections, streets, highways and freeways as well as impacts to pedestrian, non-vehicular and mass-transit circulation

- Recognize a lead agency's discretion to choose methodology, including LOS, to assess traffic impacts

- Harmonize existing requirements in congestion management programs, general plans, ordinances, and elsewhere

In response to public comments submitted on proposed amendments, the Natural Resources Agency further refined question (a) to shift the focus from the capacity of the circulation system to consistency with applicable plans, policies that establish objective measures of effectiveness.

Some comments advocated leaving the existing text in question (a) of the transportation section of Appendix G intact. As explained in the Initial Statement of Reasons,

> [Q]uestion (a) changes the focus from an increase in traffic at a given location to the effect of a project on the overall circulation system in the project area. This change is appropriate because an increase in traffic, by itself, is not necessarily an indicator of a potentially significant environmental impact. (Ronald Miliam, AICP, Transportation Impact Analysis Gets a Failing Grade When it Comes to Climate Change and Smart Growth; see also Land Use Subcommittee of the Climate Action Team LUSCAT Submission to CARB Scoping Plan on Local Government, Land Use, and Transportation Report (May, 2008) at pp. 31, 36.) Similarly, even if some projects may result in a deterioration of vehicular level of service – that is, delay experienced by drivers – the overall effectiveness of the circulation system as a whole may be improved. (*Ibid*.) Such projects could include restriping to provide bicycle lanes or creating dedicated bus lanes. Even in such cases, however, any potential adverse air quality or other impacts would still have to be addressed as provided in other sections of the checklist. Finally, the change to question (a) also recognizes that the lead agency has discretion to choose its own metric of analysis of impacts to intersections, streets, highways and freeways. (Pub. Resources Code, § 21081.2(e); *Eureka Citizens for Responsible Gov't v. City of Eureka*, *supra*, 147 Cal.App.4th at 371-373 (lead agency has discretion to choose its methodology).) Thus, "level of service" may or may not be the applicable measure of effectiveness of the circulation system.

(Initial Statement of Reasons, at pp. 64-65.) Further, evidence presented to the Natural Resources Agency indicates that "mitigation" of traffic congestion may lead to even greater environmental impacts than might result from congestion itself. (See, e.g., Cervero, Robert. (July, 2001). *Road Expansion, Urban Growth, and Induced Travel: A Path Analysis*. Journal of the American Planning Association, Vol. 69 No. 2. American Planning Association (confirming "induced demand" phenomenon associated with capacity improvements).)

While the terms "volume to capacity ratio" and "congestion at intersections" no longer appear in question (a), nothing precludes a lead agency from including such measures of effectiveness in its own general plan or policies addressing its circulation system. Though the Office of Planning and Research originally recommended specifying "vehicle miles traveled" as a question in Appendix G, it later revised its recommendation to allow lead agencies to choose their own measures of effectiveness. (Letter from OPR Director, Cynthia Bryant, to Secretary for the Natural Resources Agency, Mike Chrisman, April 13, 2009.) Thus, as revised, question (a) accommodates lead agency selection of methodology, including, as appropriate, vehicle miles traveled, levels of service, or other measures of effectiveness.

Other comments objected to any mention of the phrase "level of service" in question (b) of the transportation section of the Appendix G checklist. That question, as revised, would ask whether a project would conflict with the provisions of a congestion management program. The Government Code, beginning at section 65088, requires Congestion Management Agencies, in urbanized areas, to adopt Congestion Management Programs covering that agency's cities and county, and in consultation with local governments, transportation planning agencies, and air quality management districts. A CMP must, pursuant to statute, contain level of service standards for certain designated roadways. A CMP must also include a land use analysis program to assess the impact of land use decisions on the regional transportation system. A CMA may require that land use analysis to occur through the CEQA process. Thus, level of service standards cannot be deleted from the Appendix G checklist altogether. The proposed amendments did, however, amend question (b) to put level of service standards in the broader context of the entire CMP, which should also contain travel demand measures and other standards affecting the circulation system as a whole. Beyond this amendment, however, the Natural Resources Agency cannot remove level of service standards entirely from the Appendix G checklist.

Notably, the primary purpose of the proposed amendments is to update the CEQA Guidelines on the analysis and mitigation of greenhouse gas emissions. While certain changes to Appendix G were proposed pursuant to the Natural Resources Agency's general authority to update the CEQA Guidelines, those changes were modest and were intended to address certain misapplications of CEQA in a way that hinders the type of development necessary to reduction of greenhouse gas emissions. Transportation planning and impact analysis continues to evolve, as new multimodal methods of analysis and guidelines on the integration of all modes of transportation and users into the circulation system are being developed. Additional updates to Appendix G may be appropriate in the future to address those developments.

Parking

As explained in the Initial Statement of Reasons, the Natural Resources Agency concluded that the question related to parking adequacy should be deleted from the Appendix G checklist in part as a result of the decision in *San Franciscans Upholding the Downtown Plan v. City and County of San Francisco* (2002) 102 Cal.App.4th 656. The court in that case distinguished the social impact of inadequate parking from actual adverse environmental impacts. In particular, that court explained:

> [T]here is no statutory or case authority requiring an EIR to identify specific measures to provide additional parking spaces in order to meet an anticipated shortfall in parking availability. The social inconvenience of having to hunt for scarce parking spaces is not an environmental impact; the secondary effect of scarce parking on traffic and air quality *is*. Under CEQA, a project's social impacts need not be treated as significant impacts on the environment. An EIR need only address the *secondary physical* impacts that could be triggered by a social impact.

(*Id*. at p. 698 (emphasis in original).) The Natural Resources Agency is aware of no authority requiring an analysis of parking adequacy as part of a project's environmental review. Rather, the Agency concurs with the court in the *San Franciscans* case that inadequate parking is a social impact that may, depending on the project and its setting, result in secondary effects. Consistent with existing CEQA Guidelines section 15131(a), deletion of the parking adequacy question from Appendix G checklist will ensure that the "focus of the analysis shall be on the physical changes." Specifically, the Appendix G checklist contains questions asking about possible project impacts to air quality and traffic.

Some comments pointed to examples of potential adverse impacts that could result from parking shortages, such as double-parking and slower circulation speeds, and referred specifically to a study of "cruising" behavior by Donald Shoup that noted that cruising could result in emissions of carbon dioxide. The relationship between parking adequacy and air quality is not as clear or direct as some comments imply. Mr. Shoup, for example, submitted comments to the Natural Resources Agency supporting the deletion of the parking question. (See, Letter from Donald Shoup, Professor of Urban Planning, University of California, Los Angeles, October 26, 2009.) In those comments, Mr. Shoup opines that cruising results not from the number of parking spaces associated with a project, but rather from the price associated with those parking spaces. (*Ibid*.) The Natural Resources Agency also has evidence before it demonstrating that providing parking actually causes greater emissions due to induced demand. The California Air Pollution Control Officers Association CEQA White Paper, for example, suggests reducing available parking as a way to reduce greenhouse gas emissions. (Greg Tholen, et al. (January, 2008). CEQA & Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act. California Air Pollution Control Officers Association, at Appendix B, pp. 8-9.)

Moreover, parking analyses do not typically address either air quality or traffic impacts; rather, such analyses often focus on the number of parking spaces necessary to satisfy peak demand, which is often established by a local agency as a parking ratio (i.e., one space per 250 square feet of office space). (See, e.g., Shoup, Donald. (1999). In Lieu of Required Parking. Journal of Planning Education and Research, Vol. 18 No. 4. Association of Collegiate Schools of Planning, at p. 309.) Thus, the question in Appendix G related to parking adequacy does not necessarily lead to the development of information addressing actual environmental impacts.

In sum, nothing in the CEQA statute, or cases interpreting that statute, require an analysis of parking demand. Further, parking supply is not a reasonable proxy for direct physical impacts associated with a project because parking supply may in some circumstances adversely affect air quality and traffic while in other circumstances, it may create air quality and traffic benefits. Thus, maintaining the parking question in the general Appendix G checklist is not necessary to effectuate the purposes of the CEQA statute.

The Natural Resources Agency acknowledges, however, that parking supply may lead to social impacts that agencies may wish to regulate. Cities and counties can, and do, include parking related policies in their municipal ordinances and general plans. (See, e.g., Office of Planning and Research, General Plan Guidelines, at pp. 59-60.) To the extent an agency has developed parking related policies in a general plan, zoning ordinance, or other regulation, consistency with those policies could be analyzed as a potential land use impact. Public agencies must, moreover, develop their own procedures to implement CEQA, and so may include parking-related questions in their own checklist if appropriate in their own circumstances. (State CEQA Guidelines, §§ 15022, 15063(f).)

AB32, SB375 and CEQA

Many comments suggested various links between CEQA, AB32 and SB375. While there is some overlap between the statutes, each contains its own requirements and serves its own purposes. While recognizing the role of regulatory programs in addressing cumulative impacts analysis in CEQA, the Proposed Amendments deliberately avoided linking the determination of significance under CEQA to compliance with AB32. The following addresses the CEQA effect of compliance with AB32 and SB375.

<u>The Effect of Consistency with the Scoping Plan and the Regulations Implementing AB32</u>

The Initial Statement of Reasons explained that the Scoping Plan "may not be appropriate for use in determining the significance of individual projects … because it is conceptual at this stage and relies on the future development of regulations to implement the strategies identified in the Scoping Plan." (Initial Statement of Reasons, at p. 14.) Compliance with the regulations implementing the Scoping Plan, on the other hand, might be relevant in determining the significance of a project's emissions, if the particular regulation or regulations specifically addresses the emissions from the project. (*Ibid.*) Compliance with regulations is specifically addressed in section 15064(h)(3) and 15064.4(b)(3).

Specifically, both sections provide that a lead agency may consider compliance with such regulations, and if relying on regulations to determine that an impact is less than significant, the lead agency must explain how that particular regulation addresses the impact of the project. Both sections also recognize that a lead agency must still consider whether any evidence supports a fair argument that a project may still have a significant impact despite compliance with the regulation.

<u>The Effect of Consistency with Plans for the Reduction of Greenhouse Gas Emissions, Sustainable Communities Strategies and Alternative Planning Strategies.</u>

Several comments questioned whether the references in the Proposed Amendments to "greenhouse gas reduction plans" were intended to include a Sustainable Communities Strategy (SCS) or Alternative Planning Strategy (APS).

SB375 created both the SCS and APS as strategies to be adopted by metropolitan planning organizations for the purpose of achieving greenhouse gas emissions reductions targets established by the California Air Resources Board. SB375 inserted specific provisions into CEQA governing the review of projects that are consistent with an APS or SCS. (See, e.g., Public Resources Code, §§ 21155-21155.3, 21159.28.) Because of the specificity of those provisions, the Office of Planning and Research and the Natural Resources Agency determined that no further guidance was needed in the Proposed Amendments to address the use of an SCS or APS.

As explained in the Initial Statement of Reasons, however, OPR and the Natural Resources Agency observed that many jurisdictions were adopting plans specifically for the purpose of addressing and reducing greenhouse gas emissions. (Initial Statement of Reasons, at pp. 12-13.) Those plans may be titled Climate Action Plans, Greenhouse Gas Reduction Plans, Sustainability Plans, etc. While recognizing the great variety of such plans, as well as the lack of legislative or other direction regarding the content of such plans, OPR and the Natural Resources Agency proposed the addition of a new Guidelines section 15183.5(b) to establish criteria for those plans if they are to be used in a CEQA cumulative impacts analysis as provided in sections 15064(h)(3) and 15130(d). The proposed amendments to section 15064(h)(3) and addition of section 15183.5(b) were not intended to limit or affect the use of an APS or SCS as provided in the Public Resources Code.

SB375 included provisions that would exempt certain types of projects from CEQA, and would apply the substantial evidence standard of review to other types of projects reviewed under a Sustainable Communities Environmental Assessment. Some comments raised concerns that the proposed amendments, and section 15064(h)(3) in particular, may conflict with those provisions of SB375. The last sentence of Section 15064(h)(3), which acknowledges the application of the fair argument standard in the determination of whether to prepare an EIR, complies with existing law. (*CBE*, *supra*, 103 Cal.App.4th at 115-116.) SB375's specific statutory provisions, and not section 15064(h)(3), would control for a project that satisfies the conditions in those provisions. Thus, there is no conflict between the existing language in Section 15064(h)(3) and SB375.

Comments were also raised about the application of section 15125(d), which requires a discussion of a project's consistency with applicable regional plans, to an APS or SCS. One comment suggested that, for CEQA purposes, an SCS and APS are interchangeable. The Natural Resources Agency disagrees. An Alternative Planning Strategy is not a land use plan with which land use consistency should be analyzed under CEQA. (Government Code, § 65080(b)(2)(H)(v).) For that reason, the Natural Resources Agency deliberately did not propose to add "Alternative Planning Strategy" to the list of plans to be considered in an environmental setting pursuant to section 15125. There is no similar statement precluding analysis of consistency with a Sustainable Communities Strategy, however. Thus, the reference to a "regional transportation plan" in the existing section 15125(d) remains appropriate. As explained above, and the Initial Statement of Reasons, the reference to "plans for the reduction of greenhouse gas emissions" is intended to cover a broad range of plans that may be adopted by state and local agencies. The specific statutory provisions governing an Alternative Planning Strategy or Sustainable Communities Strategy would, however, control.

Similarly, some comments expressed concern regarding the application of the new Appendix G question asking about a project's consistency with applicable plans for the reduction of greenhouse gas emissions. That Appendix G question, as revised, asks whether a project would: "Conflict with <u>an applicable plan</u>, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?" (Emphasis added.) In response to comments, the Natural Resources Agency replaced the word "any" with the word "an" to clarify that only a plan determined to be applicable by the lead agency, and not any plan developed by any person or entity, should be considered in determining whether a project would result in a significant impact relating to greenhouse gas emissions. Government Code section 65080(b)(2)(H)(v) states: an "alternative planning strategy shall not constitute a land use plan, policy, or regulation, and the inconsistency of a project with an alternative planning strategy shall not be a consideration in determining whether a project may have an environmental effect" for CEQA purposes. By operation of that Government Code Section 65080(b)(2)(H)(v), an alternative planning strategy would not constitute "an applicable plan" for purposes of the Appendix G question. Notably, as explained in the Initial Statement of Reasons, the Appendix G checklist is meant to provide a sample checklist of questions designed to provoke thoughtful consideration of general environmental concerns. (Initial Statement of Reasons, at p. 63.) Because it is provided as a sample only, the Office of Planning and Research and the Natural Resources Agency found that it would not be possible to identify with specificity each plan that or may not apply to a particular jurisdiction or project.

Lead agencies, however, have discretion to revise the checklist in a way that is most appropriate for their own jurisdiction. If an individual agency in a region where an APS was prepared finds it necessary or desirable to restate Government Code Section 65080(b)(2)(H)(v) in its own checklist, it may do so. Further, while inconsistency with an APS is not, by itself, an indication of a potentially significant impact, other project characteristics would need to be considered as indicated in Section 15064.4 and other provisions of the CEQA Guidelines. Because Government Code Section 65080(b)(2)(H)(v) already provides that an APS is not a land use plan for CEQA purposes, and the Appendix G question asks only about "an applicable plan," the question need not specify an exception for an APS.

<u>The Effect of Compliance with Regulations Implementing AB32 or Other Laws Intended to Reduce Greenhouse Gas Emissions</u>

Some comments urged that lead agencies should be able to rely on sector-wide reductions in emissions that may result from implementation of AB32 and other regulations in mitigating an individual project's impacts. Those comments appeared to conflate the requirement that a lead agency consider cumulative impacts (i.e., the impacts resulting from a project's emissions when added to other past, present and reasonably foreseeable future emissions) with the requirement that a lead agency mitigate the significant effects of a project. The proposed amendments contain several provisions addressing the analysis of greenhouse gas emissions as a cumulative effect. For example, Section 15064(h)(3) and 15130(d) would encourage lead agencies to use existing plans for the reduction of greenhouse gas emissions in cumulative impacts analysis. Additionally, Section 15130(b)(1)(B) is proposed for amendment to allow lead agencies to use projections of emissions contained in certain plans and models. Thus, the proposed amendments would allow a lead agency to consider a project in the context of other emissions resulting from the same or other sectors.

To the extent comments suggested that reductions in emissions resulting from implementation of AB32 elsewhere can mitigate the significant effects of a separate project under CEQA, the Natural Resources Agency disagrees. (See discussion below on off-site mitigation.)

A project's compliance with regulations or requirements implementing AB32 or other laws and policies is not irrelevant. Section 15064.4(b)(3) would allow a lead agency to consider compliance with requirements and regulations in the determination of significance of a project's greenhouse gas emissions. Lead agencies should note, however, that compliance with one requirement, affecting only one source of a project's emissions, may not necessarily support a conclusion that all of the project's emissions are less than significant.

Projects That Implement AB32 or Otherwise Assist in Achieving the State's Emissions Reductions Goals

Finally, some comments noted that projects implementing AB32, or that would somehow assist the State in achieving a low-carbon future, should not be considered significant under CEQA, and that requiring such projects to mitigate their emissions would frustrate implementation of AB32. CEQA requires analysis and mitigation of a project's significant adverse environmental impacts, even if that project may be considered environmentally beneficial overall. As the Third District Court of Appeal recently explained:

> "[I]t cannot be assumed that activities intended to protect or preserve the environment are immune from environmental review. [Citations.]" …. There may be environmental costs to an environmentally beneficial project, which must be considered and assessed.

(*Cal. Farm Bureau Fed. v. Cal. Wildlife Cons. Bd.* (2006) 143 Cal. App. 4th 173, 196.) Nothing in SB97 altered this rule. Thus, lead agencies must consider whether the greenhouse gas emissions resulting from beneficial projects may be significant, and if so, whether any feasible measures exist to mitigate those emissions. If such emissions are found to be significant and unavoidable, proposed amendments to section 15093 would expressly allow lead agencies to consider the region-wide and statewide environmental benefits of a project in determining whether project benefits outweigh its adverse environmental impacts.

"Adaptation" and Analysis of the Effects of Climate Change on a Project

Several comments submitted as part of the Natural Resources Agency's SB97 rulemaking process urged it to incorporate the California Climate Adaptation Strategy (Adaptation Strategy) into the CEQA Guidelines. In considering such comments, it is important to understand several key differences between the Adaptation Strategy and the California Environmental Quality Act. First, the Adaptation Strategy is a policy statement that contains recommendations; it is not a binding regulatory document. Second, the Adaptation Strategy focuses on how the State can plan for the effects of climate change. CEQA's focus, on the other hand, is the analysis of a particular project's greenhouse gas emissions on the environment, and mitigation of those emissions if impacts from those emissions are significant. Given these differences, CEQA should not be viewed as the tool to implement the Adaptation Strategy; rather, as indicated in the Strategy's key recommendations, advanced programmatic planning is the primary method to implement the Adaptation Strategies.

There is some overlap between CEQA and the Adaptation Strategy, however. As explained in both the Initial Statement of Reasons and in the Adaptation Strategy, section 15126.2 may require the analysis of the effects of a changing climate under certain circumstances. (Initial Statement of Reasons, at pp. 68-69.) In particular, Section 15126.2 already requires an analysis of placing a project in a potentially hazardous location. Further, several questions in the Appendix G checklist already ask about wildfire and flooding risks. Many comments on the proposed amendments asked for additional guidance, however.

Having reviewed all of the comments addressing the effects of climate change, the Natural Resources Agency revised the proposed amendments to include a new sentence in Section 15126.2 clarifying the type of analysis that would be required. Existing section 15126.2(a) provides an example of a potential hazard requiring analysis: placing a subdivision on a fault line. The new sentence adds further examples, as follows:

> Similarly, the EIR should evaluate any potentially significant impacts of locating development in other areas susceptible to hazardous conditions (e.g., floodplains, coastlines, wildfire risk areas) as identified in authoritative hazard maps, risk assessments or in land use plans addressing such hazards areas.

According to the Office of Planning and Research, at least sixty lead agencies already require this type of analysis. (California Governor's Office of Planning and Research, State Clearinghouse, The California Planners' Book of Lists (January, 2009), at p. 109.) This addition is reasonably necessary to guide lead agencies as to the scope of analysis of a changing climate that is appropriate under CEQA.

As revised, section 15126.2 would provide that a lead agency should analyze the effects of bringing development to an area that is susceptible to hazards such as flooding and wildfire, both as such hazards currently exist or may occur in the future. Several limitations apply to the analysis of future hazards, however. For example, such an analysis may not be relevant if the potential hazard would likely occur sometime after the projected life of the project (i.e., if sea-level projections only project changes 50 years in the future, a five-year project may not be affected by such changes). Additionally, the degree of analysis should correspond to the probability of the potential hazard. (State CEQA Guidelines, § 15143 ("significant effects should be discussed with emphasis in proportion to their severity and probability of occurrence").) Thus, for example, where there is a great degree of certainty that sea-levels may rise between 3 and 6 feet at a specific location within 30 years, and the project would involve placing a wastewater treatment plant with a 50 year life at 2 feet above current sea level, the potential effects that may result from inundation of that plant should be addressed. On the other extreme, while there may be consensus that temperatures may rise, but the magnitude of the increase is not known with any degree of certainty, effects associated with temperature rise would not need to be examined. (State CEQA Guidelines, § 15145 ("If, after thorough investigation, a lead agency finds that a particular impact is too speculative for evaluation, the agency should note its conclusion and terminate the discussion of the impact").) Lead agencies are not required to generate their own original research on potential future changes; however, where specific information is currently available, the analysis should address that information. (State CEQA

Guidelines, § 15144 (environmental analysis "necessarily involves some degree of forecasting. While seeing the unforeseeable is not possible, an agency must use its best efforts to find out and disclose all that it reasonably can").)

The decision in *Baird v. County of Contra Costa* (1995) 32 Cal.App.4th 1464, does not preclude this analysis. In that case, the First District Court of Appeal held that a county was not required to prepare an EIR due solely to pre-existing soil contamination that the project would not change in any way. (*Id*. at 1468.) No evidence supported the petitioner's claim that the project would "expose or exacerbate" the pre-existing contamination, which was located several hundred to several thousand feet from the project site. (*Id*. at n. 1.) Moreover, the project would have no other significant effects on the environment, and other statutes exist to protect residents from contaminated soils. Thus, the question confronting that court was whether pre-existing contamination near the project was, by itself, enough to require preparation of an EIR. It held that, in those circumstances, an EIR was not required. That court also acknowledged, however, that where there is a potential for ultimately changing the environment, an EIR could be required. (*Id*. at p. 1469.) Thus, unlike the circumstances in the *Baird* case, the analysis required in section 15126.2(a) would occur if an EIR was otherwise required. Similarly, the addition to that section contemplates hazards which the presence of a project could exacerbate (i.e., potential upset of hazardous materials in a flood, increased need for firefighting services, etc.).

Finally, while the revision in section 15126.2 is consistent with the general objective of the Adaptation Strategy and is consistent with the limits of CEQA, not all issues addressed in the Adaptation Strategy are necessarily appropriate in a CEQA analysis. Thus, the revision in section 15126.2 should not be read as implementation of the entire Adaptation Strategy. Unlike hazards that can be mapped, other issues in the Adaptation Strategy, such as the health risks associated with higher temperatures, are not capable of an analysis that links a project to an ultimate impact. Habitat modification and changes in agriculture and forestry resulting from climate change similarly do not appear to be issues that can be addressed on a project-by-project basis in CEQA documents. Water supply variability is an issue that has already been addressed in depth in recent CEQA cases. (*See*, *e.g.*, *Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova* (2007) 40 Cal.4th 412, 434-435 ("If the uncertainties inherent in long-term land use and water planning make it impossible to confidently identify the future water sources, an EIR may satisfy CEQA if it acknowledges the degree of uncertainty involved, discusses the reasonably foreseeable alternatives—including alternative water sources and the option of curtailing the development if sufficient water is not available for later phases—and discloses the significant foreseeable environmental effects of each alternative, as well as mitigation measures to minimize each adverse impact.").) Further, legislation has been developed to ensure that lead agencies identify adequate water supplies to serve projects many years in the future under variable water conditions. (See, e.g., Water Code, § 10910 *et seq*.; Government Code, § 66473.7.) Thus, the analysis called for in section 15126.2(a) should be directed primarily at hazards, and not all aspects of the Adaptation Strategy.

Additional Changes

Several comments suggested revisions or requested clarification of issues that were not addressed in this rulemaking package. The Initial Statement of Reasons explained:

> [T]he Proposed Amendments suggest relatively modest changes to various portions of the existing CEQA Guidelines. Modifications address those issues where analysis of GHG emissions may differ in some respects from more traditional CEQA analysis. Other modifications are suggested to clarify existing law that may apply both to analysis of GHG emissions as well as more traditional CEQA analyses. The incremental approach in the Proposed Amendments is consistent with Public Resources Code section 21083(f), which directs OPR and the Resources Agency to regularly review the Guidelines and propose amendments as necessary.

(Initial Statement of Reasons, at p. 9.) Additionally, Public Resources Code section 21083.05(c) requires that the CEQA Guidelines be updated periodically “to incorporate new information or criteria established by the State Air Resources Board pursuant to” AB32. Therefore, the CEQA Guidelines will continually be updated to reflect evolving information and practice and to address developments regarding analysis of greenhouse gas emissions in the courts.

Determination Regarding Impacts on Local Government and School Districts

The Natural Resources Agency has determined that the Amendments to the State CEQA Guidelines do not impose additional requirements or costs on local government or school districts. Among other things, Public Resources Code section 21083.05 (reflected in amendments to State CEQA Guidelines sections 15064.4, 15064.7(c), 15126.4(c), 15130, 15183.5, 15364.5, and Appendix G) clarifies that CEQA requires analysis of a project’s greenhouse gas emissions. Public Resources Code sections 21002 and 21004 (reflected in State CEQA Guidelines section 15126.4) require a lead agency to impose feasible mitigation where a project will cause significant adverse environmental impacts. Public Resources Code sections 21003 and 21093 (reflected in the amendments to State CEQA Guidelines sections 15064, 15125, 15130, 15150 and 15183, and new State CEQA Guidelines sections 15064.4 and 15183.5) encourage lead agencies to tier environmental impact reports wherever possible and to use existing analyses to reduce duplication and expense. The decision in Berkeley Keep Jets Over the Bay Com. v. Board of Port Comm. (2001) 91 Cal.App.4th 1344, 1370, 1382 (reflected in proposed State CEQA Guidelines section 15064.4), requires that potential adverse impacts be quantified where it is possible to do so and quantification will assist in the determination of significance of the impact.

The Amendments to the State CEQA Guidelines described above merely reflect existing legislative requirements and judicial decision interpreting those requirements. Therefore, this rulemaking activity does not itself impose any costs on local government or school districts.

Determination Regarding Potential Economic Impacts Directly Affecting Business

The Natural Resources Agency has determined that the Amendments will not have a significant, statewide adverse economic impact directly affecting business. The guidelines required by sections 21083 and 21083.05 of the Public Resources Code are promulgated in the California Code of Regulations, title 14, sections 15000-15387 (the "State CEQA Guidelines"). The Natural Resources Agency has determined that most of the amendments will have no impacts on business.

CEQA applies to activities of public agencies, including projects that are funded, proposed, or approved by public agencies. Thus, the amendments to the State CEQA Guidelines would apply to public agencies, and not directly to businesses. The Natural Resources Agency is aware, however, that certain requirements reflected in the amendments that have been enacted by the Legislature and developed in case law interpreting CEQA could have an indirect economic impact on business. Among other things, project proponents could incur additional costs in assisting lead agencies to comply with the requirement to quantify greenhouse gas emissions, if possible, as part of an analysis of the effects of such emissions. Project proponents may also incur costs in implementing mitigation measures to reduce such emissions. However, the amendments to the Guidelines merely reflect existing requirements. (See, e.g., Pub. Resources Code, §§ 21004 ("a public agency may use discretionary powers … for the purpose of mitigating or avoiding a significant effect on the environment"), 21083.05 (requiring the development of guidelines on the analysis and mitigation of greenhouse gas emissions "as required by this division"); *Berkeley Keep Jets Over the Bay Com. v. Board of Port Comm*. (2001) 91 Cal.App.4th 1344, 1370, 1382 (potential hazardous emissions and noise impacts must be quantified where it is possible to do so and quantification will assist in the determination of significance of the impact).)

Many lead agencies, and some trial courts, have already determined that CEQA requires analysis and mitigation of GHG emissions independent of the SB97 CEQA Guidelines amendments. The Office of Planning and Research, for example, has cataloged over 1,000 examples of CEQA documents, prepared between July 2006 and June 2009, analyzing and mitigating greenhouse gas emissions. (Office of Planning and Research, Environmental Assessment Documents Containing a Discussion of Climate Change (Revised June 1, 2009).) Further, several trial courts have found that existing CEQA law requires analysis and mitigation of GHG emissions. (See, e.g., *Muriettans for Smart Growth v. City of Murrieta et al., Riverside Co*. Sup. Ct. Case No. RIC463320 (November 21, 2007); *Env. Council of Sac. et al v. Cal. Dept. of Trans.*, Sacramento Sup. Ct. Case No. 07CS00967 (July 15, 2008) (citing *Berkeley Keep Jets Over the Bay Committee v. Board of Commissions* (2001) 91 Cal.App. 4th 1344, 1370-

1371 and State CEQA Guidelines section 15144 as requiring a lead agency to "meaningfully attempt to quantify the Project's potential impacts on GHG emissions and determine their significance" or at least to explain what steps were undertaken to investigate the issue before concluding that the impact would be speculative).) Finally, federal courts have interpreted the National Environmental Policy Act ("NEPA") to require an analysis of potential impacts of GHG emissions. (See, e.g., *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Ad.*, 538 F.3d 1172, 1215-1217 (9th Cir. 2008).) Thus, the amendments to the CEQA Guidelines developed pursuant to SB97 do not create new requirements; rather, they interpret and clarify existing CEQA law.

Additionally, some of amendments included in this rulemaking activity may tend to reduce costs associated with environmental analysis of greenhouse gas emissions. For example, the amendments to the Guidelines encourage tiering and streamlining of existing environmental analyses to the extent possible in order to reduce duplication. Such tiering and streamlining mechanisms are also consistent with existing law. (See, e.g., Pub. Resources Code, § 21093 (lead agencies shall tier environmental impact reports wherever possible).)

The amendments update the State CEQA Guidelines to be consistent with legislative enactments and judicial decisions that have modified CEQA, but do not themselves impose any new requirements. Therefore, the amendments do not have a significant, adverse economic impact directly affecting business.

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Exhibit E

Exhibit E

TITLE: FRIENDS OF THE NORTHERN SAN JACINTO VALLEY, et al., v. COUNTY OF RIVERSIDE, et al.	DATE & DEPT: 04/11/12 D10	MASTER NUMBER: RIC10007572 RELATED CASES: RIC10007574 RIC10007586
COUNSEL: NONE	REPORTER: NONE	

PROCEEDING:
PROPOSED STATEMENT OF DECISION

This is a consolidated matter in which Friends of Northern San Jacinto Valley, Sierra Club, Center for Biological Diversity, San Bernardino Valley Audubon Society, and the City of Riverside all challenge the approval of a project proposed by real party in interest Nuevo Development Company. The Project is the Villages of Lakeview extending over 2,800 acres consisting of 11,350 dwellings, a mixed use town center including some 500,000 square feet of retail, office and commercial uses, public facilities including four schools and a library, and nearly 1,000 acres of open space/conservation areas. Respondent County of Riverside approved the Project and certified the Environmental Impact Report on March 23, 2010. Petitioners filed a joint opening and reply brief. Respondents and real party also filed a joint opposition and will be referred to collectively as "Respondents."

DISCUSSION

I. The EIR failed to adequately evaluate GHG impacts and possible mitigation of these impacts.

Petitioners contend that the County failed to proceed in the manner required by CEQA in that the EIR improperly assessed the significance of the greenhouse gas (GHG) emissions by comparing them to a potentially unrealistic, unreasonable hypothetical scenario rather than to existing conditions as required by *CBE vs. SCAQMD* (2010) 48 Cal. 4th 310, 322.

Respondents contend they first measured the Project's total GHG emissions against the baseline of existing conditions (zero emissions) to generate the Project's GHG inventory, quantified as 137,637 tons of CO2e annually and that this satisfied CEQA's mandate that project impacts be disclosed and compared to the existing physical environment which serves as a baseline for CEQA purposes. Next, the County exercised its discretion by utilizing compliance with AB 32 as the threshold against which to evaluate the impact on GHG, and compared the Project's GHG inventory against a business-as-usual (BAU) scenario to make its impact significance determination. This approach, according to respondents, provided an opportunity to evaluate the Project's emissions reduction strategy. According to respondents, the BAU hypothetical used represents the Project as proposed absent its voluntary design features, GHG reduction commitments and mitigation measures not require by existing mandates. Respondents contend that the analysis was reasonable and supported by substantial evidence in the record.[1]

It is true that agencies can exercise discretion in formulating and establishing thresholds of significance for each potentially adverse environmental effect (Guidelines §15064(b)), and may use performance standards or guidance documents adopted or issued by regulatory agencies as thresholds of significance (§15126.4(a)(1)(B)). It is also true that, at this time, no agency with particular expertise or jurisdiction over the Project's air quality and GHG emissions has established a quantitative or numeric threshold for determining when or to what extent emissions are significant for CEQA purposes in relation to GHG.

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[1] In support of their contention that this BAU approach was proper, respondents ask the court to take judicial notice of a decision from a Kern County trial court proceeding and an appellant's opening brief. The request is denied.

Nevertheless, the hypothetical project proposed for the EIR does not accurately reflect business as usual because it uses an unrealistic scenario which ignores local planning and zoning laws, strips all vegetation from the project, and contemplates development on mountainous portions of the project site. In addition, the hypothetical scenario fails to account for the fact that project approval under CEQA contemplates a process whereby the adverse environmental effects of a project of this nature are identified and analyzed; alternatives are considered; and potential impacts are eliminated or mitigated. The hypothetical project, which ignores not only local planning and zoning laws as well as potential adverse impacts, is not one that could ever be expected to actually occur in the County let alone on the project site. It does not appear the EIR used a "business as usual" approach but instead adopted a "worst-case" scenario as it began its evaluation of the GHG emissions.

Respondents' reliance on *Citizens for Responsible Equitable Environmental Development v. City of Chula Vista* (2011) 197 Cal.App.4th 327 is misplaced. While the *Chula Vista* case did conclude that compliance with AB 32 was a proper threshold of significance and implicitly approved use of a "business as usual analysis" in assessing the significance of the impact, that case is factually distinguishable. In that case, business as usual was based on the existing store – not some hypothetical scenario like here.

Chula Vista simply does not support respondents' use of a hypothetical "BAU" that has no correlation to baseline conditions or to the project as proposed and is not even based on what could be realistically developed in this area in light of existing zoning and other land use regulations.

As the Supreme Court noted in *CBE v. SCAQMD, supra*, 48 Cal.4th 310 at p. 322: "An approach using hypothetical allowable conditions as the baseline results in 'illusory' comparisons that 'can only mislead the public as to the reality of the impacts and subvert full consideration of the actual environmental impacts,' a result at direct odds with CEQA's intent. [Internal Citation Omitted.] The District's use of the prior permits' maximum operating levels as a baseline appears to have had that effect here, providing an illusory basis for a finding of no significant adverse effect despite an acknowledged increase in NOx emissions exceeding the District's published significance threshold."

Notwithstanding that the Supreme Court was addressing the issue of baseline conditions whereas here we are discussing a proper BAU model, the concerns expressed in *CBE* are the same. The use of this hypothetical "BAU" here which is tied neither to existing conditions or reasonably likely conditions serves only to mislead the public and the decision-makers in their understanding of the actual significance of the GHG emissions, and their effect on the environment. Further, because the EIR improperly assessed the significance of GHG emissions, the EIR could not and did not properly analyze and evaluate feasible mitigation for GHG impacts.

II. The County was required to recirculate the EIR.

The Court finds that new information was added after the close of the public comment period that revealed a substantial increase in the severity of environmental impacts.

In response to comments to the DEIR, a transportation analysis was conducted which indicated an increase of 100 million additional vehicle-miles traveled (VMT) per year (50% increase), and $PM_{2.5}$ concentrations 300% greater than previously disclosed and 95 times higher than Air District's threshold for determining the significance of impacts. Petitioners contend that an agency is required to recirculate an EIR when it adds significant new information after the public comment period has closed, citing §21092.1 and *American Canyon Community vs. City of American Canyon* (2006) 145 Cal.App.4th 1062, 1075-76).

Respondents argue that substantial evidence supports the County's determination that the new information merely clarified, amplified, or made insignificant modifications to the general assumptions that were presented in the draft EIR. According to respondents, the new information did not change the severity of the Project's impacts on global climate changes (GCC) or air quality. They contend that even with the new VMT estimates, the Project would still reduce emissions consistent with AB 32. They conclude that the County's decision not to recirculate was proper, citing *Silverado Modjeska Recreation and Parks vs. County of Orange* (2011) 197 Cal.App.4th 282.

The Court finds that the new information did constitute a substantial increase in the severity of GCC and air quality impacts which required recirculation. (Guidelines §15088.5; Pub. Res. §21092.1, §21166.) The new analysis which revealed the substantial increase in GHG and fine particulates was conducted after the comment period. This new information did not merely supply additional requested details or merely explain the DEIR's analysis. Instead, the methodology used in connection with the DEIR was discarded. A new, more accurate methodology disclosed air quality impacts more severe than previously disclosed.

In addition, the County's reliance on its BAU hypothetical and analysis fails. The County cannot rely on alleged consistency with AB 32 as discussed above.

Petitioners did not have an adequate opportunity to comment on the newly disclosed impacts. The determination that the increased impacts did not warrant recirculation is not supported by substantial evidence.

III. The EIR did not adequately analyze the project's impacts on air quality and the related health impacts.

The Court finds that there is inadequate analysis in the EIR as to the Project's impacts on air quality and related health effects. In discussing significant environmental impacts, direct and indirect significant effects of the project should be clearly identified and described, giving due consideration to both the short-term and long-term effects on matters including health and safety problems caused by the physical changes. (*Guidelines §15126.2(a).)* Here, the EIR makes only general references to respiratory and pulmonary conditions and cancer health risks. However, it provides little information or analysis as to the specific impacts on the general population versus sensitive receptors, or as to the degree of impacts and the specific effects on the public's health. When the informational requirements of CEQA are not met, an agency has failed to proceed in a manner required by law. (*Bakersfield Citizens for Local Control vs. City of Bakersfield* (2004) 124 Cal. App. 4th 1184, 1220).

The County's reliance on the South Coast Air Basin region-wide Air Quality Management Plan does not relieve it of its obligation to provide a reasonable analysis of the Project's cumulative impacts. (*Guidelines §15130(b).)* Pursuant to *Berkeley Keep Jets Over the Bay Committee vs. Bd. of Port Commissioners of the City of Oakland* (2001) 91 Cal. App. 4th 1344, 1371, the County is required to use its best efforts to find out and disclose all that it reasonably can. Here, Petitioners provided the County with numerous studies addressing the health effects of particulate pollution, yet County's only response was to discredit one of the reports, and to continue to rely on the SCAQMD methodology. Absent any attempt to use its best efforts to find out and disclose all that it reasonably can, the County failed to meet its obligations.

IV. The EIR failed to conduct an adequate review of the project's impacts on regional traffic.

The Court finds that the EIR failed to conduct adequate environmental review of the Project's impacts on regional traffic. The record establishes that the Project will result in over 85,000 vehicle trips per day, and will add 17,000 new car trips to the I-215 each day. Many of the residents will be driving to Moreno Valley and Riverside via the I-215, and those commuting to Orange and Los Angeles Counties will contribute to the existing problems at the I-15/SR91 interchange.

The EIR failed to analyze the impacts on any of these freeways, and instead restricted its analysis based upon the Riverside County Traffic Impact Analysis Preparation Guide (TIA) and a supplemental analysis. In accordance with the TIA, County studied the area within a five-mile radius of the Project site and conducted a supplemental analysis including 17 additional intersections and 10 additional street segments. An EIR must include a description of the environment in the vicinity of the Project from both a local and regional perspective. (*Bozung vs. Local Agency Formation Comm. (1975) 13 Cal. 3d 263, 283; Guidelines §15125.*) By failing to analyze the Project impacts on the surrounding freeways, County failed to proceed as required by CEQA.

County also argues that it specifically noted there would be a need for subsequent environmental review related to potential traffic impacts and that significant changes with respect to development of regional transportation systems are expected to occur. CEQA, however, requires that the impacts of a proposed project are to be compared to the actual environmental conditions existing at the time of the analysis. (*Sunnyvale West Neighborhood Assn. vs. City of Sunnyvale* (2010) 190 Cal. App. 4th 1351, 1380-1384.) The EIR fails to provide any specific analysis as to the impacts of the Project on the existing freeways.

V. The EIR project description was adequate.

The question concerning which acts constitute the "whole of an action" for purposes of Guidelines §15738 is a question of law. (*Tuolumne County Citizens for Responsible Growth, Inc. vs. City of Rancho Cordova* (2007) 155 Cal. App. 4th 1214, 1224.) As such, it is to be determined by the trial court's independent judgment. In this case, the Court finds that the construction of the electrical substation and transmission lines, as well as the training dike, are not part of the Project.

The EIR does acknowledge that the new electric substation is necessary to the Project: the existing Nuevo substation only has the capacity to meet projected demands through 2012, after which additional substation capacity (and the extension of transmission lines) will be necessary to provide power to support the current and future growth. The construction of the off-site training dike is necessary to significantly reduce flooding within the Project. However, neither the substation nor the dike, are component parts of the Project and there has been no improper segmentation.

There are general principles used to determine whether a particular act is part of the activity that constitutes a CEQA project. One way is to evaluate how closely the related acts are to the overall objective of the project (the relationship being sufficiently close when the proposed act is among the "various steps which taken together obtain an objective"). (*Tuolumne, supra, p. 1226.)* Another is to consider how closely the act and project are related in time and physical location, and the entity undertaking the action. (*Id.*, at p. 1227.)

In this case, both the substation and dike were planned independently of the Project, and will serve development in addition to the Project. The substation will be built by a separate entity, Southern California Edison to accommodate regional development growth beyond 2012. The dike is part of a previously approved County infrastructure plan to serve regional needs. As such, neither the substation and transmission lines nor the dike are component parts of the Project. (See *Anderson First Coalition vs. City of Anderson* (2005) 130 Cal. App. 4th 1173.)

VI. The EIR adequately addressed the project's noise impacts.

Petitioners contend that the EIR does not properly account for the already existing noise environment attributable to some of the roadways which will serve the Project. They argue that the EIR improperly uses thresholds of significance to avoid having to confront the possibility that any additional amount of noise might well be significant given the already existing problems. Petitioners contend that the EIR also fails to consider that the Project's incremental noise impacts might be cumulatively considerable. Petitioners conclude that the EIR avoids having to adopt feasible measures to mitigate the Project's contributions to noise.

On the contrary, the EIR acknowledges that because the cumulative noise without the Project is significant, any additional noise contributed by the Project would be significant. The EIR admits that the effect of the Project together with other cumulative impacts will result in significant area-wide cumulative noise impacts. Instead of refusing to examine mitigation for the noise impacts, the EIR considered the use of sound walls to mitigate the significant noise impacts. This mitigation was found not to be feasible, and the EIR concluded that the noise impacts were therefore significant and unavoidable. Petitioners do not dispute the finding that sound walls were not feasible. Nor do they suggest that there were other mitigation measures that could have been considered.

Petitioners also contend that the EIR fails to analyze specific noise impacts resulting from construction of the Project. However, the County was not required to speculate regarding construction activity for project buildup expected to take place over a 20-year period. (See *Tracy First v. City of Tracy* (2009) 177 Cal.App.4th 912, 932-933.) Instead, given the conceptual level of the Project, the County properly considered construction impacts to the extent possible and identified mitigation measures.

VII. EIR did not adequately address concerns raised with respect to the Habitat Conservation Plan.

CEQA requires the lead agency to respond to each significant environmental issue that is raised by commenters. (Pub. Res. C. §21091(d)(2).) Major environmental issues raised when the lead agency's position is at variance with recommendations and objections should be addressed in detail with reasons why specific comments and suggestions were not accepted. (Guidelines §15088(c).) Responses to comments should at least demonstrate a good faith reasoned analysis. (*Eureka Citizens for Responsible Government v. City of Eureka* (2007) 147 Cal.App.4th 357, 378.)

Commenters pointed out that the Project's plan to construct "JJ Street" interferes with so-called "Constrained Linkage 20," a habitat block identified in the MSHCP. The Constrained Linkage allows space for migration, plant propagation, and increased mating opportunities between other habitat blocks. JJ Street will be constructed across the Constrained Linkage and will create another barrier to wildlife attempting to travel between the Wildlife Area and the Lakeview Mountains.

The County's responses to comments first maintained that JJ Street does not actually cross the wildlife corridor. But JJ Street is in fact perpendicular to the linkage and will be constructed directly across it.

The County also took the position that JJ Street should be considered part of the planned Mid-County Parkway, which includes the existing Ramona Expressway. This roadway also crosses the linkage and was already anticipated and contemplated by the MSHCP. Comment responses contend that the culvert/wildlife corridor under the Mid-County Parkway will be extended and will run under JJ Street. Petitioners point out that the MSHCP indicates that small mammals are not known to use culverts longer than 64 meters. With the addition of JJ Street, even if parallel to the Mid-County Parkway, the culvert will be at least 87 meters in length. The MSCHP anticipated a 67-meter wildlife crossing, and extending it an additional 20 meters for JJ Street may make the undercrossing unusable for the species and may compromise the integrity of the Constrained Linkage. The County's analysis failed to address the additional length of the culvert which will be required in order to extend the undercrossing under JJ Street.

VIII. The EIR failed to adequately address the project's growth-inducing impacts.

Petitioners argue that EIR's brief analysis of growth-inducing impacts fails to meet the requirements of Guidelines §15126.2(d). The Project includes improvements to roads, the extension of energy services, and the extension of water lines and sewer services to serve future projects and urbanization. Petitioners further argue that pursuant to *Napa Citizens for Honest Government vs. Bd. of Supervisors* (2001) 91 Cal. App. 4th 342, 370, the EIR should have disclosed information about the housing units the infrastructure will accommodate, and the effect of the additional growth on public services.

The Court agrees that additional information about the Project's growth-inducing impacts should have been provided and analyzed. Although the County submits that such would be speculative, the record indicates that existing information is available which makes such discussion viable. The County references the expansion of the Ramona Expressway and incremental roadway improvements; the construction of new roads; and water and sewer improvements and infrastructure sized to serve future urbanization within the area. It also references "developing communities," and states how the infrastructure improvements and expansions could eliminate potential constraints for future development in the area. Given the extent of vacant and unimproved land surrounding the Project, the County should have been able to provide additional information and analysis about growth-inducing impacts.

IX. The EIR's Discussion of Project Alternatives was adequate.

Petitioners first argue that the Project's objectives are so narrow that they preclude consideration of a reasonable range of alternatives, citing *National Parks & Conservation Assn. vs. Bureau of Land Management* (9th Cir. 2010) 606 F.3d 1058, 1072. The Court finds that argument unavailing. While certain Project objectives may be possible due to the existing circumstances (e.g., single ownership and location), the objectives overall reflect the County's goals as evidenced in Chapter 2 of the County's General Plan. This is distinguishable from *National Parks*, where only one of the four project objectives served the needs of the BLM. (*National Parks*¸ supra, at pp.1071-72.)

Petitioners then argue that the EIR improperly failed to analyze an off-site alternative, which is necessary given the significant amendments and zoning changes and the inconsistencies with the General Plan. *(Citizens of Goleta Valley vs. Bd. of Supervisors ("Goleta I")* (1988) 197 Cal. App. 3d 1167, 1179-80; Guidelines §15126.6.) Again, the Court disagrees and finds that the EIR properly considered and then rejected an alternate site. Guidelines §15126.6 requires the EIR identify alternatives that were considered and rejected as infeasible during the scoping process, and briefly explain the reasons underlying the determination. The factors that may be used to eliminate alternatives from detailed consideration in an EIR are failure to meet most of the project objectives, infeasibility, or inability to avoid significant environmental impacts. (§15126.6(c).) Here, the County included such discussion at AR 3403-04. The Court finds that discussion sufficient and distinguishable from that in *Goleta I, supra*.

X. The Project is inconsistent with the General Plan Circulation Element.

Petitioners argue that the Project is inconsistent with various General Plan policies: Land Use (L.U.) Policy 2.1(e) (to concentrate growth near or within existing urban and suburban areas to maintain the rural and open space character to the greatest extent possible); L.U. Policy 17.3 (to ensure development does not adversely impact the open space & rural character of the surrounding area); L.U. Policy 10.1 (to provide sufficient opportunities to increase local employment levels and minimize long-distance commuting); L.U. Police 7.12 (to improve the relationship and ratio between jobs and housing); L.U. Policy 2.1(a) (to provide a land use mix at the countywide and area plan levels based on projected need); and Air Quality Policy 8.2 (to emphasize job creation and reductions in VMTs in job poor areas to improve air quality. Petitioners also contend the project is inconsistent with General Plan Circulation Element 2.1 which requires the County to maintain target Levels of Service: LOS "C" along all County-maintained roads and conventional state highways.

The question is whether the Project is compatible with and will not frustrate the General Plan's goals and policies. *(Napa Citizens for Honest Government vs. Napa County Board of Supervisors* (2001) 91 Cal. App. 4th 342, 379.) If the Project will frustrate the General Plan's goals and policies, it is inconsistent with the General Plan unless it also includes definite affirmative commitments to mitigate the adverse effect or effects. (*Id.*)

Here, the record establishes that the Project will frustrate the General Plan's policy of maintaining the County's Level of Service standards as described in the General Plan Circulation Element. The EIR admits that at full build-out of both the current General Plan roadway system and the Project, some roadway segments and intersections will not meet the required standards. The General Plan Circulation Element establishes definite standards regarding traffic congestion, not mere guidelines or flexible goals. The County cannot establish specific traffic requirements and at the same time approve a project that will cause unacceptable congestion without taking affirmative steps to handle that increased congestion. (*Napa Citizens, supra*, 91 Cal.App.4th, at p. 380; *Endangered Habitats League v. County of Orange* (2005) 131 Cal.App.4th 777, 782-783.) No such affirmative steps or mitigation measures have been developed. This is particularly unacceptable given the improper/inadequate analysis concerning traffic impacts from the Project discussed previously.

Otherwise, the Court accepts the Board's findings of consistency as being supported by substantial evidence despite some inconsistency with a handful of land use policies articulated in the General Plan. A given project need not be in conformity with each and every land use policy. It need only be compatible with the objectives, general land uses and programs set forth in the General Plan. (*Families Unafraid To Uphold Rural El Dorado County v. Board of Supervisors* (1988) 62 Cal.App.4th 1332, 1336.) The County's determination of consistency with its own General Plan is entitled to great deference. It has the unique competence to balance the plan's policies when applying them and has the broad discretion to construe its policies in light of the plan's purposes. (See *Eureka Citizens for Responsible Government v. City of Eureka* (2007) 147 Cal.App.4th 357, 373-374.)

XI. One of the County's findings in support of the extraordinary amendment to the general plan is inadequate.

The County's General Plan discourages amendments to the foundational elements of the Plan outside of the County's regular five-year amendment cycle. Foundational elements may not be amended outside of the five-year cycle unless specific findings are made that the amendment is justified as a result of extraordinary events. This "Extraordinary Amendment" procedure requires three particular findings to justify an Extraordinary Amendment. (General Plan, Ch. 10 at A-12; Riv. Co. Code §17.08.060(F)). These findings were necessary here because the Project included General Plan Amendment 720 which raised development densities in connections with existing foundational elements. As discussed below, the Court finds the second and third required findings were sufficient and are supported by substantial evidence.

The second required finding to support an extraordinary amendment is that a condition exists or an event has occurred that is "unusually compelling." The County's finding regarding the unusually compelling event cites "an opportunity that is presented by having 2,786 acres under the control of one entity...to pursue a comprehensive master plan." This finding is sufficient and is supported by substantial evidence.

The third required finding is that a component change is necessary to facilitate implementation of open space or transportation corridor designations arising from MSHCP and CETAP programs that could not be accomplished by a lesser change in the General Plan. The County supports this finding with the real party's commitment to widen the Ramona Expressway, the fact that real party has much of the land necessary for the expansion without the County having to condemn it, and the fact that the Project's circulation system is designed to align with planned access points for the Expressway obviating the need for a frontage road. This third finding is sufficient and is supported by substantial evidence.

The first required finding is that new conditions or circumstances justify modifying the General plan, that the modifications do not conflict with the overall County Vision, and that the modifications would not create an internal inconsistency among the elements of the General plan. Unlike the second and third findings discussed above, when the board made this required finding it did so merely by quoting the language in the extraordinary amendment procedure. The "new conditions or circumstances" are not defined and there is no indication as to what evidence the board relied on to support this finding.

To be adequate, a finding must apprise the reviewing court of the basis for the board's actions. In other words, the finding must "bridge the analytic gap between the raw evidence and the ultimate decision or order." (*Topanga Assn. for a Scenic Community vs. County of Los Angeles* (1974) 11 Cal. 3d 506, 514.) It is not the responsibility of the reviewing court to comb the record to find some evidence that might have supported the board's finding. (*Id.*, at p. 516.) Here, because the board merely quoted the language of the required finding, this Court does not know and cannot determine the basis for the county's decision. This first finding is not sufficient.

CONCLUSION

Pursuant to California Rules of Court rule 3.1590(c), this tentative decision is the Court's proposed statement of decision with respect to the petitions for writ of mandate filed in RIC10007572, RIC10007574 and RIC10007586 subject to any party's objection under rule 3.1590(g). If timely objections are not filed and served within 15 days of service of this statement of decision, petitioners in RIC10007572 and RIC10007574 are hereby ordered to prepare, serve and submit proposed judgments and peremptory writs of mandate. In RIC10007586, this proposed statement of decision addressed only the first and second causes of action. Unless the City wishes to dismiss its third and fourth causes of action for declaratory relief and injunctive relief, respectively, a final judgment cannot be entered in that case at this time.

A hearing for receipt of proposed judgment in RIC10007572 and RIC10007574 and for status conference on the City's remaining causes of action in RIC10007586 is hereby set for April 30, 2012, at 8:30 a.m., in Dept. 10.

SUPERIOR COURT OF CALIFORNIA, COUNTY OF RIVERSIDE

TITLE: FRIENDS OF THE NORTHERN SAN JACINTO VALLEY, et al., v. COUNTY OF RIVERSIDE, et al.	DATE & DEPT: 05/16/12 D10	MASTER NUMBER: RIC10007572 RELATED CASES: RIC10007574 RIC10007586
COUNSEL: NONE	REPORTER: NONE	FILED SUPERIOR COURT OF CALIFORNIA COUNTY OF RIVERSIDE MAY 16 2012
PROCEEDING: MINUTE ORDER		

The Court has read and considered respondent and real parties' Objections to the Proposed Statement of Decision as well as their Request for Judicial Notice. The request for judicial notice is denied and the objections are overruled. The proposed statement of decision shall be the Court's Statement of Decision in these three related cases.

Petitioners, in all three cases, have already, albeit prematurely, submitted proposed judgments. Respondent and real parties shall have fifteen days from the date of this order within which to submit objections to the proposed judgments.

SHARON J. WATERS
Judge of the Superior Court

Sharon Waters, Judge
L. Hall (cmg), Clerk

SUPERIOR COURT OF CALIFORNIA, COUNTY OF RIVERSIDE
4050 Main Street - 2nd Floor
Riverside, CA 92501
www.riverside.courts.ca.gov

CERTIFICATE OF MAILING

CITY OF RIVERSIDE

vs. CASE NO. RIC10007586

COUNTY OF RIVERSIDE

TO: CITY OF RIVERSIDE
CITY HALL 3900 MAIN STREET
RIVERSIDE CA 92522

I certify that I am currently employed by the Superior Court of California, County of Riverside and I am not a party to this action or proceeding. In my capacity, I am familiar with the practices and procedures used in connection with the mailing of correspondence. Such correspondence is deposited in the outgoing mail of the Superior Court. Outgoing mail is delivered to and mailed by the United States Postal Service, postage prepaid, the same day in the ordinary course of business. I certify that I served a copy of the attached minute order on this date, by depositing said copy as stated above.

Court Executive Officer/Clerk

Dated: 05/16/12

by: ____________________________
LETICIA HALL, Deputy Clerk

Exhibit F

Exhibit F

CAPCOA

CALIFORNIA AIR POLLUTION CONTROL OFFICERS ASSOCIATION

CEQA & Climate Change

Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act

January 2008

Disclaimer

The California Air Pollution Control Officers Association (CAPCOA) has prepared this white paper consideration of evaluating and addressing greenhouse gas emissions under the California Environmental Quality Act (CEQA) to provide a common platform of information and tools to support local governments.

This paper is intended as a resource, not a guidance document. It is not intended, and should not be interpreted, to dictate the manner in which an air district or lead agency chooses to address greenhouse gas emissions in the context of its review of projects under CEQA.

This paper has been prepared at a time when California law has been recently amended by the Global Warming Solutions Act of 2006 (AB 32), and the full programmatic implications of this new law are not yet fully understood. There is also pending litigation in various state and federal courts pertaining to the issue of greenhouse gas emissions. Further, there is active federal legislation on the subject of climate change, and international agreements are being negotiated. Many legal and policy questions remain unsettled, including the requirements of CEQA in the context of greenhouse gas emissions. This paper is provided as a resource for local policy and decision makers to enable them to make the best decisions they can in the face of incomplete information during a period of change.

Finally, this white paper reviews requirements and discusses policy options, but it is not intended to provide legal advice and should not be construed as such. Questions of legal interpretation, particularly in the context of CEQA and other laws, or requests for advice should be directed to the agency's legal counsel.

Acknowledgements

This white paper benefited from the hard work and creative insights of many people. CAPCOA appreciates the efforts of all who contributed their time and energy to the project. In particular, the Association thanks the following individuals:

Principal Authors

Greg Tholen, BAAQMD
Dave Vintze, BAAQMD
Jean Getchell, MBUAPCD
Matt Jones, YSAQMD
Larry Robinson, SMAQMD
Ron Tan, SBCAPCD

Editor

Barbara Lee, NSAPCD

Reviewers

CAPCOA Climate Protection Committee

Barbara Lee (NSCAPCD), Chair

Larry Allen, SLOCPCD
Bobbie Bratz, SBAPCD
Karen Brooks, SLOCAPCD
Chris Brown, MCAQMD
Tom Christofk, PCAPCD
Jorge DeGuzman, SMAQMD
Mat Ehrhardt, YSAQMD
Jean Getchell, MBUAPCD
Larry Greene, SMAQMD
Henry Hilken, BAAQMD
Alan Hobbs, PCAPCD
Jim Jester, SMAQMD
Dave Jones, KCAPCD
Tom Jordan, SJVUAPCD
Tom Murphy, SBAPCD
Don Price, VCAPCD
Jean Roggenkamp, BAAQMD
Ana Sandoval, BAAQMD
Amy Taketomo, MBUAPCD
Tim Taylor, SMAQMD
Mike Villegas, VCAPCD
David Vintze, BAAQMD
Dave Warner, SJVUAPCD
Jill Whynot, SCAQMD
John Yu, CAPCOA
Mel Zeldin, CAPCOA

CAPCOA Planning Managers:
CEQA & Climate Change Subcommittee

Dave Vintze (BAAQMD), Chair
Greg Tholen (BAAQMD), Project Manager

Charles Anderson, SMAQMD
Aeron Arlin Genet, SLOCAPCD
Jean Getchell, MBUAPCD
Melissa Guise, SLOCAPCD
Matt Jones, YSAQMD
Barbara Lee, NSCAPCD
Ryan Murano, NSAQMD
Tom Murphy, SBCAPCD
Susan Nakamura, SCAQMD
Larry Robinson, SMAQMD
Jean Roggenkamp, BAAQMD
Ana Sandoval, BAAQMD
Ron Tan, SBCAPCD
Brigette Tollstrup, SMAQMD
Jill Whynot, SCAQMD

External Reviewers

James Goldstene, CARB
Annmarie Mora, CARB
Terri Roberts, OPR

Proofing & Layout

Jake Toolson, CAPCOA
John Yu, CAPCOA

Contract Support

Jones & Stokes, Sacramento, CA *(analysis of non-zero threshold approaches)*
EDAW, Inc., Sacramento, CA *(review of analytical methods and mitigation strategies)*.

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List of Acronyms and Abbreviations

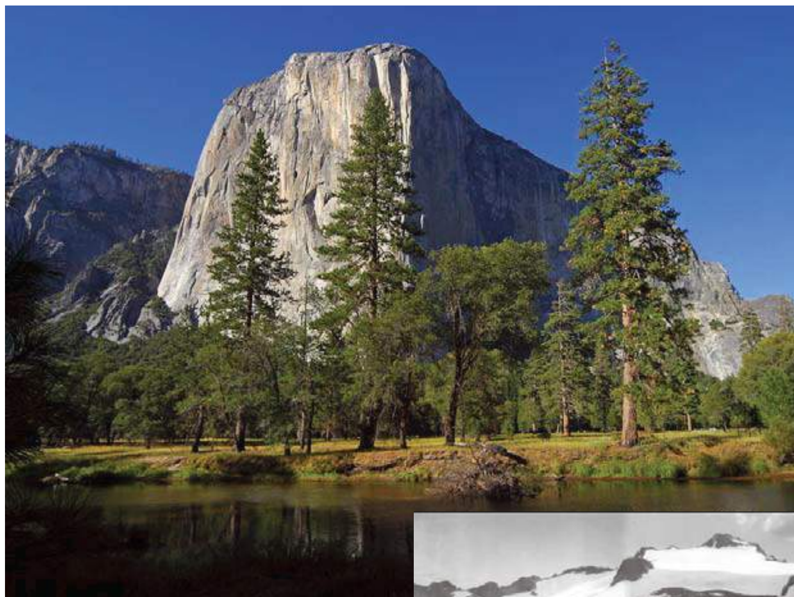
Acronym/ Abbreviation	Meaning
AB 32	Assembly Bill 32 Global Warming Solutions Act of 2006
AG	Attorney General
ARB	Air Resources Board
ASTM	American Society of Testing and Material
BAAQMD	Bay Area Air Quality Management District
BAU	Business as Usual
BEES	Building for Environmental and Economic Sustainability
Calfire	California Fire
Caltrans	California Department of Transportation
CAP	Criteria Air Pollutants
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resource Board
CAT	Climate Action Team
CCAP	Center for Clean Air Policy
CCAR	California Climate Action Registry
CDFA	California Department of Food and Agriculture
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CF	Connectivity Factor
CH_4	Methane
CIWMB	California Integrated Waste Management Board
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CNG	Compressed Natural Gas
CPUC	California Public Utilities Commission
CUFR	California Urban Forestry
DGS	Department of General Services
DOE	U.S. Department of Energy
DOF	Department of Finance
DPF	Diesel Particulate Filter
DWR	Department of Water Resources
E85	85% Ethanol
EEA	Massachusetts Executive Office of Energy and Environmental Affairs
EERE	Energy Efficiency and Renewable Energy
EIR	Environmental Impact Report
EOE	Encyclopedia of Earth
EPA	U.S. Environmental Protection Agency
ETC	Edmonton Trolley Coalition
EV	Electric Vehicles
FAR	Floor Area Ratio

GHG	Greenhouse Gas
GGEP	Greenhouse Gas Emissions Policy
GGRP	Greenhouse Gas Reduction Plan
GP	General Plan
GWP	Global Warming Potential
IGCC	Integrated Gasification Combined Cycle
IOU	Investor Owned Utility
IPCC	International Panel on Climate Change
IT	Information Technology
ITE	Institute of Transportation Engineers
J&S	Jones & Stokes
km	Kilometer
LandGem	Landfill Gas Emissions Model
LEED	Leadership in Energy and Environmental Design
LNG	Liquefied Natural Gas
MBUAPCD	Monterey Bay Unified Air Pollution Control District
MEPA	Massachusetts Environmental Policy Act
MND	Mitigated Negative Declaration
MMT CO_2e	Million Metric Tons Carbon Dioxide Equivalent
MW	Megawatts
N_2O	Nitrous Oxide
NACAA	National Association Clean Air Agencies
ND	Negative Declaration
NEV	Neighborhood Electric Vehicle
NIST	National Institute of Standards and Technology
NO_X	Oxides of Nitrogen
NREL	National Renewable Energy Laboratory
NSCAPCD	Northern Sonoma County Air Pollution Control District
NSR	New Source Review
OPR	State Office of Planning and Research
PFC	Perfluorocarbon
PG&E	Pacific Gas & Electric
POU	Publicly Owned Utility
PM	Particulate Mater
RoadMod	Road Construction Emissions Model
ROG	Reactive Organic Gas
RPS	Renewable Portfolio Standards
RTP	Regional Transportation Plan
S-3-05	Executive Order S-3-05
SB	Senate Bill
SBCAPCD	Santa Barbara County Air Pollution Control District
SCAQMD	South Coast Air Quality Management District
SCM	Sustainable Communities Model
SIP	State Implementation Plan
SJVAPCD	San Joaquin Valley Unified Air Pollution Control District
SLOCAPCD	San Luis Obispo County Air Pollution Control District

SMAQMD	Sacramento Metropolitan Air Quality Management District
SMUD	Sacramento Municipal Utilities District
SO_X	Sulfur Oxides
SP	Service Population
SRI	Solar Reflectance Index
SWP	State Water Project
TAC	Toxic Air Contaminants
TBD	To Be Determined
TDM	Transportation Demand Management
TMA	Transportation Management Association
THC	Total Hydrocarbon
UC	University of California
ULEV	Ultra Low Emission Vehicle
UNFCCC	United Nations Framework Convention on Climate Change
URBEMIS	Urban Emissions Model
USGBC	U.S. Green Building Council
VMT	Vehicle Miles Traveled
VTPI	Victoria Transit Policy
YSAQMD	Yolo-Solano Air Quality Management District

Introduction

The California Environmental Quality Act (CEQA) requires that public agencies refrain from approving projects with significant adverse environmental impacts if there are feasible alternatives or mitigation measures that can substantially reduce or avoid those impacts. There is growing concern about greenhouse gas emissions[1] (GHG) and recognition of their significant adverse impacts on the world's climate and on our environment. In its most recent reports, the International Panel on Climate Change (IPCC) has called the evidence for this "unequivocal." In California, the passage of the Global Warming Solutions Act of 2006 (AB 32) recognizes the serious threat to the "economic well-being, public health, natural resources, and the environment of California" resulting from global warming. In light of our current understanding of these impacts, public agencies approving projects subject to the CEQA are facing increasing pressure to identify and address potential significant impacts due to GHG emissions. Entities acting as lead agencies in the CEQA process are looking for guidance on how to adequately address the potential climate change impacts in meeting their CEQA obligations.



Air districts have traditionally provided guidance to local lead agencies on evaluating and addressing air pollution impacts from projects subject to CEQA. Recognizing the need for a common platform of information and tools to support decision makers as they establish policies and programs for GHG and CEQA, the California Air Pollution Control Officers Association has prepared a white paper reviewing policy choices, analytical tools, and mitigation strategies.

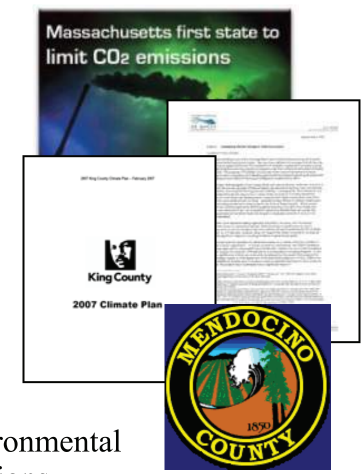
This paper is intended to serve as a resource for public agencies as they establish agency procedures for reviewing GHG emissions from projects under CEQA. It considers the application of thresholds and offers three alternative programmatic approaches toward

[1] Throughout this paper GHG, CO_2, CO_2e, are used interchangeably and refer generally to greenhouse gases but do not necessarily include all greenhouse gases unless otherwise specified.

determining whether GHG emissions are significant. The paper also evaluates tools and methodologies for estimating impacts, and summarizes mitigation measures. It has been prepared with the understanding that the programs, regulations, policies, and procedures established by the California Air Resources Board (CARB) and other agencies to reduce GHG emissions may ultimately result in a different approach under CEQA than the strategies considered here. The paper is intended to provide a common platform for public agencies to ensure that GHG emissions are appropriately considered and addressed under CEQA while those programs are being developed.

Examples of Other Approaches

Many states, counties, and cities have developed policies and regulations concerning greenhouse gas emissions that seek to require or promote reductions in GHG emissions through standards for vehicle emissions, fuels, electricity production/renewables, building efficiency, and other means. A few have developed guidance and are currently considering formally requiring or recommending the analysis of greenhouse gas emissions for development projects during their associated environmental processes. Key work in this area includes:



- Massachusetts Office of Energy and Environmental Affairs Greenhouse Gas Emissions Policy;
- King County, Washington, Executive Order on the Evaluation of Climate Change Impacts through the State Environmental Policy Act;
- Sacramento AQMD interim policy on addressing climate change in CEQA documents; and
- Mendocino AQMD updated guidelines for use during preparation of air quality impacts in Environmental Impact Reports (EIRs) or mitigated negative declarations.

The following paper evaluates options for lead agencies to ensure that GHG emissions are appropriately addressed as part of analyses under CEQA. It considers the use of significance thresholds, tools and methodologies for analyzing GHG emissions, and measures and strategies to avoid, reduce, or mitigate impacts.

Greenhouse Gas Significance Criteria

This white paper discusses three basic options air districts and lead agencies can pursue when contemplating the issues of CEQA thresholds for greenhouse gas emissions. This paper explores each path and discusses the benefits and disbenefits of each. The three basic paths are:

- No significance threshold for GHG emissions;

- GHG emissions threshold set at zero; or

- GHG threshold set at a non-zero level.

Each has inherent advantages and disadvantages. Air districts and lead agencies may believe the state or national government should take the lead in identifying significance thresholds to address this global impact. Alternatively, the agency may believe it is premature or speculative to determine a clear level at which a threshold should be set. On the other hand, air districts or lead agencies may believe that every GHG emission should be scrutinized and mitigated or offset due to the cumulative nature of this impact. Setting the threshold at zero will place all discretionary projects under the CEQA microscope. Finally, an air district or lead agency may believe that some projects will not benefit from a full environmental impact report (EIR), and may believe a threshold at some level above zero is needed.

This paper explores the basis and implications of setting no threshold, setting a threshold at zero and two primary approaches for those who may choose to consider a non-zero threshold. The first approach is grounded in statute (AB 32) and executive order (EO S-3-05) and explores four possible options under this scenario. The options under this approach are variations of ways to achieve the 2020 goals of AB 32 from new development, which is estimated to be about a 30 percent reduction from business as usual.

The second approach explores a tiered threshold option. Within this option, seven variations are discussed. The concepts explored here offer both quantitative and qualitative approaches to setting a threshold as well as different metrics by which tier cut-points can be set. Variations range from setting the first tier cut-point at zero to second-tier cut-points set at defined emission levels or based on the size of a project. It should be noted that some applications of the tiered threshold approach may require inclusion in a General Plan or adoption of enabling regulations or ordinances to render them fully effective and enforceable.

Greenhouse Gas Analytical Methodologies

The white paper evaluates various analytical methods and modeling tools that can be applied to estimate the greenhouse gas emissions from different project types subject to CEQA. In addition, the suitability of the methods and tools to characterize accurately a project's emissions is discussed and the paper provides recommendations for the most appropriate methodologies and tools currently available.

The suggested methodologies are applied to residential, commercial, specific plan and general plan scenarios where GHG emissions are estimated for each example. This chapter also discusses estimating emissions from solid waste facilities, a wastewater treatment plant, construction, and air district rules and plans.

Another methodology, a service population metric, that would measure a project's overall GHG efficiency to determine if a project is more efficient than the existing statewide average for per capita GHG emissions is explored. This methodology may be more directly correlated to a project's ability to help achieve objectives outlined in AB 32, although it relies on establishment of an efficiency-based significance threshold. The subcommittee believes this methodology may eventually be appropriate to evaluate the long-term GHG emissions from a project in the context of meeting AB 32 goals. However, this methodology will need further work and is not considered viable for the interim guidance presented in this white paper.

Greenhouse Gas Mitigation Measures

Common practice in environmental protection is first to avoid, then to minimize, and finally to compensate for impacts. When an impact cannot be mitigated on-site, off-site mitigation can be effectively implemented in several resource areas, either in the form of offsetting the same impact or preserving the resource elsewhere in the region.

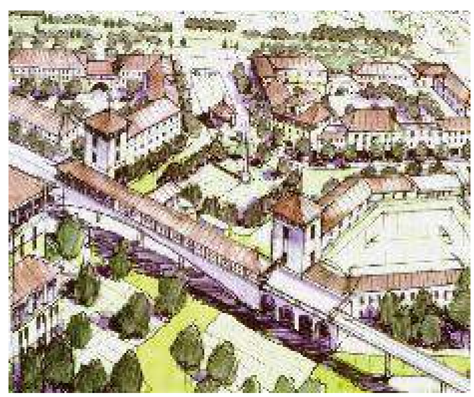
This white paper describes and evaluates currently available mitigation measures based on their economic, technological and logistical feasibility, and emission reduction effectiveness. The potential for secondary impacts to air quality are also identified for each measure. A summary of current rules and regulations affecting greenhouse gas emissions and climate change is also provided.

Reductions from transportation related measures (e.g., bicycle, pedestrian, transit, and parking) are explored as a single comprehensive approach to land use. Design measures that focus on enhancing alternative transportation are discussed. Mitigation measures are identified for transportation, land use/building design, mixed-use development, energy efficiency, education/social awareness and construction.

Purpose

CEQA requires the avoidance or mitigation of significant adverse environmental impacts where there are feasible alternatives available. The contribution of GHG to climate change has been documented in the scientific community. The California Global Warming Solutions Act of 2006 (AB 32) mandates significant reductions in greenhouse gases (GHG); passage of that law has highlighted the need to consider the impacts of GHG emissions from projects that fall under the jurisdiction of the California Environmental Quality Act (CEQA). Because we have only recently come to fully recognize the potential for significant environmental impacts from GHG, most public agencies have not yet established policies and procedures to consider them under CEQA. As a result, there is great need for information and other resources to assist public agencies as they develop their programs.

Air districts have historically provided guidance to local governments on the evaluation of air pollutants under CEQA. As local concern about climate change and GHG has increased, local governments have requested guidance on incorporating analysis of these impacts into local CEQA review. The California Air Pollution Control Officers Association (CAPCOA), in coordination with the CARB, the Governor's Office of Planning and Research (OPR) and two environmental consulting firms, has harnessed the collective expertise to evaluate approaches to analyzing GHG in CEQA. The purpose of this white paper is to provide a common platform of information and tools to address climate change in CEQA analyses, including the evaluation and mitigation of GHG emissions from proposed projects and identifying significance threshold options.

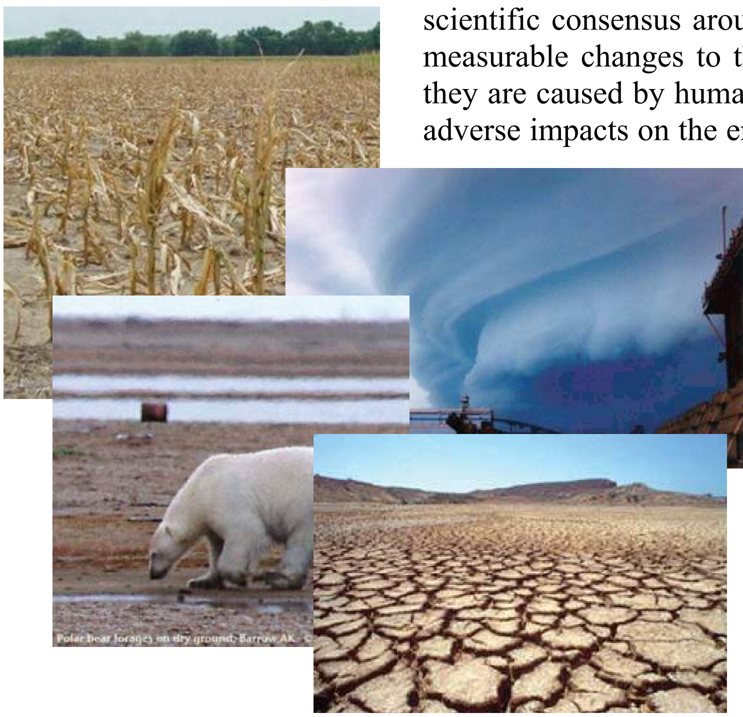


CEQA requires public agencies to ensure that potentially significant adverse environmental effects of discretionary projects are fully characterized, and avoided or mitigated where there are feasible alternatives to do so. Lead agencies have struggled with how best to identify and characterize the magnitude of the adverse effects that individual projects have on the global-scale phenomenon of climate change, even more so since Governor Schwarzenegger signed Executive Order S-3-05 and the state Legislature enacted The Global Warming Solutions Act of 2006 (AB 32). There is now a resounding call to establish procedures to analyze and mitigate greenhouse gas (GHG) emissions. The lack of established thresholds does not relieve lead agencies of their responsibility to analyze and mitigate significant impacts, so many of these agencies are seeking guidance from state and local air quality agencies. This white paper addresses issues inherent in establishing CEQA thresholds, evaluates tools, catalogues mitigation measures and provides air districts and lead agencies with options for incorporating climate change into their programs.

Background

National and International Efforts

International and Federal legislation have been enacted to deal with climate change issues. The Montreal Protocol was originally signed in 1987 and substantially amended in 1990 and 1992. In 1988, the United Nations and the World Meteorological Organization established the IPCC to assess the scientific, technical and socioeconomic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts, and options for adaptation and mitigation. The most recent reports of the IPCC have emphasized the scientific consensus around the evidence that real and measurable changes to the climate are occurring, that they are caused by human activity, and that significant adverse impacts on the environment, the economy, and human health and welfare are unavoidable.



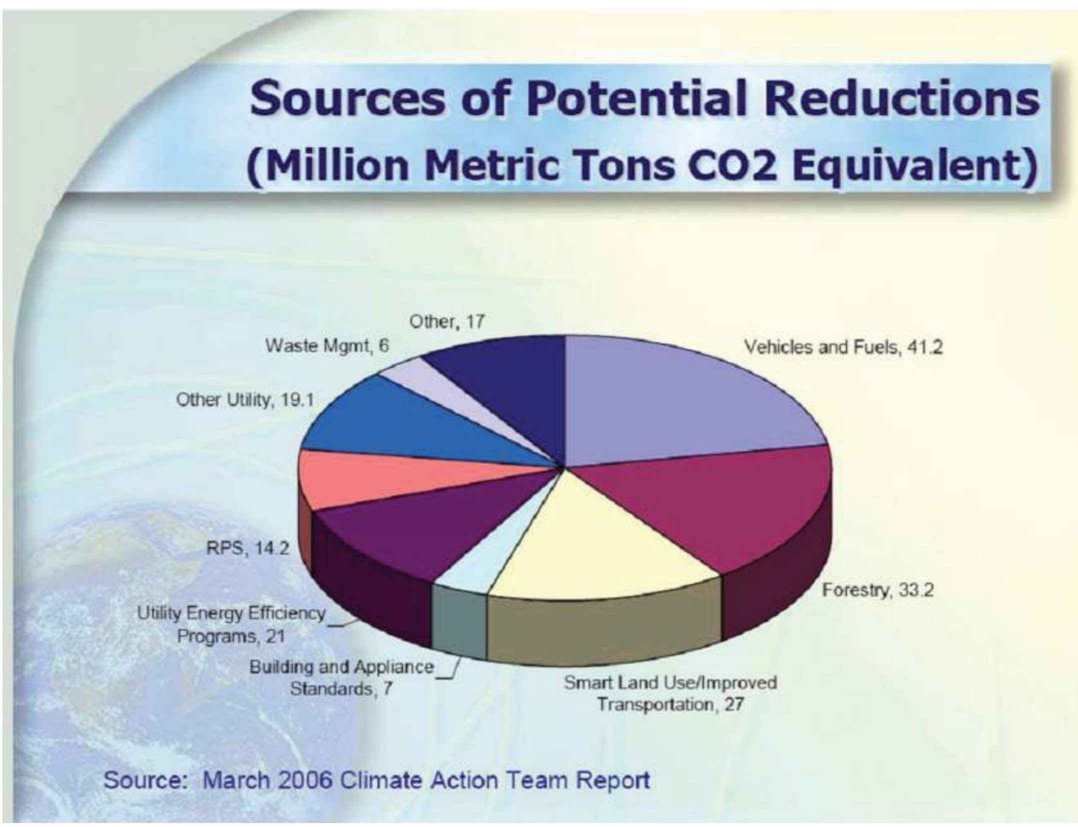
In October 1993, President Clinton announced his Climate Change Action Plan, which had a goal to return greenhouse gas emissions to 1990 levels by the year 2000. This was to be accomplished through 50 initiatives that relied on innovative voluntary partnerships between the private sector and government aimed at producing cost-effective reductions in greenhouse gas emissions. On March 21, 1994, the United States joined a number of countries around the world in signing the United Nations Framework Convention on Climate Change (UNFCCC). Under the Convention, governments agreed to gather and share information on greenhouse gas emissions, national policies, and best practices; launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and cooperate in preparing for adaptation to the impacts of climate change.

These efforts have been largely policy oriented. In addition to the national and international efforts described above, many local jurisdictions have adopted climate change policies and programs. However, thus far little has been done to assess the significance of the affects new development projects may have on climate change.

Executive Order S-3-05

On June 1, 2005, Governor Schwarzenegger issued Executive Order S-3-05 (S-3-05). It included the following GHG emission reduction targets: by 2010, reduce GHG emissions to 2000 levels; by 2020, reduce GHG emissions to 1990 levels; by 2050, reduce GHG emissions to 80 percent below 1990 levels. To meet the targets, the Governor directed the Secretary of the California Environmental Protection Agency to coordinate with the Secretary of the Business, Transportation and Housing Agency, Secretary of the Department of Food and Agriculture, Secretary of the Resources Agency, Chairperson of the CARB, Chairperson of the Energy Commission and President of the Public Utilities Commission on development of a Climate Action Plan.

The Secretary of CalEPA leads a Climate Action Team (CAT) made up of representatives from the agencies listed above to implement global warming emission reduction programs identified in the Climate Action Plan and report on the progress made toward meeting the statewide greenhouse gas targets that were established in the Executive Order.



SOURCE: ARB 2007

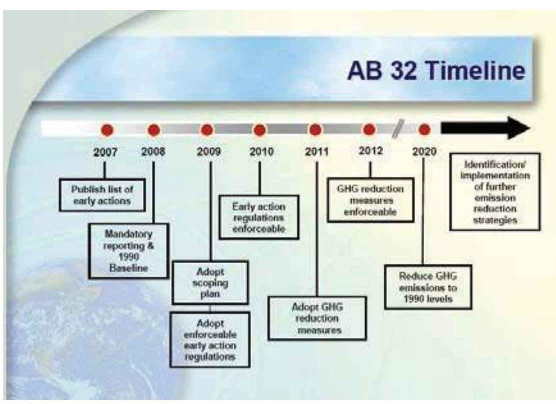
In accord with the requirements of the Executive Order, the first report to the Governor and the Legislature was released in March 2006 and will be issued bi-annually thereafter. The CAT Report to the Governor contains recommendations and strategies to help ensure the targets in Executive Order S-3-05 are met.

California Global Warming Solutions Act of 2006 (AB 32)

In 2006, the California State Legislature adopted the California Global Warming Solutions Act of 2006. AB 32 establishes a cap on statewide greenhouse gas emissions and sets forth the regulatory framework to achieve the corresponding reduction in statewide emissions levels. AB 32 charges the California Air Resources Board (CARB), the state agency charged with regulating statewide air quality, with implementation of the act. Under AB 32, greenhouse gases are defined as: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

The regulatory steps laid out in AB 32 require CARB to: adopt early action measures to reduce GHGs; to establish a statewide greenhouse gas emissions cap for 2020 based on 1990 emissions; to adopt mandatory reporting rules for significant source of greenhouse gases; and to adopt a scoping plan indicating how emission reductions will be achieved via regulations, market mechanisms and other actions; and to adopt the regulations needed to achieve the maximum technologically feasible and cost-effective reductions in greenhouse gases.

AB 32 requires that by January 1, 2008, the State Board shall determine what the statewide greenhouse gas emissions inventory was in 1990, and approve a statewide greenhouse gas emissions limit that is equivalent to that level, to be achieved by 2020. While the level of 1990 GHG emissions has not yet been approved, CARB's most recent emission inventory indicates that California had annual emissions of 436 million metric tons of carbon dioxide equivalent (MMT CO_2e) in 1990 and 497 MMT CO_2e in 2004.



SOURCE: ARB 2007

The regulatory timeline laid out in AB 32 requires that by July 1, 2007, CARB adopt a list of discrete early action measures, or regulations, to be adopted and implemented by January 1, 2010. These actions will form part of the State's comprehensive plan for achieving greenhouse gas emission reductions. In June 2007, CARB adopted three discrete early action measures. These three new proposed regulations meet the definition of "discrete early action greenhouse gas reduction measures," which include the following: a low carbon fuel standard; reduction of HFC-134a emissions from non-professional servicing of motor vehicle air conditioning systems; and improved landfill methane capture. CARB estimates that by 2020, the reductions from those three discrete early action measures would be approximately 13-26 MMT CO_2e.

CARB evaluated over 100 possible measures identified by the CAT for inclusion in the list of discrete early action measures. On October 25, 2007 CARB gave final approval to the list of Early Action Measures, which includes nine discrete measures and 35 additional measures, all of which are to be enforceable by January 1, 2010. AB 32 requires that by January 1, 2009, CARB adopt a scoping plan indicating how emission reductions will be achieved via regulations, market mechanisms and other actions.

<u>Senate Bill 97</u>

Senate Bill (SB) 97, signed in August 2007, acknowledges that climate change is an important environmental issue that requires analysis under CEQA. This bill directs the OPR to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions, by July 1, 2009. The Resources Agency is required to certify or adopt those guidelines by January 1, 2010. This bill also protects projects funded by the Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act of 2006, or the Disaster Preparedness and Flood Protection Bond Act of 2006 (Proposition 1B or 1E) from claims of inadequate analysis of GHG as a legitimate cause of action. This latter provision will be repealed on January 1, 2010. Thus, this "protection" is highly limited to a handful of projects and for a short time period.

The Role of Air Districts in the CEQA Process

Air districts assume one of three roles in the CEQA process. They may be lead agencies when they are adopting regulations and air quality plans. In some instances, they can also be a lead agency when approving permits to construct or operate for applicants subject to district rules. However, in many cases where an air district permit is involved, another agency has broader permitting authority over the project and assumes the role of lead agency. In these situations, the air district becomes what is referred to as a responsible agency under CEQA. When CEQA documents are prepared for projects that do not involve discretionary approval of a district regulation, plan or permit, the air district may assume the role of a concerned or commenting agency. In this role, it is typical for air districts to comment on CEQA documents where there may be air quality-related adverse impacts, such as projects that may create significant contributions to existing violations of ambient standards, cause a violation of an ambient standard or create an exposure to toxic air contaminants or odors. In some cases, the air district may also act in an "advisory" capacity to a lead agency early on in its review of an application for a proposed development project.

A few air districts in California began developing significance thresholds for use in CEQA analyses in the late 1980's and early 1990's. By the mid-1990's most air districts had developed CEQA thresholds for air quality analyses. Many of the districts have included in their guidance the analysis of rule development and permits that may be subject to CEQA.

What is Not Addressed in this Paper

Impacts of Climate Change to a Project

The focus of this paper is addressing adverse impacts to climate change and the ability to meet statewide GHG reduction goals caused by proposed new land development projects.

CEQA also requires an assessment of significant adverse impacts a project might cause by bringing development and people into an area affected by climate change (CEQA Guidelines §15126.2). For example, an area that experiences higher average temperatures due to climate change may expose new development to more frequent exceedances and higher levels of ozone concentrations. Alternatively, a rise in sea level brought on by climate change may inundate new development locating in a low-lying area. The methodologies, mitigation and threshold approaches discussed in this paper do not specifically address the potential adverse impacts resulting from climate change that may affect a project.

Impacts from Construction Activity

Although construction activity has been addressed in the analytical methodologies and mitigation chapters, this paper does not discuss whether any of the threshold approaches adequately addresses impacts from construction activity. More study is needed to make this assessment or to develop separate thresholds for construction activity. The focus of this paper is the long-term adverse operational impacts of land use development.

Introduction

Any analysis of environmental impacts under CEQA includes an assessment of the nature and extent of each impact expected to result from the project to determine whether the impact will be treated as significant or less than significant. CEQA gives lead agencies discretion whether to classify a particular environmental impact as significant. "The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved," ref: CEQA Guidelines §15064(b) ("Guidelines"). Ultimately, formulation of a standard of significance requires the lead agency to make a policy judgment about where the line should be drawn distinguishing adverse impacts it considers significant from those that are not deemed significant. This judgment must, however, be based on scientific information and other factual data to the extent possible (Guidelines §15064(b)).

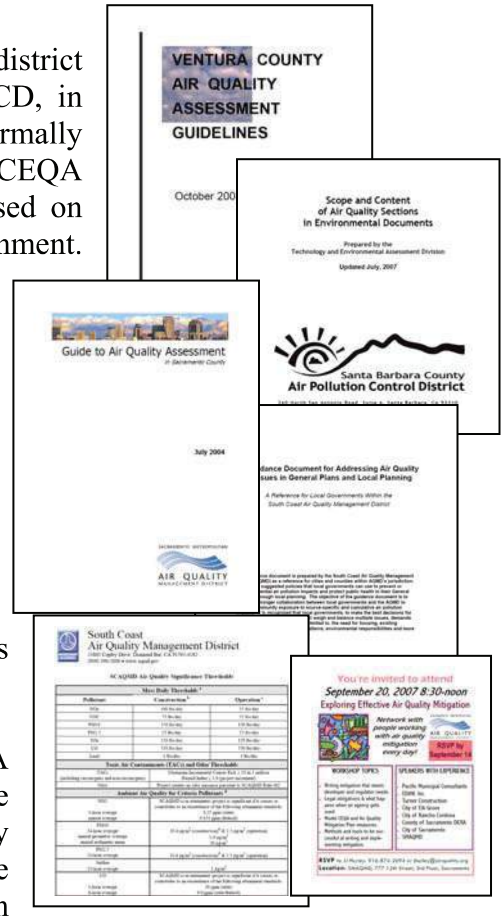
CEQA does not require that agencies establish thresholds of significance. Guidelines §15064.7(a) encourages each public agency "…to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which normally means the effect will be determined to be less than significant."

Once such thresholds are established, an impact that complies with the applicable threshold will "normally" be found insignificant and an impact that does not comply with the applicable threshold will "normally" be found significant.

Additionally, Guidelines §15064.7(b) requires that if thresholds of significance are adopted for general use as part of the lead agency's environmental review process they must be adopted by ordinance, resolution, rule or regulation, and developed through a public review process and be supported by substantial evidence.

While many public agencies adopt regulatory standards as thresholds, the standards do not substitute for a public agency's use of careful judgment in determining significance. They also do not replace the legal standard for significance (i.e., if there is a fair argument, based on substantial evidence in light of the whole record that the project may have a significant effect, the effect should be considered significant) (Guidelines §15064(f)(1). Also see *Communities for a Better Environment v. California Resource Agency* 103 Cal. App. 4th 98 (2002)). In other words, the adoption of a regulatory standard does not create an irrebuttable presumption that impacts below the regulatory standard are less than significant.

Summary of CEQA Thresholds at Air Districts



This section briefly summarizes the evolution of air district CEQA significance thresholds. Ventura County APCD, in 1980, was the first air district in California that formally adopted CEQA significance thresholds. Their first CEQA assessment document contained impact thresholds based on project type: residential, nonresidential, and government. Then, as now, the District's primary CEQA thresholds applied only to ROG and NO_x. The 1980 Guidelines did not address other air pollutants.

Santa Barbara County APCD and the Bay Area AQMD adopted thresholds in 1985. The South Coast AQMD recommended regional air quality thresholds in 1987 for CO, SO_2, NO_2, particulates, ROG, and lead. Most of the other California air districts adopted CEQA guidance and thresholds during the 1990's. Air districts have updated their thresholds and guidelines several times since they were first published.

Originally, most districts that established CEQA thresholds focused on criteria pollutants for which the district was nonattainment and the thresholds only addressed project level impacts. Updates during the 1990's began to add additional air quality impacts such as odors, toxic air contaminants and construction. Several air districts also developed thresholds for General Plans that relied on an assessment of the plan consistency with the district's air quality plans. A consistency analysis involves comparing the project's land use to that of the general plan and the population and employment increase to the forecasts underlying the assumptions used to develop the air quality plan.

Most air district thresholds for CEQA are based on the threshold for review under the New Source Review (NSR). The NSR threshold level is set by district rule and is different depending on the nonattainment classification of the air district. Areas with a less severe classification have a higher NSR trigger level while the most polluted areas have the lowest NSR trigger level. Some districts, such as Ventura County APCD, have significantly lower CEQA thresholds that are not tied to the NSR requirements. In Ventura, one set of CEQA thresholds is 25 pounds per day for all regions of Ventura County, except the Ojai Valley. The second set of CEQA thresholds was set at 5 pounds per day for the Ojai Valley.

The Sacramento Metropolitan AQMD bases its thresholds for ozone precursors on the projected land use share of emission reductions needed for attainment. The emission reductions needed to reach attainment are based on commitments made in the state implementation plan (SIP) prepared for the federal clean air act.

CEQA Considerations in Setting Thresholds

Public agencies use significance thresholds to disclose to their constituents how they plan on evaluating and characterizing the severity of various environmental impacts that could be associated with discretionary projects that they review. Significance thresholds are also used to help identify the level of mitigation needed to reduce a potentially significant impact to a less than significant level and to determine what type of an environmental document should be prepared for a project; primarily a negative declaration, mitigated negative declaration or an environmental impact report.

While public agencies are not required to develop significance thresholds, if they decide to develop them, they are required to adopt them by ordinance, resolution, rule or regulation through a public process. A lead agency is not restrained from adopting any significance threshold it sees as appropriate, as long as it is based on substantial evidence. CEQA Guidelines §15064.7 encourages public agencies to develop and publish significance thresholds that are identifiable, quantitative, qualitative or performance level that the agency uses in the determination of the significance of environmental effects. The courts have ruled that a "threshold of significance" for a given environmental effect is simply that level at which the lead agency finds the effects of the project to be significant.

Before an agency determines its course with regard to climate change and CEQA, it must be made clear that a threshold, or the absence of one, will not relieve a lead agency from having to prepare an EIR or legal challenges to the adequacy of an analysis leading to a conclusion, or lack of a conclusion, of significance under CEQA. CEQA has generally favored the preparation of an EIR where there is any substantial evidence to support a fair argument that a significant adverse environmental impact may occur due to a proposed project. This paper explores three alternative approaches to thresholds, including a no threshold option, a zero threshold option and a non-zero threshold option.

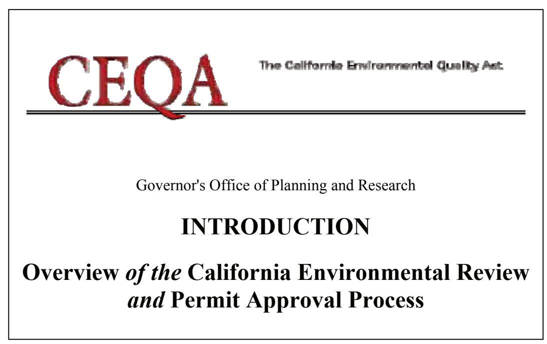
Fair Argument Considerations

Under the CEQA fair argument standard, an EIR must be prepared whenever it can be fairly argued, based on substantial evidence in the administrative record, that a project may have a significant adverse effect on the environment. "Substantial evidence" comprises "enough relevant information and reasonable inferences from this information that a fair argument can be made to support a conclusion, even though other conclusions might also be reached." (Guidelines §15384) This means that if factual information is presented to the public agency that there is a reasonable possibility the project could have a significant effect on the environment, an EIR is required even if the public agency has information to the contrary (Guidelines §15064 (f)).

The courts have held that the fair argument standard "establishes a low threshold for initial preparation of an EIR, which reflects a preference for resolving doubts in favor of environmental review." (*Santa Teresa Citizen Action Group v. City of San Jose* [2003] 114 Cal.App.4th 689) Although the determination of whether a fair argument exists is made by the public agency, that determination is subject to judicial scrutiny when challenged in litigation. When the question is whether an EIR should have been prepared, the court will review the administrative record for factual evidence supporting a fair argument.

The fair argument standard essentially empowers project opponents to force preparation of an EIR by introducing factual evidence into the record that asserts that the project may have a significant effect on the environment. This evidence does not need to be conclusive regarding the potential significant effect.

In 1998, the Resources Agency amended the State CEQA Guidelines to encourage the use of thresholds of significance. Guidelines §15064 (h) provided that when a project's impacts did not exceed adopted standards, the impacts were to be considered less than significant. The section went on to describe the types of adopted standards that were to be considered thresholds. Guidelines § 15064.7 provided that agencies may adopt thresholds of significance to guide their determinations of significance. Both of these sections were challenged when environmental groups sued the Resources Agency in 2000 over the amendments. The trial court concluded that §15064.7 was proper, if it was applied in the context of the fair argument standard.


CEQA The California Environmental Quality Act

Governor's Office of Planning and Research

INTRODUCTION

Overview *of the* California Environmental Review *and* Permit Approval Process

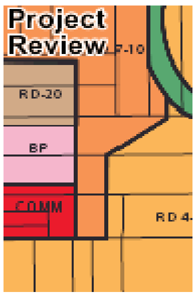
At the appellate court level, §15064(h) was invalidated. [2] Establishing a presumption that meeting an adopted standard would avoid significant impacts was "inconsistent with controlling CEQA law governing the fair argument approach." The Court of Appeal explained that requiring agencies to comply with a regulatory standard "relieves the agency of a duty it would have under the fair argument approach to look at evidence beyond the regulatory standard, or in contravention of the standard, in deciding whether an EIR must be prepared. Under the fair argument approach, any substantial evidence supporting a fair argument that a project may have a significant environmental effect would trigger the preparation of an EIR." (*Communities for a Better Environment v. California Resources Agency* [2002] 103 Cal.App.4th 98)

[2] Prior §15064(h) has been removed from the State CEQA Guidelines. Current §15064(h) discusses cumulative impacts.

In summary, CEQA law does not require a lead agency to establish significance thresholds for GHG. CEQA guidelines encourage the development of thresholds, but the absence of an adopted threshold does not relieve the agency from the obligation to determine significance.

Defensibility of CEQA Analyses

The basic purposes of CEQA, as set out in the State CEQA Guidelines, include: (1) informing decision makers and the public about the significant environmental effects of proposed projects; (2) identifying ways to reduce or avoid those impacts; (3) requiring the implementation of feasible mitigation measures or alternatives that would reduce or avoid those impacts; and (4) requiring public agencies to disclose their reasons for approving any project that would have significant and unavoidable impacts (Guidelines §15002). CEQA is enforced through civil litigation over procedure (i.e., did the public agency follow the correct CEQA procedures?) and adequacy (i.e., has the potential for impacts been disclosed, analyzed, and mitigated to the extent feasible?).



The California Supreme Court has held that CEQA is "to be interpreted in such manner as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language." (*Friends of Mammoth v. Board of Supervisors* [1972] 8 Cal.3d 247, 259) Within that context, the role of the courts is to weigh the facts in each case and apply their judgment. Although the court may rule on the adequacy of the CEQA work, the court is not empowered to act in the place of the public agency to approve or deny the project for which the CEQA document was prepared. Further, the court's review is limited to the evidence contained in the administrative record that was before the public agency when it acted on the project.

Putting aside the issue of CEQA procedure, the defensibility of a CEQA analysis rests on the following concerns:

- whether the public agency has sufficiently analyzed the environmental consequences to enable decision makers to make an intelligent decision;
- whether the conclusions of the public agency are supported by substantial evidence in the administrative record; and
- whether the agency has made a good faith effort at the full disclosure of significant effects.

CEQA analyses need not be perfect or exhaustive -- the depth and breadth of the analysis is limited to what is "reasonably feasible." (Guidelines §15151) At the same time, the analysis "must include detail sufficient to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed project." (Laurel Heights Improvement Assn. v. Regents of University of California (1988) 47 Cal.3d 376)

By itself, establishment of a GHG threshold will not insulate individual CEQA analyses from challenge. Defensibility depends upon the adequacy of the analysis prepared by the lead agency and the process followed. However, the threshold can help to define the boundaries of what is a reasonable analysis by establishing when an analysis will be required and the basic scope of that analysis. The threshold would attempt to define the point at which an analysis will be required and when a level of impact becomes significant, requiring preparation of an EIR. If the threshold includes recommendations for the method or methods of analysis, it can establish the minimum level of analysis to address this issue.

Considerations in Setting Thresholds for Stationary Source Projects

In many respects, the analysis of GHG emissions from stationary sources is much more straightforward than the analysis of land use patterns, forecasted energy consumption, and emissions from mobile sources. The reason is that, for the most part, the latter analyses depend largely on predictive models with myriad inputs and have a wider range of error. Emissions from stationary sources involve a greater reliance on mass and energy balance calculations and direct measurements of emissions from the same or similar sources. Energy demand is more directly tied to production, and even associated mobile source emissions will likely fall within narrower predictive windows.

<u>Implementing CEQA Without a Threshold</u>

A lead agency is not required to establish significance thresholds for GHG emissions from stationary sources. The lead agency may find that it needs more information or experience evaluating GHG from these types of projects to determine an appropriate significance threshold. As with other project types, the lead agency could conduct a project specific analysis to determine whether an environmental impact report is needed and to determine the level of mitigation that is appropriate. The agency might also rely on thresholds established for criteria pollutants as a screening method, and analyze GHG emissions (and require mitigation) from projects with emissions above the criteria pollutant thresholds. Over time, the agency could amass information and experience with specific project categories that would support establishing explicit thresholds. The lead agency may also choose to base local CEQA thresholds on state guidelines or on the category-specific reduction targets established by ARB in its scoping plan for implementing AB32. Resource constraints and other considerations associated with implementing CEQA without GHG thresholds for stationary sources would be similar to those outlined for other types of projects (see Chapter 5 – No Threshold Option).

Implementing CEQA with Threshold of Zero

A lead agency may find that any increase in GHG emissions is potentially significant under CEQA. The resources and other considerations for implementing a threshold of zero for stationary sources are the same as those outlined for other types of projects (see Chapter 6 – Zero Threshold Option).

Implementing CEQA with a Non-Zero Threshold

A lead agency may identify one or more non-zero thresholds for significance of emissions of GHG from stationary sources. The agency could elect to rely on existing thresholds for reviewing new or modified stationary sources of GHG, if the state or local air district has established any. The agency could also apply the threshold(s) established for non-stationary sources to GHG emissions from stationary sources. Significance thresholds could also be established by ordinance, rule, or policy for a given category of stationary sources; this approach is especially conducive to a tiered threshold approach. For example, the agency could establish significance and mitigation tiers for stationary compression-ignition diesel-fueled generators. Under such an approach, the project proponent could be first required to use a lower GHG-emitting power source if feasible, and if not, to apply mitigation based on the size of the generator and other defined considerations, such as hours of operation. Certain classes of generators could be found to be insignificant under CEQA (e.g., those used for emergency stand-by power only, with a limit on the annual hours of use). As with non-stationary projects, the goal of establishing non-zero thresholds is to maximize environmental protection, while minimizing resources used. Resource and other considerations outlined for non-stationary projects are applicable here (see Chapter 7 – Non-Zero Threshold Options).

Implementing CEQA with Different Thresholds for Stationary and Non-stationary Projects

Although a lead agency may apply the same thresholds to stationary and non-stationary projects, it is not required to do so. There are, in fact, some important distinctions between the two types of projects that could support applying different thresholds. The lead agency should consider the methods used to estimate emissions. Are the estimates a "best/worst reasonable scenario" or are they based on theoretical maximum operation? How accurate are the estimates (are they based on models, simulations, emission factors, source test data, manufacturer specifications, etc.)? To what extent could emissions be reduced through regulations after the project is constructed if they were found to be greater than originally expected (i.e., is it possible to retrofit emissions control technology onto the source(s) of GHG at a later date, how long is the expected project life, etc.)? Are there emission limits or emissions control regulations (such as New Source Review) that provide certainty that emissions will be mitigated? Generally, stationary source emissions are based on maximum emissions (theoretical or allowed under law or regulation), are more accurate, and are more amenable to retrofit at a later time than non-stationary source emissions. It is also more likely that category specific rules or some form of NSR will apply to stationary sources than non-stationary projects. Notwithstanding, it is almost always more effective and cost-efficient to apply emission reduction technology at the design phase of a project. There are, therefore, a number of considerations that need to be evaluated and weighed before establishing thresholds – and which may support different thresholds for stationary and non-stationary projects. Furthermore, the considerations may change over time as new regulations are established and as emissions estimation techniques and control technology evolves.

Direct GHG Emissions from Stationary Sources

The main focus of this paper has been the consideration of projects that do not, in the main, involve stationary sources of air pollution, because stationary source projects are generally a smaller percentage of the projects seen by most local land use agencies. That said, some discussion of stationary sources is warranted. As the broader program for regulating GHG from these sources is developed, the strategies for addressing them under CEQA will likely become more refined.

The primary focus of analysis of stationary source emissions has traditionally been those pollutants that are directly emitted by the source, whether through a stack or as fugitive releases (such as leaks). CAPCOA conducted a simplified analysis of permitting activity to estimate the number of stationary source projects with potentially significant emissions of greenhouse gases that might be seen over the course of a year. This analysis looked only at stationary combustion sources (such as boilers and generators), and only considered direct emissions. A lead agency under CEQA may see a different profile of projects than the data provided here suggest, depending on what other resources are affected by projects. In addition, air districts review like-kind replacements of equipment to ensure the new equipment meets current standards, but such actions might not constitute a project for many land use agencies or other media regulators. The data does provide a useful benchmark, however, for lead agencies to assess the order of magnitude of potential stationary source projects. A similar analysis is included for non-stationary projects in Chapter 7.

Table 1: Analysis of GHG Emissions from Stationary Combustion Equipment Permits[3]

	BAAQMD	SMAQMD	SJVUAPCD	SCAQMD
Total Applications for Year	1499	778	1535	1179
Affected at threshold of:				
900 metric tons/year	26	43	63	108
10,000 metric tons/year	7	5	26	8
25,000 metric tons/year	3	1	11	4

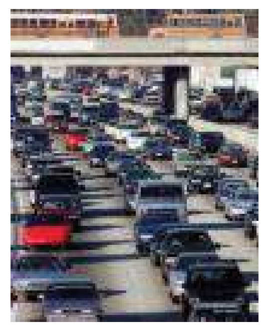
[3] District data varies based on specific local regulations and methodologies.

Emissions from Energy Use

In addition to the direct emissions of GHG from stationary projects, CEQA will likely need to consider the project's projected energy use. This could include an analysis of opportunities for energy efficiency, onsite clean power generation (e.g., heat/energy recovery, co-generation, geothermal, solar, or wind), and the use of dedicated power contracts as compared to the portfolio of generally available power. In some industries, water use and conservation may provide substantial GHG emissions reductions, so the CEQA analysis should consider alternatives that reduce water consumption and wastewater discharge. The stationary project may also have the opportunity to use raw or feedstock materials that have a smaller GHG footprint; material substitution should be evaluated where information is available to do so.

Emissions from Associated Mobile Sources

The stationary project will also include emissions from associated mobile sources. These will include three basic components: emissions from employee trips, emissions from delivery of raw or feedstock materials, and emissions from product transport. Employee trips can be evaluated using trip estimation as is done for non-stationary projects, and mitigations would include such measures as providing access to and incentives for use of public transportation, accessibility for bicycle and pedestrian modes of transport, employer supported car or vanpools (including policies such as guaranteed rides home, etc). Upstream and downstream emissions related to goods movement can also be estimated with available models. The evaluation will need to determine the extent of the transport chain that should be included (to ensure that all emissions in the chain have been evaluated and mitigated, but to avoid double counting). Mitigations could include direct actions by operators who own their own fleet, or could be implemented through contractual arrangements with independent carriers; again, the evaluation will need to consider how far up and down the chain mitigation is feasible and can be reasonably required.



Comparing Emissions Changes Across Pollutant Categories

The potential exists for certain GHG reduction measures to increase emissions of criteria and toxic pollutants known to cause or aggravate respiratory, cardiovascular, and other health problems. For instance, GHG reduction efforts such as alternative fuels and methane digesters may create significant levels of increased pollutants that are detrimental to the health of the nearby population (e.g.; particulate matter, ozone precursors, toxic air contaminants). Such considerations should be included in any CEQA analysis of a project's environmental impacts. While there are many win-win strategies that can reduce both GHG and criteria/toxic pollutant emissions, when faced with situations that involve tradeoffs between the two, the more immediate public health concerns that may arise from an increase in criteria or toxic pollutant emissions should take precedence. GHG emission reductions could be achieved offsite through other mitigation programs.

Introduction

Under state law, it is the purview of each lead agency to determine what, if any, significance thresholds will be established to guide its review of projects under CEQA. While the state does provide guidelines for implementing CEQA, the guidelines have left the decision of whether to establish thresholds (and if so, at what level) to individual lead agencies. Frequently, lead agencies consult with resource-specific agencies (such as air districts) for assistance in determining what constitutes a significant impact on that specific resource.

With the passage of AB 32, the ARB has broad authority to regulate GHG emissions as necessary to meet the emission reduction goals of the statute. This may include authority to establish emission reduction requirements for new land use projects, and may also enable them to recommend statewide thresholds for GHG under CEQA.

In developing this white paper, CAPCOA recognizes that, as the GHG reduction program evolves over time, GHG thresholds and other policies and procedures for CEQA may undergo significant revision, and that uniform statewide thresholds and procedures may be established. This paper is intended to serve as a resource for public agencies until such time that statewide guidance is established, recognizing that decisions will need to be made about GHG emissions from projects before such guidance is available. This paper is not, however, uniform statewide guidance. As stated before, it outlines several possible approaches without endorsing any one over the others.

Some air districts may choose to use this paper to support their establishment of guidance for GHG under CEQA, including thresholds. This paper does not, nor should it be construed to require a district to implement any of the approaches evaluated here. Decisions about whether to provide formal local guidance on CEQA for projects with GHG emissions, including the question of thresholds, will be made by individual district boards.

Each of the 35 air districts operates independently and has its own set of regulations and programs to address the emissions from stationary, area and mobile sources, consistent with state and federal laws, regulations, and guidelines. The independence of the districts allows specific air quality problems to be addressed on a local level. In addition, districts have also established local CEQA thresholds of significance for criteria pollutants – also to address the specific air quality problems relative to that particular district.

The overall goal of air district thresholds is to achieve and maintain health based air quality standards within their respective air basins and to reduce transport of emissions to other air basins. In establishing recommended thresholds, air districts consider the existing emission inventory of criteria pollutants and the amount of emission reductions needed to attain and maintain ambient air quality standards.

However, unlike criteria pollutants where individual districts are characterized by varying levels of pollutant concentrations and source types, greenhouse gases (GHG) and their attendant climate change ramifications are a global problem and, therefore, may suggest a uniform approach to solutions that ensure both progress and equity.

Under SB97, the Office of Planning and Research is directed to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions through CEQA by July 1, 2009. Those guidelines may recommend thresholds. As stated, this paper is intended to provide a common platform of information and tools to support local decision makers until such time that statewide guidance or requirements are promulgated.

Local Ability to Promulgate District-Specific GHG Thresholds

One of the primary reasons behind the creation of air districts in California is the recognition that some regions within the state face more critical air pollution problems than others and, as has often been pointed out – one size does not fit all. For example, a “Serious” federal nonattainment district would need greater emission reductions than a district already in attainment – and, therefore, the more “serious” district would set its criteria pollutant CEQA thresholds of significance much lower than the air district already in attainment.

The action of GHGs is global in nature, rather than local or regional (or even statewide or national). Ultimately there may be a program that is global, or at least national in scope. That said, actions taken by a state, region, or local government can contribute to the solution of the global problem. Local governments are not barred from developing and implementing programs to address GHGs. In the context of California and CEQA, lead agencies have the primary responsibility and authority to determine the significance of a project’s impacts.

Further, air districts have primary authority under state law for "control of air pollution from all sources, other than emissions from motor vehicles." (H&SC §40000) The term air contaminant or "air pollutant" is defined extremely broadly, to mean "any discharge, release, or other propagation into the atmosphere" and includes, but is not limited to, soot, carbon, fumes, gases, particulate matter, etc. Greenhouse gases and other global warming pollutants such as black carbon would certainly be included in this definition, just as the U.S. Supreme Court held in Massachusetts v. EPA that greenhouse gases were air pollutants under the federal Clean Air Act. Therefore, air districts have the primary authority to regulate global warming pollutants from nonvehicular sources. AB 32 does not change this result. Although it gives wide responsibility to CARB to regulate greenhouse gases from all sources, including nonvehicular sources, it does not preempt the districts. AB 32 specifically states That "nothing in this division shall limit or expand the existing authority of any district..."(H&SC § 38594). Thus, districts and CARB retain concurrent authority over nonvehicular source greenhouse gas emissions.

Introduction

The CEQA statutes do not require an air district or any lead agency to establish significance thresholds under CEQA for any pollutant. While there are considerations that support the establishment of thresholds (which are discussed in other sections of this document), there is no obligation to do so.

An air district or other lead agency may elect not to establish significance thresholds for a number of reasons. The agency may believe that the global nature of the climate change problem necessitates a statewide or national framework for consideration of environmental impacts. SB 97 directs OPR to develop "guidelines for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions by July 1, 2009," and directs the California Resources Agency to certify and adopt the guidelines by June 30, 2010.

An agency may also believe there is insufficient information to support selecting one specific threshold over another. As described earlier, air districts have historically set CEQA thresholds for air pollutants in the context of the local clean air plan, or (in the case of toxic air pollutants) within the framework of a rule or policy that manages risks and exposures due to toxic pollutants. There is no current framework that would similarly manage impacts of greenhouse gas pollutants, although the CARB is directed to establish one by June 30, 2009, pursuant to AB 32. A local agency may decide to defer any consideration of thresholds until this framework is in place.

Finally, an agency may believe that the significance of a given project should be assessed on a case-by-case basis in the context of the project at the time it comes forward.

Implementing CEQA Without Significance Thresholds for GHG

The absence of a threshold does not in any way relieve agencies of their obligations to address GHG emissions from projects under CEQA. The implications of not having a threshold are different depending on the role the agency has under CEQA – whether it is acting in an advisory capacity, as a responsible agency, or as a lead agency.

<u>Implications of No Thresholds for an Agency Acting in an Advisory Capacity</u>

Air districts typically act in an advisory capacity to local governments in establishing the framework for environmental review of air pollution impacts under CEQA. This may include recommendations regarding significance thresholds, analytical tools to assess emissions and impacts, and mitigations for potentially significant impacts. Although districts will also address some of these issues on a project-specific basis as responsible agencies, they may provide general guidance to local governments on these issues that are program wide, and these are advisory (unless they have been established by regulation).

An air district that has not established significance thresholds for GHG will not provide guidance to local governments on this issue. This does not prevent the local government from establishing thresholds under its own authority. One possible result of this would be the establishment of different thresholds by cities and counties within the air district. Alternatively, the air district could advise local governments not to set thresholds and those jurisdictions may follow the air district's guidance.

It is important to note here (as has been clearly stated by the Attorney General in comments and filings) that lack of a threshold does *not* mean lack of significance. An agency may argue lack of significance for any project, but that argument would have to be carried forth on a case-by-case, project specific basis. By extension then, a decision not to establish thresholds for GHG is likely to result in a greater workload for responsible and lead agencies as they consider individual projects under CEQA.

Implications of No Thresholds for a Responsible Agency

If there are no established thresholds of significance, the significance of each project will have to be determined during the course of review. The responsible agency (e.g., the air district) will review each project referred by the lead agency. The review may be qualitative or quantitative in nature. A qualitative review would discuss the nature of GHG emissions expected and their potential effect on climate change as the district understands it. It could also include a discussion of the relative merits of alternative scenarios. A quantitative analysis would evaluate, to the extent possible, the expected GHG emissions; it would also need to evaluate their potential effect on climate change and might include corresponding analysis of alternatives. The air district, as a responsible agency, may also identify mitigation measures for the project.

The lack of established thresholds will make the determination of significance more resource intensive for each project. The district may defer to the lead agency to make this determination, however the district may be obligated, as a responsible agency, to evaluate the analysis and determination.

Implications of No Thresholds for a Lead Agency

The main impact of not having significance thresholds will be on the primary evaluation of projects by the lead agency. Without significance thresholds, the agency will have to conduct some level of analysis of every project to determine whether an environmental impact report is needed. There are three fundamental approaches to the case-by-case analysis of significance, including presumptions of significance or insignificance, or no presumption:

1. The agency can begin with a presumption of significance and the analysis would be used to support a case-specific finding of no significance. This is similar to establishing a threshold of zero, except that here, the "threshold" is rebuttable. This approach may result in a large number of projects proceeding to preparation of an environmental impact report. Because of the attendant costs, project proponents may challenge the determination of significance, although formal challenge is less likely than attempts to influence the determination.

2. The agency can begin with a presumption of insignificance, and the analysis would be used to support a case-specific finding of significance. A presumption of insignificance could be based on the perspective that it would be speculative to attempt to identify the significance of GHG emissions from a project relative to climate change on a global scale. This approach might reduce the number of projects proceeding to preparation of environmental impact reports. It is likely to have greater success with smaller projects than larger ones, and a presumption of *insignificance* may be more likely to be challenged by project opponents.

3. It is not necessary for the lead agency to have any presumption either way. The agency could approach each project from a *tabula rasa* perspective, and have the determination of significance more broadly tied to the specific context of the project; this approach is likely to be resource intensive, and creates the greatest uncertainty for project proponents. To the extent that it results in a lead agency approving similar projects based on different determinations of significance for GHG emissions, it may be more vulnerable to challenge from either proponents or opponents of the project. Alternatively, in the absence of either thresholds or presumptions, the lead agency could use each determination of significance to build its approach in the same way that subsequent judgments define the law.

Relevant Citations

The full text of relevant citations is in Appendix A.

Public Resources Code – §21082.2, Significant Effect on Environment; Determination; Environmental Impact Report Preparation.

State CEQA Guidelines – §15064, Determining the Significance of the Environmental Effects Caused by a Project.

Introduction

If an air district or lead agency determines that any degree of project-related increase in GHG emissions would contribute considerably to climate change and therefore would be a significant impact, it could adopt a zero-emission threshold to identify projects that would need to reduce their emissions. A lead agency may determine that a zero-emission threshold is justified even if other experts may disagree. A lead agency is not prevented from adopting any significance threshold it sees as appropriate, as long as it is based on substantial evidence.

If the zero threshold option is chosen, all projects subject to CEQA would be required to quantify and mitigate their GHG emissions, regardless of the size of the project or the availability of GHG reduction measures available to reduce the project's emissions. Projects that could not meet the zero-emission threshold would be required to prepare environmental impact reports to disclose the unmitigable significant impact, and develop the justification for a statement of overriding consideration to be adopted by the lead agency.

Implementing CEQA With a Zero Threshold for GHG

The scientific community overwhelmingly agrees that the earth's climate is becoming warmer, and that human activity is playing a role in climate change. Unlike other environmental impacts, climate change is a global phenomenon in that all GHG emissions generated throughout the earth contribute to it. Consequently, both large and small GHG generators cause the impact. While it may be true that many GHG sources are individually too small to make any noticeable difference to climate change, it is also true that the countless small sources around the globe combine to produce a very substantial portion of total GHG emissions.

A zero threshold approach is based on a belief that, 1) all GHG emissions contribute to global climate change and could be considered significant, and 2) not controlling emissions from smaller sources would be neglecting a major portion of the GHG inventory.

CEQA explicitly gives lead agencies the authority to choose thresholds of significance. CEQA defers to lead agency discretion when choosing thresholds. Consequently, a zero-emission threshold has merits.

The CEQA review process for evaluating a project's impact on global climate change under the zero threshold option would involve several components. Air quality sections would be written by lead agencies to include discussions on climate change in CEQA documents, GHG emissions would be calculated, and a determination of significance would be made. The local air districts would review and comment on the climate change discussions in environmental documents. Lead agencies may then revise final EIRs to accommodate air district comments. More than likely, mitigation measures will be specified for the project, and a mitigation monitoring program will need to be put in place to ensure that these measures are being implemented.

Since CEQA requires mitigation to a less than significant level, it is conceivable that many projects subjected to a zero threshold could only be deemed less than significant with offsite reductions or the opportunity to purchase greenhouse gas emission reduction credits. GHG emission reduction credits are becoming more readily available however the quality of the credits varies considerably. High quality credits are generated by actions or projects that have clearly demonstrated emission reductions that are real, permanent, verifiable, enforceable, and not otherwise required by law or regulation. When the pre- or post-project emissions are not well quantified or cannot be independently confirmed, they are considered to be of lesser quality. Similarly, if the reductions are temporary in nature, they are also considered to be poor quality. Adoption of a zero threshold should consider the near-term availability and the quality of potential offsets.

There are also environmental justice concerns about the effects of using offsite mitigations or emission reduction credits to offset, or mitigate, the impacts of a new project. Although GHGs are global pollutants, some of them are emitted with co-pollutants that have significant near-source or regional impacts. Any time that increases in emissions at a specific site will be mitigated at a remote location or using emission reduction credits, the agency evaluating the project should ensure that it does not create disproportionate impacts.

The Climate Registry

CALIFORNIA Climate ACTION Registry

Administrative Considerations

If electing to pursue a zero threshold, an air district or lead agency should consider the administrative costs and the environmental review system capacity. Some projects that previously would have qualified for an exemption could require further substantial analysis, including preparation of a Negative Declaration (ND), a Mitigated Negative Declaration (MND) or an EIR. Moreover, the trade-offs between the volume of projects requiring review and the quality of consideration given to reviews should be considered. It may also be useful to consider whether meaningful mitigation can be achieved from smaller projects.

Consideration of Exemptions from CEQA

A practical concern about identifying GHG emissions as a broad cumulative impact is whether the zero threshold option will preclude a lead agency from approving a large set of otherwise qualified projects utilizing a Categorical Exemption, ND, or MND. The results could be a substantial increase in the number of EIR's. This is a valid and challenging concern, particularly for any threshold approach that is based on a zero threshold for net GHG emission increases.

CEQA has specified exceptions to the use of a categorical exception. Specifically, CEQA Guidelines §15300.2 includes the following exceptions:

"(b) Cumulative Impact. All exemptions for these classes are inapplicable when the cumulative impact of successive projects of the same type in the same place, over time is significant."

(c) Significant Effect. A categorical exemption shall not be used for an activity where there is a reasonable possibility that the activity will have a significant effect on the environment due to unusual circumstances."

These CEQA Guidelines sections could be argued to mean that any net increase in GHG emissions would preclude the use of a categorical exemption. However, as described below, if the following can be shown, then the exceptions above could be argued not to apply:

(1) Cumulative local, regional and/or state GHG emissions are being reduced or will be reduced by adopted, funded, and feasible measures in order to meet broader state targets.

(2) Mandatory state or local GHG reduction measures would apply to the project's emissions such that broader GHG reduction goals would still be met and the project contributions would not be cumulatively considerable.

(3) Project GHG emissions are below an adopted significance threshold designed to take into account the cumulative nature of GHG emissions.

A similar argument could be made relative to the use of a ND (provided no additional mitigation (beyond existing mandates) is required to control GHG emissions) and to the use of a MND instead of an EIR. However, due to the "fair argument" standard, which is discussed in Chapter 3, caution is recommended in use of a ND or MND unless all three elements above can be fully supported through substantial evidence and there is no substantial evidence to the contrary. Establishing a significance threshold of zero is likely to preclude the use of a categorical exemption.

Relevant Citations

The full text of relevant citations is in Appendix A.

Public Resources Code – §21004, Mitigating or Avoiding a Significant Effect; Powers of Public Agency.

State CEQA Guidelines – §15064, Determining the Significance of the Environmental Effects Caused by a Project.

State CEQA Guidelines – §15130, Discussion of Cumulative Impacts.

State CEQA Guidelines – §15064.7, Thresholds of Significance.

Introduction

A non-zero threshold could minimize the resources spent reviewing environmental analyses that do not result in real GHG reductions or to prevent the environmental review system from being overwhelmed. The practical advantages of considering non-zero thresholds for GHG significance determinations can fit into the concept regarding whether the project's GHG emissions represent a "considerable contribution to the cumulative impact" and therefore warrant analysis.

Specifying a non-zero threshold could be construed as setting a *de minimis* value for a cumulative impact. In effect, this would be indicating that there are certain GHG emission sources that are so small that they would not contribute substantially to the global GHG budget. This could be interpreted as allowing public agencies to approve certain projects without requiring any mitigation of their GHG. Any threshold framework should include a proper context to address the *de minimis* issue. However, the CEQA Guidelines recognize that there may be a point where a project's contribution, although above zero, would not be a *considerable contribution* to the cumulative impact and, therefore, not trigger the need for a significance determination.

GHG emissions from all sources are under the purview of CARB and as such may eventually be "regulated" no matter how small. Virtually all projects will result in some direct or indirect release of GHG. However, a decision by CARB to regulate a class of sources does not necessarily mean that an individual source in that class would constitute a project with significant GHG impacts under CEQA. For example, CARB has established criteria pollutant emission standards for automobiles, but the purchase and use of a single new car is not considered a project with significant impacts under CEQA. At the same time, it is important to note that it is likely that all meaningful sources of emissions, no matter how small are likely to be considered for regulation under AB 32. It is expected that projects will have to achieve some level of GHG reduction to comply with CARB's regulations meant to implement AB 32. As such all projects will have to play a part in reducing our GHG emissions budget and no project, however small, is truly being considered *de minimis* under CARB's regulations.

This chapter evaluates a range of conceptual approaches toward developing GHG significance criteria. The air districts retained the services of J&S an environmental consulting, firm to assist with the development of a Statute and Executive Order-based threshold (Approach 1) and a tiered threshold (Approach 2) based on a prescribed list of tasks and deliverables. Time and financial constraints limited the scope and depth of this analysis, however, the work presented here may be useful in developing interim guidance while AB 32 is being implemented. J&S recognized that approaches other than those described here could be used.

As directed, J&S explored some overarching issues, such as:

- what constitutes "new" emissions?

- how should "baseline emissions" be established?
- what is cumulatively "considerable" under CEQA?
- what is "business as usual" ? and
- should an analysis include "life-cycle" emissions?

The answers to these issues were key to evaluating each of the threshold concepts.

Approach 1 – Statute and Executive Order Approach

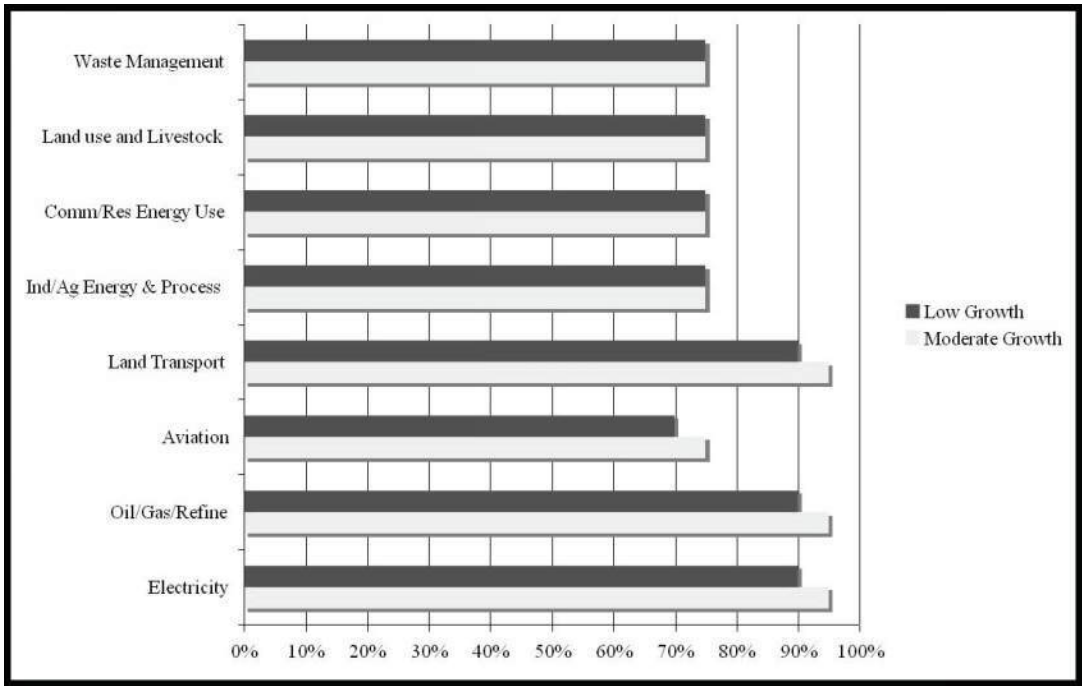
Thresholds could be grounded in existing mandates and their associated GHG emission reduction targets. A project would be required to meet the targets, or reduce GHG emissions to the targets, to be considered less than significant.

AB 32 and S-3-05 target the reduction of statewide emissions. It should be made clear that AB 32 and S-3-05 do not specify that the emissions reductions should be achieved through uniform reduction by geographic location or by emission source characteristics. For example, it is conceivable, although unlikely, that AB 32 goals could be achieved by new regulations that only apply to urban areas or that only apply to the transportation and/or energy sector. However, this approach to evaluating GHG under CEQA is based on the presumption that a new project must at least be consistent with AB 32 GHG emission reduction mandates.

The goal of AB 32 and S-3-05 is the significant reduction of future GHG emissions in a state that is expected to rapidly grow in both population and economic output. As such, there will have to be a significant reduction in the per capita GHG output for these goals to be met. CEQA is generally used to slow or zero the impact of new emissions, leaving the reduction of existing emission sources to be addressed by other regulatory means. With these concepts in mind, four options were identified for statute/executive order-based GHG significance thresholds and are described below.

<u>Threshold 1.1: AB 32/S-3-05 Derived Uniform Percentage-Based Reduction.</u> AB 32 requires the state to reduce California-wide GHG emissions to 1990 levels by 2020. Reducing greenhouse gas emission levels from 2020 to 1990 levels could require a 28 to 33 percent reduction of business-as-usual GHG emissions depending on the methodology used to determine the future emission inventories. The exact percent reduction may change slightly once CARB finalizes its 1990 and 2020 inventory estimates. In this context, business-as-usual means the emissions that would have occurred in the absence of the mandated reductions. The details of the business-as-usual scenario are established by CARB in the assumptions it uses to project what the state's GHG emissions would have been in 2020, and the difference between that level and the level that existed in 1990 constitutes the reductions that must be achieved if the mandated goals are to be met.

This threshold approach would require a project to meet a percent reduction target based on the average reductions needed from the business-as-usual emission from all GHG sources. Using the 2020 target, this approach would require all discretionary projects to achieve a 33 percent reduction from projected business-as-usual emissions in order to be considered less than significant. A more restrictive approach would use the 2050 targets. S-3-05 seeks to reduce GHG emissions to 80 percent below 1990 levels by 2050. To reach the 2050 milestone would require an estimated 90 percent reduction (effective immediately) of business-as-usual emissions. Using this goal as the basis for a significance threshold may be more appropriate to address the long-term adverse impacts associated with global climate change. Note that AB 32 and S-3-05 set emission inventory goals at milestone years; it is unclear how California will progress to these goals in non-milestone years.



SOURCE: ARB 2007

<u>Threshold 1.2: Uniform Percentage-Based (e.g.50%) Reduction for New Development</u>. This threshold is based on a presumption that new development should contribute a greater percent reduction from business-as-usual because greater reductions can be achieved at lower cost from new projects than can be achieved from existing sources. This approach would establish that new development emit 50 percent less GHG emissions than business-as-usual development. This reduction rate is greater than the recommended reduction rate for meeting the Threshold 1.1 2020 target (33 percent) but is significantly less restrictive than the Threshold 1.1 2050 target reduction rate (90 percent). If a 50 percent GHG reduction were achieved from new development, existing emissions would have to be reduced by 25 to 30 percent in order to meet the 2020 emissions goal depending on the year used to determine the baseline inventory. Although this reduction goal is reasonable for achieving the 2020 goal, it would not be possible to

reach the 2050 emissions target with this approach even if existing emissions were 100 percent controlled.

Threshold 1.3: Uniform Percentage-Based Reduction by Economic Sector. This threshold would use a discrete GHG reduction goal specific to the economic sector associated with the project. There would be specific reduction goals for each economic sector, such as residential, commercial, and industrial development. Specifying different reduction thresholds for each market sector allows selection of the best regulatory goal for each sector taking into account available control technology and costs. This approach would avoid over-regulating projects (i.e. requiring emissions to be controlled in excess of existing technology) or under-regulating projects (i.e. discouraging the use of available technology to control emissions in excess of regulations). This approach requires extensive information on the emission inventories and best available control technology for each economic sector. This data will be compiled as CARB develops its scoping plan under AB 32 and its implementing regulations; as a result, this approach will be more viable in the long term.

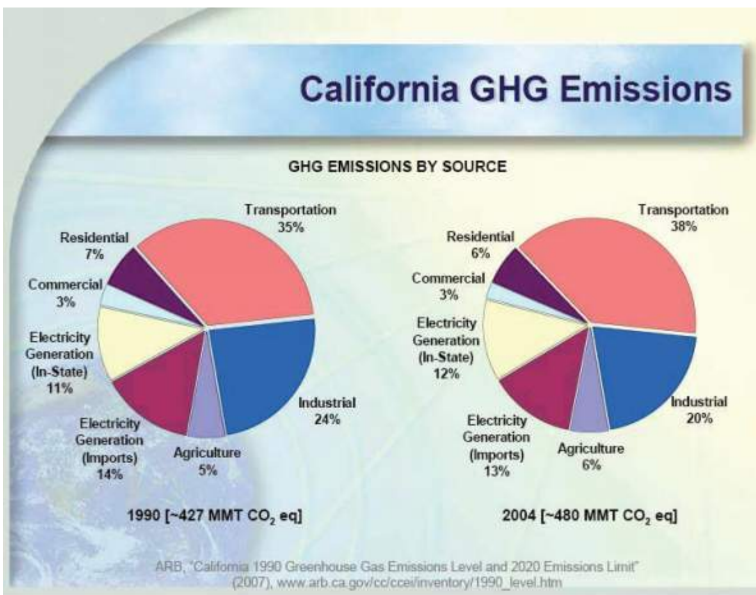
Threshold 1.4: Uniform Percentage-Based Reduction by Region. AB 32 and S-3-05 are written such that they apply to a geographic region (i.e. the entire state of California) rather than on a project or sector level. One could specify regions of the state such as the South Coast Air Basin, Sacramento Valley, or Bay Area which are required to plan (plans could be developed by regional governments, such as councils of governments) and demonstrate compliance with AB 32 and S-3-05 reduction goals at a regional level. To demonstrate that a project has less than significant emissions, one would have to show compliance with the appropriate regional GHG plan. Effectively this approach allows for analysis of GHG emissions at a landscape scale smaller than the state as a whole. Specifying regions in rough correlation to existing air basins or jurisdictional control allows for regional control of emissions and integration with regional emission reduction strategies for criteria and toxic air pollutants. Although differing GHG reduction controls for each region are possible, it is likely that all regions would be

required to achieve 1990 emission inventories by the year 2020 and 80 percent less emissions by 2050. Threshold 1.4 is considered viable long-term significance criteria that is unlikely to be used in the short term.

Implementing CEQA Thresholds Based on Emission Reduction Targets

Characterizing Baseline and Project Emissions

While the population and economy of California is expanding, all new projects can be considered to contribute new emissions. Furthermore, GHG impacts are exclusively cumulative impacts; there are no non-cumulative GHG emission impacts from a climate change perspective. "Business-as-usual" is the projection of GHG emissions at a future date based on current technologies and regulatory requirements in absence of other reductions. For example to determine the future emissions from a power plant for "business-as-usual" one would multiply the projected energy throughput by the current emission factor for that throughput. If adopted regulations (such as those that may be promulgated by CARB for AB 32) dictate that power plant emissions must be reduced at some time in the future, it is appropriate to consider these regulation standards as the new business-as-usual for a future date. In effect, business-as-usual will continue to evolve as regulations manifest. Note that "business-as-usual" defines the CEQA No Project conditions, but does not necessarily form the baseline under CEQA. For instance, it is common to subtract the future traffic with and without a project to determine the future cumulative contribution of a project on traffic conditions. However, existing conditions at the time of issuance of the notice of preparation is normally the baseline.



SOURCE: ARB 2007

Establishing Emission Reduction Targets

One of the obvious drawbacks to using a uniform percent reduction approach to GHG control is that it is difficult to allow for changes in the 1990 and future emission inventories estimates. To determine what emission reductions are required for new projects one would have to know accurately the 1990 budget and efficacy of other GHG promulgated regulations as a function of time. Since CARB will not outline its regulation strategy for several more years, it is difficult to determine accurately what the new project reductions should be in the short term. Future updates to the 1990 inventory could necessitate changes in thresholds that are based on that inventory. It is important to note that it is difficult to create near term guidance for a uniform reduction threshold strategy since it would require considerable speculation regarding the implementation and effectiveness of forthcoming CARB regulations.

Of greater importance are the assumptions used to make the projected 2020 emission inventories. Projecting future inventories over the next 15-50 years involves substantial uncertainty. Furthermore, there are likely to be federal climate change regulations and possibly additional international GHG emission treaties in the near future. To avoid such speculation, this paper defines all future emission inventories as hypothetical business-as-usual projections.

This white paper is intended to support local decisions about CEQA and GHG in the near term. During this period, it is unlikely that a threshold based on emission reduction targets would need to be changed. However, it is possible that future inventory updates will show that targets developed on the current inventory were not stringent enough, or were more stringent than was actually needed.

Approach 2 – Tiered Approach

The goal of a tiered threshold is to maximize reduction predictability while minimizing administrative burden and costs. This would be accomplished by prescribing feasible mitigation measures based on project size and type, and reserving the detailed review of an EIR for those projects of greater size and complexity. This approach may require inclusion in a General Plan, or adoption of specific rules or ordinances in order to fully and effectively implement it.

A tiered CEQA significance threshold could establish different levels at which to determine if a project would have a significant impact. The tiers could be established based on the gross GHG emission estimates for a project or could be based on the physical size and characteristics of the project. This approach would then prescribe a set of GHG mitigation strategies that would have to be incorporated into the project in order for the project to be considered less than significant.

The framework for a tiered threshold would include the following:

- disclosure of GHG emissions for all projects;
- support for city/county/regional GHG emissions reduction planning;
- creation and use of a "green list" to promote the construction of projects that have desirable GHG emission characteristics;
- a list of mitigation measures;

- a decision tree approach to tiering; and
- quantitative or qualitative thresholds.

Decision-Tree Approach to Tiering

CEQA guidance that allows multiple methodologies to demonstrate GHG significance will facilitate the determination of significance for a broad range of projects/plans that would otherwise be difficult to address with a single non-compound methodology. Even though there could be multiple ways that a project can determine GHG significance using a decision-tree approach, only one methodology need be included in any single CEQA document prepared by the applicant. The presence of multiple methodologies to determine significance is designed to promote flexibility rather than create additional analysis overhead. Figure 1 shows a conceptual approach to significance determination using a tiered approach that shows the multiple routes to significance determination.

Figure 1 Detail Description

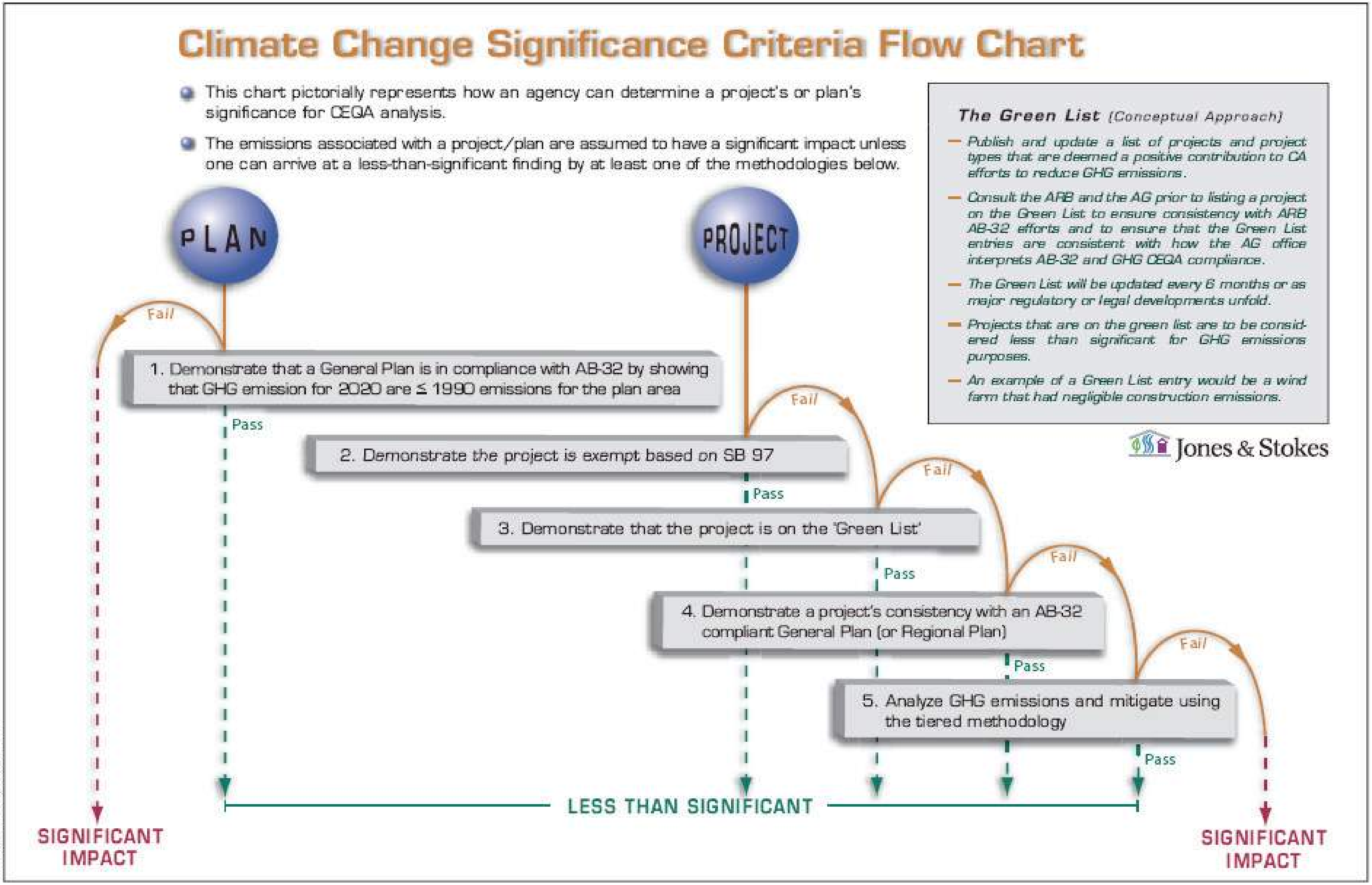
Figure 1 pictorially represents how an agency can determine a project's or plan's significance for CEQA analysis using the non-zero threshold methodology. The emissions associated with a project/plan are assumed to have a significant impact unless one can arrive at a less-than-significant finding by at least one of the methodologies below.

1. Demonstrate that a General Plan (GP) or Regional Plan is in Compliance with AB32

   - For most GPs or RPs this will require demonstration that projected 2020 emissions will be equal to or less than 1990 emissions.
   - GPs or RPs are expected to fully document 1990 and 2020 GHG emission inventories.
   - Projection of 2020 emissions is complicated by the fact that CARB is expected to promulgate emission reductions in the short term. Until explicit CARB regulations are in place, unmitigated GP 2020 emission inventories represent business-as-usual scenarios.
   - EIRs for GPs or RPs which demonstrate 2020 mitigated emissions are less than or equal to 1990 emissions are considered less than significant.

2. Demonstrate the Project is Exempt Based on SB 97

   - As specified in SB 97, projects that are funded under November 2006 Proposition 1B (Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act) and 1C (Disaster Preparedness and Flood Prevention Bond Act) may be exempt from analysis until January 1, 2010.



00802.07 GHG Emissions (rev 10/07)

Jones & Stokes

Figure 1
Climate Change Significance Criteria Flow Chart

- An exemption can be used in an ND, MND, or EIR to support a less than significant finding for GHG impacts.

3. Demonstrate that the Project is on the 'Green List'

- This list would include projects that are deemed a positive contribution to California efforts to reduce GHG emissions. If the project is of the type described on the Green List it is considered less than significant.
- If the Green List entry description requires mitigation for impacts other than GHG, this methodology can be used in MNDs or EIRs; if the Green List entry does not require mitigation this methodology can be used in NDs, MNDs, or EIRs.

4. Demonstrate a Project's Compliance with a General Plan

- If a project is consistent with an appropriate General Plan's Greenhouse Gas Reduction Plan (GGRP), a project can be declared less than significant.
- Note that at this time there are no known jurisdictions that have a GGRP that has been fully subject to CEQA review. While Marin County has adopted a forward-thinking GGRP and it is described in the most recent GP update, the associated EIR does not analyze the secondary environmental impacts of some of the GGRP measures such as tidal energy. While one can reference GGRPs that have not been reviewed fully in CEQA, to attempt to show a project's compliance with such a plan as evidence that the project's GHG emission contributions are less than significant may not be supported by substantial evidence that cumulative emissions are being fully addressed in the particular jurisdiction.
- Compliance with a CEQA-vetted GGRP can be cited as evidence for all CEQA documents (Categorical Exemption, ND, MND, and EIR).

5. Analyze GHG Emissions and Mitigate using the Tiered Methodology

- Guidance and mitigation methodology for various development projects (residential, commercial, industrial) are listed in the form of tiered thresholds. If a project incorporates the mitigation measures specified in the tiered threshold tables the project is considered less than significant.
- All project emissions are considered less than significant if they are less than the threshold(s).
- If the tiered approach requires mitigation, this methodology can be used in MNDs or EIRs; if the tiered approach does not require mitigation this methodology can be used in NDs, MNDs, or EIRs.

The Green List

- The Green List would be a list of projects and project types that are deemed a positive contribution to California's efforts to reduce GHG emissions.
- If this approach is followed, it is suggested that CARB and the Attorney General (AG) are consulted prior to listing a project on the Green List to ensure consistency with CARB AB 32 efforts and to ensure that the Green List entries are consistent with how the AG office interprets AB 32 and GHG CEQA compliance.
- The Green List should be updated every 6 months or as major regulatory or legal developments unfold.
- Projects that are on the Green List are to be considered less than significant for GHG emissions purposes.
- A tentative list of potential Green List entries is presented below. Actual Green List entries should be far more specific and cover a broad range of project types and mitigation approaches. The list below is merely a proof-of-concept for the actual Green List.

1. Wind farm for the generation of wind-powered electricity
2. Extension of transit lines to currently developed but underserved communities
3. Development of high-density infill projects with easily accessible mass transit
4. Small hydroelectric power plants at existing facilities that generate 5 mw or less (as defined in Class 28 Categorical Exemption)
5. Cogeneration plants with a capacity of 50 mw or less at existing facilities (as defined in Class 29 Cat Exemption)
6. Increase in bus service or conversion to bus rapid transit service along an existing bus line
7. Projects with LEED "Platinum" rating
8. Expansion of recycling facilities within existing urban areas
9. Recycled water projects that reduce energy consumption related to water supplies that services existing development
10. Development of bicycle, pedestrian, or zero emission transportation infrastructure to serve existing regions

There are also several options for tiering and thresholds, as shown in Table 2 below. One could establish strictly numeric emissions thresholds and require mitigation to below the specific threshold to make a finding of less than significant. One could establish narrative emissions threshold that are based on a broader context of multiple approaches to GHG reductions and a presumption that projects of sufficiently low GHG intensity are less than significant.

In Concept 2A, a zero threshold would be applied to projects and thus only projects that result in a reduction of GHG emissions compared to baseline emissions would be less than significant absent mitigation. All projects would require quantified inventories. All projects that result in a net increase of GHG emissions would be required to mitigate their emissions to zero through direct mitigation or through fees or offsets or the impacts

Table 2: Approach 2 Tiering Options

	Concept 2A Zero	Concept 2B Quantitative	Concept 2C Qualitative
Tier 1	Project results in a net reduction of GHG emissions *Less than Significant*	Project in compliance with an AB 32-compliant General/Regional Plan, on the Green List, or below Tier 2 threshold. Level 1 Reductions (Could include such measures as: bike parking, transit stops for planned route, Energy Star roofs, Energy Star appliances, Title 24, water use efficiency, etc.) *Less than Significant*	Project in compliance with an AB 32-compliant General/Regional Plan, on the Green List, or below Tier 2 threshold. Level 1 Reductions (See measures under 2B) *Less than Significant*
Tier 2	Project results in net increase of GHG emissions Mitigation to zero (including offsets) *Mitigated to Less than Significant*	Above Tier 2 threshold Level 2 Mitigation (Could include such measures as: Parking reduction beyond code, solar roofs, LEED Silver or Gold Certification, exceed Title 24 by 20%, TDM measures, etc.) *Mitigated to Less than Significant*	Above Tier 2 threshold Level 2 Mitigation (See measures under 2B) *Mitigated to Less than Significant*
Tier 3	Mitigation infeasible to reduce emissions to zero (e.g., cost of offsets infeasible for project or offsets not available) *Significant and Unavoidable*	Above Tier 2 threshold With Level 1, 2 Mitigation Level 3 Mitigation: (Could include such measures as: On-site renewable energy systems, LEED Platinum certification, Exceed Title 24 by 40%, required recycled water use for irrigation, zero waste/high recycling requirements, mandatory transit passes, offsets/carbon impact fees) *Mitigated to Less than Significant*	Above Tier 3 thresholds Quantify Emissions, Level 3 Mitigation (see measures under 2B), and Offsets for 90% of remainder *Significance and Unavoidable*

would be identified as significant and unavoidable. This could be highly problematic and could eliminate the ability to use categorical exemptions and negative declarations for a wide range of projects.

In Concepts 2B and 2C, the first tier of a tiered threshold includes projects that are within a jurisdiction with an adopted greenhouse gas reduction plan (GGRP) and General Plan/Regional Plan that is consistent with AB 32 (and in line with S-3-05), or are on the Green List, or are below the Tier 2 threshold. All Tier 1 projects would be required to implement mandatory reductions required due to other legal authority (Level 1 reductions) such as AB 32, Title 24, or local policies and ordinances. With Level 1 reduction measures, qualifying Tier 1 projects would be considered less than significant without being required to demonstrate mitigation to zero.

In Concept 2B, the Tier 2 threshold would be quantitative, and quantified inventories would be required. Several quantitative threshold options are discussed below. A more comprehensive set of Level 2 mitigation would be required. If the project's emissions still exceed the Tier 2 threshold, an even more aggressive set of Level 3 mitigation measures would be required including offsets (when feasible) to reduce emissions below the Tier 2 threshold.

In Concept 2C, there would be two thresholds, a lower Tier 2 threshold (the "low bar") and a higher Tier 3 threshold (the "high bar"). The Tier 2 threshold would be the significance threshold for the purposes of CEQA and would be qualitative in terms of units (number of dwelling units, square feet of commercial space, etc.) or a per capita ratio. Projects above the Tier 2 threshold would be required to implement the comprehensive set of Level 2 mitigation. Projects below the Tier 2 threshold would not be required to quantify emissions or reductions. The Tier 3 threshold would be a threshold to distinguish the larger set of projects for which quantification of emissions would be required. Level 3 mitigation would be required and the project would be required to purchase offsets (when feasible) in the amount of 90 percent of the net emissions after application of Level 1 reductions and Level 2 and 3 mitigation. A variant on Concept 2C would be to require mandatory Level 3 mitigation without quantification and offsets.

<u>Approach 2 Threshold Options</u>

Seven threshold options were developed for this approach. The set of options are framed to capture different levels of new development in the CEQA process and thus allow different levels of mitigation. Options range from a zero first-tier threshold (Threshold 2.1) up to a threshold for GHG that would be equivalent to the capture level (i.e., number of units) of the current criteria pollutant thresholds used by some air districts (Threshold 2.4). The decision-based implementation approach discussed above could be used for any of these options. Table 3 below compares the results of each of the approaches discussed here.

<u>Threshold 2.1: Zero First Tier Tiered Threshold</u>.

This option would employ the decision tree concept and set the first tier cut-point at zero. The second tier cut-point could be one of the qualitative or quantitative thresholds discussed below. First-tier projects would be required to implement a list of very feasible and readily available mitigation measures.

<u>Threshold 2.2: Quantitative Threshold Based on Market Capture</u>

A single quantitative threshold was developed in order to ensure capture of 90 percent or more of likely future discretionary developments. The objective was to set the emission threshold low enough to capture a substantial fraction of future residential and non-residential development that will be constructed to accommodate future statewide population and job growth, while setting the emission threshold high enough to exclude small development projects that will contribute a relatively small fraction of the cumulative statewide GHG emissions.

The quantitative threshold was created by using the following steps:

- Reviewing data from four diverse cities (Los Angeles in southern California and Pleasanton, Dublin, and Livermore in northern California) on pending applications for development.

- Determining the unit (dwelling unit or square feet) threshold that would capture approximately 90 percent of the residential units or office space in the pending application lists.

- Based on the data from the four cities, the thresholds selected were 50 residential units and 30,000 square feet of commercial space.

- The GHG emissions associated with 50 single-family residential units and 30,000 square feet of office were estimated and were found to be 900 metric tons and 800 metric tons, respectively. Given the variance on individual projects, a single threshold of 900 metric tons was selected for residential and office projects.

- A 900 metric ton threshold was also selected for non-office commercial projects and industrial projects to provide equivalency for different projects in other economic sectors.

- If this threshold is preferred, it is suggested that a more robust data set be examined to increase the representativeness of the selected thresholds. At a minimum, a diverse set of at least 20 cities and/or counties from throughout the state should be examined in order to support the market capture goals of this threshold. Further, an investigation of market capture may need to be conducted for different commercial project types and for industrial projects in order to examine whether multiple quantitative emissions thresholds or different thresholds should be developed.

The 900-ton threshold corresponds to 50 residential units, which corresponds to the 84th percentile of projects in the City of Los Angeles, the 79th percentile in the City of Pleasanton, the 50th percentile in the City of Livermore and the 4th percentile in the City of Dublin. This is suggestive that the GHG reduction burden will fall on larger projects that will be a relatively small portion of overall projects within more developed central cities (Los Angeles) and suburban areas of slow growth (Pleasanton) but would be the higher portion of projects within moderately (Livermore) or more rapidly developing areas (Dublin). These conclusions are suggestive but not conclusive due to the small sample size. The proposed threshold would exclude the smallest proposed developments from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. While this would exclude perhaps 10 percent of new residential development, the capture of 90 percent of new residential development would establish a strong basis for demonstrating that cumulative reductions are being achieved across the state. It can certainly serve as an interim measure and could be revised if subsequent regulatory action by CARB shows that a different level or different approach altogether is called for.

The 900-ton threshold would correspond to office projects of approximately 35,000 square feet, retail projects of approximately 11,000 square feet, or supermarket space of approximately 6,300 square feet. 35,000 square feet would correspond to the 46th percentile of commercial projects in the City of Los Angeles, the 54th percentile in the City of Livermore, and the 35th percentile in the City of Dublin. However, the commercial data was not separated into office, retail, supermarket or other types, and thus the amount of capture for different commercial project types is not known. The proposed threshold would exclude smaller offices, small retail (like auto-parts stores), and small supermarkets (like convenience stores) from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA but would include many medium-scale retail and supermarket projects.

The industrial sector is less amenable to a unit-based approach given the diversity of projects within this sector. One option would be to adopt a quantitative GHG emissions threshold (900 tons) for industrial projects equivalent to that for the residential/commercial thresholds described above. Industrial emissions can result from both stationary and mobile sources. CARB estimates that their suggested reporting threshold for stationary sources of 25,000 metric tons accounts for more than 90 percent of the industrial sector GHG emissions (see Threshold 2.3 for 25,000 metric ton discussion). If the CARB rationale holds, then a 900 metric ton threshold would likely capture at least 90 percent (and likely more) of new industrial and manufacturing sources. If this approach is advanced, we suggest further examination of industrial project data to determine market capture.

This threshold would require the vast majority of new development emission sources to quantify their GHG emissions, apportion the forecast emissions to relevant source categories, and develop GHG mitigation measures to reduce their emissions.

Threshold 2.3: CARB Reporting Threshold

CARB has recently proposed to require mandatory reporting from cement plants, oil refineries, hydrogen plants, electric generating facilities and electric retail providers, cogeneration facilities, and stationary combustion sources emitting $\geq$ 25,000 MT CO_2e/yr. AB 32 requires CARB to adopt a regulation to require the mandatory reporting and verification of emissions. CARB issued a preliminary draft version of its proposed reporting requirements in August 2007 and estimates that it would capture 94 percent of the GHG emissions associated with stationary sources.

This threshold would use 25,000 metric tons per year of GHG as the CEQA significance level. CARB proposed to use the 25,000 metric tons/year value as a reporting threshold, not as a CEQA significance threshold that would be used to define mitigation requirements. CARB is proposing the reporting threshold to begin to compile a statewide emission inventory, applicable only for a limited category of sources (large industrial facilities using fossil fuel combustion).

A 25,000 metric ton significance threshold would correspond to the GHG emissions of approximately 1,400 residential units, 1 million square feet of office space, 300,000 square feet of retail, and 175,000 square feet of supermarket space. This threshold would capture far less than half of new residential or commercial development.

As noted above, CARB estimates the industrial-based criteria would account for greater than 90 percent of GHG emissions emanating from stationary sources. However, industrial and manufacturing projects can also include substantial GHG emissions from mobile sources that are associated with the transportation of materials and delivery of products. When all transportation-related emissions are included, it is unknown what portion of new industrial or manufacturing projects a 25,000-ton threshold would actually capture.

An alternative would be to use a potential threshold of 10,000 metric tons considered by the Market Advisory Committee for inclusion in a Greenhouse Gas Cap and Trade System in California. A 10,000 metric ton significance threshold would correspond to the GHG emissions of approximately 550 residential units, 400,000 square feet of office space, 120,000 square feet of retail, and 70,000 square feet of supermarket space. This threshold would capture roughly half of new residential or commercial development.

Threshold 2.4: Regulated Emissions Inventory Capture

Most California air districts have developed CEQA significance thresholds for NOx and ROG emissions to try to reduce emissions of ozone precursors from proposed sources that are not subject to NSR pre-construction air quality permitting. The historical management of ozone nonattainment issues in urbanized air districts is somewhat analogous to today's concerns with greenhouse gas emissions in that regional ozone concentrations are a cumulative air quality problem caused by relatively small amounts of NOx and ROG emissions from thousands of individual sources, none of which emits enough by themselves to cause elevated ozone concentrations. Those same conditions apply to global climate change where the environmental problem is caused by emissions from a countless number of individual sources, none of which is large enough by itself to cause the problem. Because establishment of NOx/ROG emissions CEQA significance thresholds has been a well-tested mechanism to ensure that individual projects address cumulative impacts and to force individual projects to reduce emissions under CEQA, this threshold presumes the analogy of NOx/ROG emission thresholds could be used to develop similar GHG thresholds.

The steps to develop a GHG emission threshold based on the NOx/ROG analogy were as follows:

- For each agency, define its NOx/ROG CEQA thresholds.
- For each agency, define the regional NOx/ROG emission inventory the agency is trying to regulate with its NOx/ROG thresholds.
- For each agency, calculate the percentage of the total emission inventory for NOx represented by that agency's CEQA emission threshold. That value represents the "minimum percentage of regulated inventory" for NOx.
- The current (2004) California-wide GHG emission inventory is 499 million metric tons per year of CO_2 equivalent (MMT CO_2e). Apply the typical "minimum percentage of regulated inventory" value to the statewide GHG inventory, to develop a range of analogous GHG CEQA thresholds.

The preceding methodology was applied to two different air quality districts: the Bay Area Air Quality Management District (BAAQMD), a mostly-urbanized agency within which most emissions are generated from urban areas; and the San Joaquin Valley Air Pollution Control District (SJVAPCD), which oversees emissions emanating in part from rural areas that are generated at dispersed agricultural sources and area sources. For example, in the Bay Area the NOx threshold is 15 tons/year. The total NOx inventory for 2006 was 192,000 tons/year (525 tons/day). The threshold represents 0.008 percent of the total NOx inventory. Applying that ratio to the total statewide GHG emissions inventory of 499 MMT CO_2e (2004) yields an equivalent GHG threshold of 39,000 MMT CO_2e.

The range of analogous CEQA GHG thresholds derived from those two agencies is tightly clustered, ranging from 39,000 to 46,000 tons/year. A 39,000 to 46,000 metric ton threshold would correspond to the GHG emissions of approximately 2,200 to 2,600 residential units, 1.5 to 1.8 million square feet of office space, 470,000 to 560,000 square feet of retail, and 275,000 to 320,000 square feet of supermarket space. This threshold would capture far less than half of new residential or commercial development. Similarly, this threshold would capture less of new industrial/manufacturing GHG emissions inventory than Thresholds 2.2 or 2.3.

<u>Threshold 2.5: Unit-Based Thresholds Based on Market Capture</u>

Unit thresholds were developed for residential and commercial developments in order to capture approximately 90 percent of future development. The objective was to set the unit thresholds low enough to capture a substantial fraction of future housing and commercial developments that will be constructed to accommodate future statewide population and job growth, while setting the unit thresholds high enough to exclude small development projects that will contribute a relatively small fraction of the cumulative statewide GHG emissions. Sector-based thresholds were created by using the same steps and data used to create Threshold 2.2- Quantitative Threshold Based on Market Capture above.

The distribution of pending application data suggests that the GHG reduction burden will fall on larger projects that will be a relatively small portion of overall projects within more developed central cities and suburban areas of slow growth but would be the higher portion of projects within moderately or rapidly developing areas. The proposed threshold would exclude the smallest proposed developments from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. While this would exclude perhaps 10 percent of new residential development, the capture of 90 percent of new residential development would establish a strong basis for demonstrating that cumulative reductions are being achieved across the state. It can certainly serve as an interim measure and could be revised if subsequent regulatory action by CARB shows that a different level or different approach altogether is called for.

A similar rationale can be applied to the development of a commercial threshold. Threshold 2.5 would exclude many smaller businesses from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. It should be noted that the GHG emissions of commercial projects vary substantially. For example, the carbon dioxide emissions associated with different commercial types were estimated as follows:

- 30,000 square-foot (SF) office = 800 metric tons/year CO_2
- 30,000 SF retail = 2,500 metric tons/year CO_2
- 30,000 SF supermarket = 4,300 metric tons/year CO_2

Thus, in order to assure appropriate market capture on an emissions inventory basis, it will be important to examine commercial project size by type, instead of in the aggregate (which has been done in this paper).

The industrial sector is less amenable to a unit-based approach given the diversity of projects within this sector. One option would be to use a quantitative threshold of 900 tons for industrial projects in order to provide for rough equivalency between different sectors. Industrial emissions can result from both stationary and mobile sources. However, if the CARB rationale for > 90 percent stationary source capture with a threshold of 25,000 metric tons holds, then a 900 metric ton threshold would likely capture at least 90 percent (and likely more) of new industrial sources. Further examination of unit-based industrial thresholds, such as the number of employees or manufacturing floor space or facility size, may provide support for a unit-based threshold based on market capture.

This threshold would require the vast majority of new development emission sources to quantify their GHG emissions, apportion the forecast emissions to relevant source categories, and develop GHG mitigation measures to reduce their emissions.

Threshold 2.6. Projects of Statewide, Regional, or Areawide Significance

For this threshold, a set of qualitative, tiered CEQA thresholds would be adopted based on the definitions of "projects with statewide, regional or areawide significance" under the Guidelines for California Environmental Quality Act, CCR Title 14, Division 6, Section 15206(b).

Project sizes defined under this guideline include the following:

- Proposed residential development of more than 500 dwelling units.
- Proposed shopping center or business establishment employing more than 1,000 persons or encompassing more than 500,000 square feet of floor space.
- Proposed commercial office building employing more than 1,000 persons or encompassing more than 250,000 square feet of floor space.
- Proposed hotel/motel development of more than 500 rooms.
- Proposed industrial, manufacturing or processing plant or industrial park planned to house more than 1,000 persons, or encompassing more than 600,000 square feet of floor space.

These thresholds would correspond to the GHG emissions of approximately 9,000 metric tons for residential projects, 13,000 metric tons for office projects, and 41,000 metric tons for retail projects. These thresholds would capture approximately half of new residential development and substantially less than half of new commercial development. It is unknown what portion of the new industrial or manufacturing GHG inventory would be captured by this approach.

Threshold 2.7 Efficiency-Based Thresholds

For this approach, thresholds would be based on measurements of efficiency. For planning efforts, the metric could be GHG emissions per capita or per job or some combination thereof. For projects, the metric could be GHG emission per housing unit or per square foot of commercial space. In theory, one could also develop metrics for GHG emissions per dollar of gross product to measure the efficiency of the economy.

This approach is attractive because it seeks to benchmark project GHG intensity against target levels of efficiency. The thresholds would need to be set such that there is reasonably foreseeable and sufficient reductions compared to business as usual to support meeting AB 32 and S-3-05 goals in time (in combination with command and control regulations). Because this approach would require substantial data and modeling to fully develop, this is a concept considered as a potential future threshold and not appropriate for interim guidance in the short term. Thus, it is not evaluated in the screening evaluation in the next section.

Table 3 compares the results for each of the approaches.

Table 3: Comparison of Approach 2 Tiered Threshold Options

Threshold	**GHG Emission Threshold (metric tons/year)**	**Future Development Captured by GHG Threshold**
2.1: Zero Threshold	0 tons/year	All
2.2: Quantitative Threshold Based on Market Capture	~900 tons/year	Residential development > 50 dwelling units Office space > 36,000 ft^2 Retail space >11,000 ft^2 Supermarkets >6.300 ft^2 small, medium, large industrial
2.3: CARB GHG Mandatory Reporting Threshold OR Potential Cap and Trade Entry Level	25,000 metric tons/year OR 10,000 metric tons/year	Residential development >1,400 dwelling units OR 550 dwelling units Office space >1 million ft^2 OR 400,000 ft^2 Retail space >300,000 ft^2 OR 120,000 ft^2 Supermarkets >175,000 ft^2 OR 70,000 ft^2 medium/larger industrial
2.4: Regulated Inventory Capture	40,000 – 50,000 metric tons/year	Residential development >2,200 to 2,600 dwelling units Office space >1.5 to 1.8 million ft^2 Retail space >470,000 to 560,000 ft^2 Supermarkets >270,000 to 320,000 ft^2 medium/larger industrial
2.5: Unit-Based Threshold Based on Market Capture	Not applicable.	Residential development >50 dwelling units Commercial space >50,000 ft^2 > small, medium, large industrial (with GHG emissions > 900 tonsCO2e)
2.6: Projects of Statewide, Regional, or Areawide Significance	Not applicable.	Residential development >500 dwelling units Office space >250,000 ft^2 Retail space >500,000 ft^2 Hotels >500 units Industrial project >1,000 employees Industrial project >40 acre or 650,000 ft^2
2.7: Efficiency-Based Thresholds	TBD tons/year/person TBD tons/year/unit	Depends on the efficiency measure selected.

Implementing CEQA With Tiered Thresholds

Several issues related to Approach 2 are addressed below:

1. *Some applications of this approach may need to be embodied in a duly approved General Plan, or in some other formal regulation or ordinance to be fully enforceable.* Because CEQA does not expressly provide that projects may be deemed insignificant based on implementation of a set of mitigations, this approach may need to be supported with specific and enforceable mechanisms adopted with due public process.

2. *How would this concept affect adoption of air district rules and regulations?* Proposed air district rules and regulations may be subject to CEQA like other projects and plans. Thus, if significance thresholds were adopted by an APCD or AQMD, then they could also apply to air district discretionary actions. If GHG emissions would be increased by a rule or regulation for another regulated pollutant, that would be a potential issue for review under CEQA.

3. *Mitigation measures may not be all-inclusive; better measures now or new future technology would make these measures obsolete.* The mandatory mitigation measures could be periodically updated to reflect current technology, feasibility, and efficiency.

4. *Total reduction may not be quantified or difficult to quantify.* CEQA only requires the adoption of feasible mitigation and thus the reduction effectiveness of required mitigation should not be in question. However, the precise reduction effectiveness may indeed be difficult to identify. As described above, if a quantitative threshold is selected as the measure of how much mitigation is mandated, then best available evidence will need to be used to estimate resultant GHG emissions with mitigation adoption. If a qualitative threshold is selected, then it may not be necessary to quantify reductions.

5. *Difficult to measure progress toward legislative program goals.* One could require reporting of project inventories to the Climate Action Registry, air district, or regional council of governments, or other suitable body. Collection of such data would allow estimates of the GHG intensity of new development over time, which could be used by CARB to monitor progress toward AB 32 goals.

6. *Measures may have adverse impacts on other programs.* The identification of mandatory mitigation will need to consider secondary environmental impacts, including those to air quality.

7. *Consideration of life-cycle emissions.* In many cases, only direct and indirect emissions may be addressed, rather than life-cycle emissions. A project applicant has traditionally been expected to only address emissions that are closely related and within the capacity of the project to control and/or influence. The long chain

8. of economic production resulting in materials manufacture, for example, involves numerous parties, each of which in turn is responsible for the GHG emissions associated with their particular activity. However, there are situations where a lead agency could reasonably determine that a larger set of upstream and downstream emissions should be considered because they are being caused by the project and feasible alternatives and mitigation measures may exist to lessen this impact.

Approach 2 Tiered Threshold with Mandatory Mitigation

As shown in Table 2, due to the cumulative nature of GHG emissions and climate change impacts, there could be a level of mandatory reductions and/or mitigation for all projects integrated into a tiered threshold approach. In order to meet AB 32 mandates by 2020 and S-3-05 goals, there will need to be adoption of GHG reduction measures across a large portion of the existing economy and new development. As such, in an effort to support a determination under CEQA that a project has a less than considerable contribution to significant cumulative GHG emissions, mitigation could be required on a progressively more comprehensive basis depending on the level of emissions.

- Level 1 Reductions – These reduction measures would apply to all projects and would only consist of AB 32 and other local/state mandates. They would be applied to a project from other legal authority (not CEQA). Level 1 reductions could include such measures as bike parking, transit stops for planned routes, Energy Star roofs, Energy Star appliances, Title 24 compliance, water use efficiency, and other measures. All measures would have to be mandated by CARB or local regulations and ordinances.

- Level 2 Mitigation – Projects that exceed the determined threshold would be required to first implement readily available technologies and methodologies with widespread availability. Level 2 Mitigation could include such measures as: parking reduction below code minimum levels, solar roofs, LEED Silver or Gold Certification, exceed Title 24 building standards by 20 percent, Traffic Demand Management (TDM) measures, and other requirements.

- Level 3 Mitigation - If necessary to reduce emissions to the thresholds, more extensive mitigation measures that represent the top tier of feasible efficiency design would also be required. Level 3 Mitigation could include such measures as: on-site renewable energy systems, LEED Platinum certification, exceed Title 24 building requirements by 40 percent, required recycled water use for irrigation, zero waste/high recycling requirements, mandatory transit pass provision, and other measures.

- Offset Mitigation – If, after adoption of all feasible on-site mitigation, the project is still found to exceed a Tier 2 quantitative threshold, or exceed a Tier 3 qualitative threshold, or if a project cannot feasibly implement the mandatory on-site mitigation, then purchases of offsets could be used for mitigation. In the case of a quantitative threshold, the amount of purchase would be to offset below the Tier 2 significance threshold. In the case of a qualitative threshold, the amount of purchase could be to offset GHG emissions overall to below the lowest equivalent GHG emissions among the Tier 2 qualitative thresholds. With Threshold 2.5, this would be approximately 900 tons of GHG emissions (corresponding to 50 residential units). With Threshold 2.6, this would be approximately 9,000 tons (corresponding to 500 residential units). Alternatively, one could require purchase of offsets in the amount of a set percentage (such as 90% or 50% for example) of the residual GHG emissions (after other mitigation). As discussed earlier, any decision to include or require the use of emission reduction credits (or offsets) must consider issues of availability, quality, and environmental justice.

Substantial Evidence Supporting Different Thresholds

If a project can be shown by substantial evidence not to increase GHG emissions relative to baseline emissions, then no fair argument will be available that the project contributes considerably to a significant cumulative climate change impact.

It is more challenging to show that a project that increases GHG emissions above baseline emissions does not contribute considerably to a significant cumulative climate change impact. It is critical therefore, to establish an appropriate cumulative context, in which, although an individual project may increase GHG emissions, broader efforts will result in net GHG reductions.

Approach 1-based thresholds that by default will require an equal level of GHG reductions from the existing economy (Thresholds 1.1, 1.3, and 1.4) may be less supportable in the short run (especially before 2012) than Approach 1.2 (which requires new development to be relatively more efficient than a retrofitted existing economy). This is because, prior to 2012, there will only be limited mandatory regulations implementing AB 32 that could address the existing economy in a truly systematic way that can be relied upon to demonstrate that overall GHG reduction goals can be achieved by 2020. Approach 1.2 will still rely on substantial reductions in the existing economy but to a lesser degree.

Approach 1-based thresholds that would spread the mitigation burden across a sector (Threshold 1.3) or across a region (Threshold 1.4) will allow for tradeoffs between projects or even between municipalities. In order to demonstrate that a sector or a region is achieving net reductions overall, there would need to be feasible, funded, and mandatory requirements in place promoting an overall reduction scheme, in order for a project to result in nominal net increased GHG emissions.

Approach 2-based thresholds that capture larger portions of the new development GHG inventory (Thresholds 2.2 and 2.5) would promote growth that results in a smaller increase in GHG emissions; they may therefore be more supportable than thresholds that do not and that have a greater reliance on reductions in the existing economy (Thresholds

2.3, 2.4, and 2.6), especially in the next three to five years. With an established cumulative context that demonstrates overall net reductions, all threshold approaches could be effective in ensuring growth and development that significantly mitigates GHG emissions growth in a manner that will allow the CARB to achieve the emission reductions necessary to meet AB 32 targets. In that respect, all of these thresholds are supported by substantial evidence.

Evaluation of Non-Zero Threshold Options

Overarching issues concerning threshold development are reviewed below. Where appropriate, different features or application of the two conceptual approaches and the various options for thresholds under each conceptual approach described above are analyzed. The screening evaluation is summarized in Tables 4 (Approach 1) and 5 (Approach 2). The summary tables rate each threshold for the issues discussed below based on the level of confidence (low, medium or high) ascribed by J&S. The confidence levels relate to whether a threshold could achieve a particular attribute, such as emission reduction effectiveness. For example, a low emission reduction effectiveness rating means the threshold is not expected to capture a relatively large portion of the new development inventory.

As described above, Threshold 2.7 is not included in this evaluation because the data to develop an efficiency-based threshold has not been reviewed at this time and because this threshold is not considered feasible as an interim approach until more detailed inventory information is available across the California economy.

<u>What is the GHG Emissions Effectiveness of Different Thresholds?</u>

Effectiveness was evaluated in terms of whether a threshold would capture a large portion of the GHG emissions inventory and thus require mitigation under CEQA to control such emissions within the larger framework of AB 32. In addition, effectiveness was also evaluated in terms of whether a threshold would require relatively more or less GHG emissions reductions from the existing economy verses new development. This is presumptive that gains from the existing economy (through retrofits, etc.) will be more difficult and inefficient relative to requirements for new development.

Approach 1-based thresholds that require equivalent reductions relative to business-as-usual (Thresholds 1.1, 1.3, and 1.4) for both the existing and new economy will be less effective than thresholds that support lower-GHG intensity new development (Approach 1.2). However, since Approach 1-based thresholds do not establish a quantitative threshold below which projects do not have to mitigate, the market capture for new development is complete.

Approach 2-based thresholds can be more or less effective at capturing substantial portions of the GHG inventory associated with new development depending on where the quantitative or qualitative thresholds are set. Lower thresholds will capture a broader range of projects and result in greater mitigation. Based on the review of project data for the select municipalities described in the Approach 2 section above, thresholds based on the CARB Reporting Threshold/Cap and Trade Entry Level (Threshold 2.4) or CEQA definitions of "Statewide, Regional or Areawide" projects (Threshold 2.6) will result in a limited capture of the GHG inventory. Lower quantitative or qualitative thresholds (Thresholds 2.1, 2.2 and 2.5) could result in capture of greater than 90 percent of new development.

Are the Different Thresholds Consistent with AB 32 and S-3-05?

Thresholds that require reductions compared to business-as-usual for all projects or for a large portion of new development would be consistent with regulatory mandates. In time, the required reductions will need to be adjusted from 2020 (AB 32) to 2050 (S-3-05) horizons, but conceptually broad identification of significance for projects would be consistent with both of these mandates. Thresholds that exclude a substantial portion of new development would likely not be consistent, unless it could be shown that other more effective means of GHG reductions have already been, or will be adopted, within a defined timeframe.

All Approach 1-based thresholds would be consistent with AB 32 and S-3-05 if it can be demonstrated that other regulations and programs are effective in achieving the necessary GHG reduction from the existing economy to meet the overall state goals.

Approach 2-based thresholds that include substantive parts of the new development GHG inventory (Thresholds 2.1, 2.2 and 2.5) will be more consistent with AB 32 and S-3-05 than those that do not (Thresholds 2.3, 2.4, and 2.6) unless it can be demonstrated that other regulations and programs are effective in achieving the necessary GHG reduction from the existing economy to meet the overall state goals.

What are the Uncertainties Associated with Different Thresholds?

All thresholds have medium to high uncertainties associated with them due to the uncertainty associated with the effectiveness of AB 32 implementation overall, the new character of GHG reduction strategies on a project basis, the immaturity of GHG reduction technologies or infrastructure (such as widespread biodiesel availability), and the uncertainty of GHG reduction effectiveness of certain technologies (such as scientific debate concerning the relative lifecycle GHG emissions of certain biofuels, for example).

In general, Approach 1-based thresholds have higher uncertainties than Approach 2 thresholds because they rely on a constantly changing definition of business-as-usual. Threshold 1.2, with its relatively smaller reliance on the existing economy for GHG reductions has relatively less uncertainty than other Approach 1 thresholds. Thresholds that spread mitigation more broadly (Thresholds 1.3 and 1.4) have less uncertainty by avoiding the need for every project to mitigate equally.

Approach 2 thresholds with lower quantitative (2.1 and 2.2) or qualitative (2.5) thresholds will have uncertainties associated with the ability to achieve GHG reductions from small to medium projects. Approach 2 thresholds with higher quantitative (2.3, 2.4) or qualitative (2.6) thresholds will have uncertainties associated with the ability to achieve relatively larger GHG reductions from the existing economy.

What are Other Advantages/Disadvantages of the Different Thresholds?

Thresholds with a single project metric (Thresholds 1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 2.5, and 2.6) will be easier to apply to individual projects and more easily understood by project applicants and lead agencies broadly. Thresholds that spread mitigation across sectors (1.3) or regions (1.4), while simple in concept, will require adoption of more complicated cross-jurisdictional reduction plans or evaluation of broad sector-based trends in GHG intensity reduction over time. Approach 1 options would require all projects to quantify emissions in order to determine needed reductions relative to business-as-usual (which will change over time as described above). Concepts that are unit-based (Threshold 2.5 and 2.6) will not result in thresholds that have equal amount of GHG emissions, and thus equity issues may arise.

Table 4: Non-Zero Threshold Evaluation Matrix – Approach 1

Approach 1	**1.1**	**1.2**	**1.3**	**1.4**
	28% - 33% Reduction from BAU by 2020 by Project	**50% Reduction from BAU by 2020 by Project**	**28% - 33% Reduction by 2020 by Sector**	**28% - 33% Reduction by 2020 by Region**
GHG Emissions Reduction Effectiveness	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.	**Medium** - Captures all new projects and has a more realistic level of reductions from the existing economy.	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.
Economic Feasibility	**Low** - Some projects will not be able to afford this level of reduction without effective market-based mechanisms like offsets.	**Low** - Some projects will not be able to afford this level of reduction without effective market-based mechanisms like offsets.	**Medium** - Sectors as a whole will be better able to achieve reductions than individual projects.	**Low** - Some regions and newly developed areas may not be able to afford this level of reduction without effective market-based mechanisms like offsets.
Technical Feasibility	**Medium** - Some projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**Low** - Relatively larger set of projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**High** - Some projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**Medium** - Some regions and newly developed areas may not be able to afford this level of reduction without effective market-based mechanisms like offsets.
Logistical Feasibility	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.
Consistency with AB-32 and S-03-05	**Medium** - Would require heavy reliance on command and control gains.	**High**	**Medium-High** - Would rely on command and control gains, but would allow sectoral flexibility.	**Medium-High** - Would rely on command and control gains, but would allow regional flexibility.
Cost Effectiveness	**Low** - Will require all types of projects to reduce the same regardless of the cost/ton of GHG reductions.	**Low** - Will require all types of projects to reduce the same regardless of the cost/ton of GHG reductions.	**Low/Medium** - Allows tradeoffs within sector between high and low cost reduction possibilities but not between sectors.	**Low/Medium** - Allows tradeoffs within region between high and low cost reduction possibilities, but not between regions.
Uncertainties	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.	**Medium/High** - BAU changes over time. Ability to limit GHG emissions from other new development will take years to demonstrate.	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.
Other Advantages	Simple/easy to explain.	Simple/easy to explain.	Spreads mitigation broadly	Spreads mitigation broadly
Other Disadvantages	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.

Table 5: Non-Zero Threshold Evaluation Matrix – Approach 2

Approach 2	**2.1** **Zero Threshold**	**2.2** **Quantitative** **(900 tons)**	**2.3** **Quantitative** **CARB Reporting Threshold/Cap and Trade (25,000 tons/ 10,000 tons)**	**2.4** **Quantitative** **Regulated Inventory Capture** **(~40,000 - 50,000 tons)**	**2.5** **Qualitative** **Unit-Based Thresholds**	**2.6** **Statewide, Regional or Areawide** **(CEQA Guidelines 15206(b)).**
GHG Emissions Reduction Effectiveness	**High** - Captures all sources.	**High** - Market capture at >90%. Captures diverse sources.	**Medium** - Moderate market capture.	**Low** - Low market capture.	**High** - Market capture at ~90%. Captures diverse sources; excl. smallest proj.	**Medium** - Moderate market capture. Excludes small and med. projects.
Economic Feasibility	**Low** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**High** - Large projects have greater ability to absorb cost.	**High** - Large projects have greater ability to absorb cost.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**High** - Large projects have greater ability to absorb cost.
Technical Feasibility	**Low** - Early phases will be substantial change in BAU, esp. for smaller projects; may be inefeasible to mitigate.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be inefficient to mitigate.	**High** - Greater opportunities for multiple reduction approaches.	**High** - Greater opportunities for multiple reduction approaches.	**Medium** - Early phases will be substantial change in BAU, particularly for smaller projects may be inefficient to mitigate.	**High** - Greater opportunities for multiple reduction approaches.
Logistical Feasibility	**Low** - Unless fee or offset basis,very difficult to mitigate all projects.	**Medium** - BMPs broadly written to allow diversity; new req. will take time to integrate into new dev.	**High** - Less mitigation.	**High** - Less mitigation.	**Medium** - BMPs broadly written to allow diversity; new req. will take time to integrate into new dev.	**High** - Less mitigation.
Consistency with AB-32 and S-03-05	**High** - Market capture.	**High** - Market capture at >90%.	**Low** - Would rely on command and control success heavily.	**Low** - Would rely on command and control success heavily.	**Medium** - Need to demonstrate adequate market capture over time.	**Low** - Would rely on command and control success heavily.
Cost Effectiveness	**Low** - Will result in inefficient mitigation approaches. Efficiency will improve in time.	**Medium** - Emphasis is on new dev., req. for mitigation will result in inefficient mitigation approaches in early phases. Efficiency will improve in time.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.	**Medium** - Emphasis is on new dev.; req. for mitigation will result in inefficient mitigation approaches in early phases. Efficiency will improve in time.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.
Uncertainties	**High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects unlikely.	**Medium/High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects uncertain.	**High** - Gains from command and control likely longer to be realized.	**High** - Gains from command and control likely longer to be realized.	**Medium/High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects uncertain.	**High** - Gains from command and control likely longer to be realized.
Other Advantages	Single threshold.	Single threshold. BMPs can be updated. Greenlist can be updated.	Single threshold. Does not change CEQA processing for most projects. CARB inventory = project inv.. All projects treated same.	Single threshold. Does not change CEQA processing for most projects. Follows established SIP practice.	BMPs can be updated. Greenlist can be updated. Unit-Based thresholds can be updated.	Existing guideline. Does not change CEQA processing for most projects. Endorsed by Cal. Chapter of the APA.
Other Disadvantages	Requires all projects to quantify emissions.	Requires nearly all projects to quantify emissions.			Sectoral projects have different GHG emis. Only largest projects to quantify emis.	Sectoral projects have different GHG emissions.

Introduction

This chapter evaluates the availability of various analytical methods and modeling tools that can be applied to estimate the greenhouse gas emissions from different project types subject to CEQA. This chapter will also provide comments on the suitability of the methods and tools to accurately characterize a projects emissions and offer recommendations for the most favorable methodologies and tools available. Some sample projects will be run through the methodologies and modeling tools to demonstrate what a typical GHG analysis might look like for a lead agency to meet its CEQA obligations. The air districts retained the services of EDAW environmental consultants to assist with this effort.

Methodologies/Modeling Tools

There are wide varieties of discretionary projects that fall under the purview of CEQA. Projects can range from simple residential developments to complex expansions of petroleum refineries to land use or transportation planning documents. It is more probably than not, that a number of different methodologies would be required by any one project to estimate its direct and indirect GHG emissions. Table 10 contains a summary of numerous modeling tools that can be used to estimate GHG emissions associated with various emission sources for numerous types of project's subject to CEQA. The table also contains information about the models availability for public use, applicability, scope, data requirements and its advantages and disadvantages for estimating GHG emissions.

In general, there is currently not one model that is capable of estimating all of a project's direct and indirect GHG emissions. However, one of the models identified in Table 9 would probably be the most consistently used model to estimate a projects direct GHG emissions based on the majority of projects reviewed in the CEQA process. The Urban Emissions Model (URBEMIS) is designed to model emissions associated with development of urban land uses. URBEMIS attempts to summarize criteria air pollutants and CO_2 emissions that would occur during construction and operation of new development. URBEMIS is publicly available and already widely used by CEQA practitioners and air districts to evaluate criteria air pollutants emissions against air district-adopted significance thresholds. URBEMIS is developed and approved for statewide use by CARB. The administrative reasons for using URBEMIS are less important than the fact that this model would ensure consistency statewide in how CO_2 emissions are modeled and reported from various project types.

One of the shortfalls of URBEMIS is that the model does not contain emission factors for GHGs other than CO_2, except for methane (CH_4) from mobile-sources, which is converted to CO_2e. This may not be a major problem since CO_2 is the most important GHG from land development projects. Although the other GHGs have a higher global warming potential, a metric used to normalize other GHGs to CO_2e, they are emitted in far fewer quantities. URBEMIS does not calculate other GHG emissions associated with off-site waste disposal, wastewater treatment, emissions associated with goods and services consumed by the residents and workers supported by a project. Nor does URBEMIS calculate GHGs associated with consumption of energy produced off-site. (For that matter, URBEMIS does not report criteria air pollutant emissions from these sources either).

Importantly, URBEMIS does not fully account for interaction between land uses in its estimation of mobile source operational emissions. Vehicle trip rates are defaults derived from the Institute of Transportation Engineers trip generation manuals. The trip rates are widely used and are generally considered worst-case or conservative. URBEMIS does not reflect "internalization" of trips between land uses, or in other words, the concept that a residential trip and a commercial trip are quite possibly the same trip, and, thus, URBEMIS counts the trips separately. There are some internal correction settings that the modeler can select in URBEMIS to correct for "double counting"; however, a project-specific "double-counting correction" is often not available. URBEMIS does allow the user to overwrite the default trip rates and characteristics with more project-specific data from a traffic study prepared for a project.

Residential, Commercial, Mixed-Use Type Projects/ Specific Plans

Direct Emissions

URBEMIS can be used to conduct a project-specific model run and obtain CO_2e emissions for area and mobile sources from the project, and convert to metric tons CO_2e. When a project-specific traffic study is not available, the user should consult with their local air district for guidance. Many air district staff are experienced practitioners of URBEMIS and can advise the lead agency or the modeler on how to best tailor URBEMIS default input parameters to conduct a project-specific model run. When a traffic study has been prepared for the project, the user must overwrite default trip length and trip rates in URBEMIS to match the total number of trips and vehicle miles traveled (VMT) contained in the traffic study to successfully conduct a project-specific model run. URBEMIS is recommended as a calculation tool to combine the transportation study (if available) and EMFAC emission factors for mobile-sources. Use of a project-specific traffic study gets around the main shortfall of URBEMIS: the lack of trip internalization. URBEMIS also provides the added feature of quantifying direct area-source GHG emissions.

Important steps for running URBEMIS

1. Without a traffic study prepared for the project, the user should consult with the local air district for direction on which default options should be used in the modeling exercise. Some air districts have recommendations in the CEQA guidelines.

2. If a traffic study was prepared specifically for the project, the following information must be provided:

a. Total number of average daily vehicle trips *or* trip-generation rates by land use type per number of units; and,

b. Average VMT per residential *and* nonresidential trip.

c. The user overwrites the “Trip Rate (per day)” fields for each land use in URBEMIS such that the resultant “Total Trips” and the “Total VMT” match the number of total trips and total VMT contained in the traffic study.

d. Overwrite “Trip Length” fields for residential and nonresidential trips in UBEMIS with the project-specific lengths obtained form the traffic study.

3. Calculate results and obtain the CO_2 emissions from the URBEMIS output file (units of tons per year [TPY]).

<u>Indirect Emissions</u>

URBEMIS does estimate indirect emissions from landscape maintenance equipment, hot water heaters, etc. URBEMIS does not however, provide modeled emissions from indirect sources of emissions, such as those emissions that would occur off-site at utility providers associated with the project’s energy demands. The California Climate Action Registry (CCAR) Protocol v.2.2 includes methodology, which could be used to quantify and disclose a project’s increase in indirect GHG emissions from energy use. Some assumptions must be made for electrical demand per household or per square foot of commercial space, and would vary based on size, orientation, and various attributes of a given structure. An average rate of electrical consumption for residential uses is 7,000 kilowatt hours per year per household and 16,750 kilowatt hours per thousand square feet of commercial floor space. Commercial floor space includes offices, retail uses, warehouses, and schools. These values have been increasing steadily over the last 20 years. Energy consumption from residential uses has increased due to factors such as construction and occupation of larger homes, prices of electricity and natural gas, and increased personal income allowing residents to purchase more electronic appliances. Commercial energy consumption is linked to factors such as vacancy rates, population, and sales.

The modeler will look up the estimated energy consumption for the project’s proposed land uses under year of project buildout, or use the values given in the previous paragraph for a general estimate. The CCAR Protocol contains emission factors for CO_2, CH_4, and nitrous oxide. The “CALI” region grid serves most of the State of California. If a user has information about a specific utility provider’s contribution from renewable sources, the protocol contains methodology to reflect that, rather than relying on the statewide average grid. The incremental increase in energy production associated with project operation should be accounted for in the project’s total GHG emissions for inclusion in the environmental document.

The incremental increase in energy production associated with project operation should be accounted for in the project's total GHG emissions, but it should be noted that these emissions would be closely controlled by stationary-source control-based regulations and additional regulations are expected under AB 32. However, in the interest of disclosing project-generated GHG emissions and mitigating to the extent feasible, the indirect emissions from off-site electricity generation can be easily calculated for inclusion in the environmental document.

Example Project Estimates for GHG Emissions

Residential Project

Project Attributes:

- 68 detached dwelling units
- 15.9 acres
- 179 residents
- 0 jobs
- Located in unincorporated Placer County (PCAPCD jurisdiction)
- Analysis year 2009

As shown in Table 6, the project's direct GHG emissions per service population (SP) would be approximately 8 metric tons CO_2e/SP/year.

Table 6: Residential Project Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	251	Residents	179
Mobile-source emissions	1,044	Jobs	0
Indirect emissions (from CCAR Protocol)	174		
Total operational emissions	**1,469**	Service population	179
Operational emissions/SP	**8.2**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population(see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Commercial Project

Project Attributes:

- Free Standing Discount Superstore: 241 thousand square feet (ksf)
- 0 residents

- 400 jobs
- Located in the San Joaquin Valley Air Pollution Control District's (SJVAPCD) jurisdiction
- Analysis year 2009

Table 7: Commercial Project Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	464	Residents	0
Mobile-source emissions	13,889	Jobs	400
Indirect emissions (from CCAR Protocol)	1,477		
Total operational emissions	**15,830**	Service population	400
Operational emissions/SP	**39.6**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Specific Plan

If used traditionally with default trip rates and lengths, rather than project-specific (Traffic Analysis Zone-specific) trip rates and lengths, URBEMIS does not work well for specific plan or general plan-sized projects with multiple land use types proposed. However, in all instances, projects of these sizes (several hundred or thousand acres) would be accompanied by a traffic study. Thus, for large planning-level projects, URBEMIS can be used as a calculation tool to easily obtain project-specific mobile-source emissions. The user should follow the steps discussed above; wherein he/she overwrites the default ITE trip rates for each land use type with that needed to make total VMT match that contained in the traffic study. The URBEMIS interface is a simple calculator to combine the traffic study and EMFAC emissions factors for mobile-source CO_2.

Project Attributes:

- 985 acres
- Total dwelling units: 5,634
- Commercial/Mixed Use: 429 ksf
- Educational: 2,565 ksf
- 14,648 residents
- 3,743 jobs
- Located in Sacramento County (SMAQMD jurisdiction)
- Analysis year 2009

Table 8: Specific Plan Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	23,273	Residents	14,648
Mobile-source emissions	73,691	Jobs	3,743
Indirect emissions (from CCAR Protocol)	32,744		
Total operational emissions	**129,708**	Service population	18,391
Operational emissions/SP	**7.1**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

The specific plan example, when compared to the residential or commercial examples, illustrates the benefit of a mixed-use development when you look at CO_2e emissions per resident or job (service population) metric (see definition of service population below in discussion of Normalization/Service Population Metric). Though this particular specific plan is not an example of a true jobs/housing balance, the trend is clear: accommodating residents and jobs in a project is more efficient than residents or jobs alone.

Stationary- and Area-Source Project Types

GHG emissions from stationary or area sources that require a permit to operate from the air district also contain both direct and indirect sources of emissions. Examples of these types of sources would be fossil fuel power plants, cement plants, landfills, wastewater treatment plants, gas stations, dry cleaners and industrial boilers. All air districts have established procedures and methodologies for projects subject to air district permits to calculate their regulated pollutants. It is anticipated that these same procedures and methodologies could be extended to estimate a permitted facility's GHG calculations. For stationary and area sources that do not require air district permits, the same methodologies used for permitted sources could be used in addition to URBEMIS and CCAR GRP to calculate GHG emissions from these facilities.

Wastewater Treatment Facilities

Direct GHG emissions associated with a proposed waste water treatment plant can be calculated using AP-42 emission factors from Chapter 4.3.5 Evaporative Loss Sources: Waste Water-Greenhouse Gases and the CCAR methodology. In general, most wastewater operations recover CH_4 for energy, or use a flare to convert the CH_4 to CO_2. There are many types of wastewater treatment processes and the potential for GHG emissions from different types of plants varies substantially. There is not one standard set of emission factors that could be used to quantify GHG emissions for a state "average" treatment plant. Thus, research will need to be conducted on a case-by-case basis to determine the "Fraction Anaerobically Digested" which is a function of the type of treatment process. Indirect emissions from these facilities can be calculated using the CCAR energy use protocols and URBEMIS model for transportation emissions.

Solid Waste Disposal Facilities

Air districts will have emission estimate methodologies established for methane emissions at permitted landfills. In addition, EPA's Landfill Gas Emissions Model (LandGem) and the CCAR methodology could also be used to quantify GHG emissions from landfill off gassing; however, this model requires substantial detail be input. The model uses a decomposition rate equation, where the rate of decay is dependent on the quantity of waste in place and the rate of change over time. This modeling tool is free to the public, but substantial project detail about the operation of the landfill is needed to run the model. Indirect emissions from these facilities can be calculated using the CCAR energy use protocols and URBEMIS model for transportation emissions.

Construction Emissions

GHG emissions would occur during project construction, over a finite time. In addition, a project could result in the loss of GHG sequestration opportunity due primarily to the vegetation removed for construction. URBEMIS should be used to quantify the mass of CO_2 that would occur during the construction of a project for land development projects. Some construction projects would occur over an extended period (up to 20–30 years on a planning horizon for general plan buildout, or 5–10 years to construct a dam, for example). OFFROAD emission factors are contained in URBEMIS for CO_2 emissions from construction equipment. For other types of construction projects, such as roadway construction projects or levee improvement projects, SMAQMD's spreadsheet modeling tool, the Road Construction Emissions Model (RoadMod), should be used. This tool is currently being updated to include CO_2 emissions factors from OFFROAD.

The full life-cycle of GHG emissions from construction activities is not accounted for in the modeling tools available, and the information needed to characterize GHG emissions from manufacture, transport, and end-of-life of construction materials would be speculative at the CEQA analysis level. The emissions disclosed will be from construction equipment and worker commutes during the duration of construction activities. Thus, the mass emissions in units of metric tons CO_2e/year should be reported in the environmental document as new emissions.

General Plans

In the short-term, URBEMIS can be used as a calculation tool to model GHG emissions from proposed general plans, but only if data from the traffic study is incorporated into model input. The same methodology applied above in the specific plan example applies to general plans. The CCAR GRP can be used to approximate indirect emissions from increased energy consumption associated with the proposed plan area. The same models and methodologies discussed previously for wastewater, water supply and solid waste would be used to estimate indirect emissions resulting from buildout of the general plan.

In the longer-term, more complex modeling tools are needed, which would integrate GHG emission sources from land use interaction, such as I-PLACE^{3}S or CTG Energetics' Sustainable Communities Custom Model attempt to do. These models are not currently available to the public and only have applicability in certain areas of the state. It is important that a tool with statewide applicability be used to allow for consistency in project treatment, consideration, and approval under CEQA.

Scenarios

At the general plan level, the baseline used for analyzing most environmental impacts of a general plan update is typically no different from the baseline for other projects. The baseline for most impacts represents the existing conditions, normally on the date the Notice of Preparation is released. Several comparative scenarios could be relevant, depending on the exact methodological approach and significance criteria used for GHG assessment:

- Existing Conditions. The GHG emissions associated with the existing, on-the-ground conditions within the planning area.

- 1990 conditions. The GHG emissions associated with the general plan area in 1990. This is relevant due to the state's AB 32 GHG emission reduction goals' benchmark year of 1990. The GHG-efficiency of 1990 development patterns could be compared to that of the general plan buildout.

- Buildout of the Existing General Plan. The GHG emissions associated with buildout of the existing general plan (without the subject update). This is the no project alternative for the purposes of general plan CEQA analysis.

- Buildout of the Updated General Plan. The GHG emissions associated with buildout of the general plan, as proposed as a part of the subject update. This would include analysis of any changes included as a part of the general plan update for the existing developed portions of the planning area. Many communities include redevelopment and revitalization strategies as a part of the general plan update. The general plan EIR can include assumptions regarding what level and type of land use change could be facilitated by infill and redevelopment. Many jurisdictions wish to provide future projects consistent with these land use change assumptions with some environmental review streamlining. In addition, many communities include transit expansions, pedestrian/bicycle pathway improvements, multi-modal facility construction, travel demand policies, energy efficiency policies, or other measures that could apply to the existing developed area, just as they may apply to any new growth areas. Such policies could affect the overall GHG emissions of the built out general plan area.

- Increment between Buildout of Updated General Plan and Existing General Plan Area. There are many important considerations associated with the characterization of the impact of the General Plan update. The actual GHG emissions impact could be described as the difference between buildout under the existing and proposed land use plan (No-Build Alternative). However, the courts have held that an EIR should also analyze the difference between the proposed General Plan and the existing environment (*Environmental Planning & Information Council v. County of El Dorado* (EPIC) (1982) 131 Cal.App.3d 350). At the General Plan level, over the course of buildout, some new land uses are introduced, which could potentially add operational GHG emissions and potentially remove existing sequestration potential. Some properties become vacant and are not redeveloped. Other properties become vacant and then are redeveloped. Communities cannot pretend to understand fully in advance each component of land use change. The programmatic document is the preferred method of environmental analysis. Through this programmatic framework, communities develop buildout assumptions as a part of the General Plan that are normally used as a basis of environmental analysis. For certain aspects of the impact analysis, it becomes important not just to understand how much "new stuff" could be accommodated under the updated General Plan, but also the altered interactions between both "new" and "existing" land uses within the planning area. As addressed elsewhere, there are tools available for use in understanding land use/transportation interactions at the General Plan level. Without the GHG targets established by AB 32, a simple mass comparison of existing conditions to General Plan buildout might be appropriate.

However, within the current legal context, the GHG efficiency of the updated General Plan becomes the focus of analysis. Some options in this regard include:

- Estimate the GHG emissions associated with all the land uses included within the planning area upon buildout of the General Plan using no project specific information (regional, countywide, or statewide defaults). Estimate GHG emissions using project specific information from the transportation engineer, transportation demand policies, community design elements, energy efficiency requirements, wastewater treatment and other public infrastructure design changes, and other components. Compare these two calculations. Is the second calculation reduced by the percent needed to meet AB 32 goals compared to the first calculation?

- Estimate the GHG emissions associated with the 1990 planning area and the per-capita or per-service population GHG associated with the 1990 planning area. (Many communities are establishing GHG inventories using different tools). Estimate the GHG emissions associated with buildout of the proposed General Plan update and the resulting per-capita or per-service population GHG emissions. Compare the two calculations. Is the General Plan buildout per-capita or per-service population level greater than the 1990 estimate?

<u>Example General Plan Update: Proposed new growth area</u>

Project Attributes:

- 10,050 single family dwelling units
- 652 multi-family dwelling units
- 136 acres parks
- 2,047 ksf commercial (regional shopping center)
- 2,113 ksf office
- 383 acres industrial park
- 31,293 new residents
- 4,945 new jobs
- Located in Stanislaus County (SJVAPCD jurisdiction)
- Analysis year 2025

Table 9: General Plan Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	**Metric CO_2e Tons/Year**	**Demographic Data**	
Construction emissions	12,083*	Residents	31,293
Area-source emissions	45,708		
Mobile-source emissions	263,954	Jobs	4,945
Indirect emissions (from CCAR Protocol)	78,385		
Total operational emissions	**388,046**	Service population	36,238
Operational emissions/SP	**10.7**		

* Approximately 241,656 metric tons CO_2e total at general plan buildout (assumes 20-year buildout period). Construction emissions were not included in total operational emissions.
Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).
Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Due to the programmatic level of analysis that often occurs at the general plan level, and potential for many relevant GHG emission quantities, it could be preferable to use a qualitative approach. Such an analysis could address the presence of GHG-reducing policy language in the general plan.

Three possible tiers of approaches to addressing GHG mitigation strategies, either as general plan policy, general plan EIR mitigation measures, or both, include:

- Forward planning
- Project toolbox
- Defer to GHG reductions plan

The three basic approaches are described below.

1. Bring reduction strategies into the plan itself. The most effective way for local jurisdictions to achieve GHG emissions reductions in the medium- and long-term is through land use and transportation policies that are built directly into the community planning document. This involves creating land use diagrams and circulation diagrams, along with corresponding descriptive standards, that enable and encourage alternatives to travel and goods movement via cars and trucks. The land use and circulation diagrams provide a general framework for a community where people can conduct their everyday business without necessarily using their cars. The overall community layout expressed as a part of the land use and circulation diagrams is accompanied by a policy and regulatory scheme designed to achieve this community layout. Impact fees, public agency spending, regulations, administrative procedures, incentives, and other techniques are designed to facilitate land use change consistent with the communities' overall vision, as expressed in policy and in the land use diagram. There are many widely used design principles that can be depicted in land use and circulation diagrams and implemented according to narrative objectives, standards, and policies:

- Connectivity. A finely-connected transportation network shortens trip lengths and creates the framework for a community where homes and destinations can be placed close in proximity and along direct routes. A hierarchical or circuitous transportation network can increase trip lengths and create obstacles for walking, bicycling, and transit access. This policy language would likely be found in the Circulation Element.

- Compactness. Compact development, by its nature, can increase the efficiency of infrastructure provision and enable travel modes other than the car. If communities can place the same level of activity in a smaller space, GHG emissions would be reduced concurrently with VMT and avoid unnecessary conversion of open space. This policy language would likely be found in the Land Use Element.

- Diversity. Multiple land use types mixed in proximity around central "nodes" of higher-activity land uses can accommodate travel through means other than a car. The character and overall design of this land use mix is, of course, different from community to community. This policy language would likely be found in the Land Use Element.

- Facilities. Pedestrian, bicycle, and public transportation improvements, planning, and programming are sometimes an afterthought. To get a more GHG-efficient mode share, safe and convenient bike lanes, pedestrian pathways, transit shelters, and other facilities are required to be planned along with the vehicular travel network. This policy language would likely be found in the Circulation Element.

- Redevelopment. One way to avoid GHG emissions is to facilitate more efficient and economic use of the lands in already-developed portions of a community. Reinvestment in existing neighborhoods and retrofit of existing buildings is appreciably more GHG efficient than greenfield development, and can even result in a net reduction in GHG emissions. This policy language would likely be found in the Conservation or Land Use Element.

- Housing and Employment. Most communities assess current and future economic prospects along with long-range land use planning. Part of the objective for many communities is to encourage the coalescence of a labor force with locally available and appropriate job opportunities. This concept is best known as "jobs-housing balance." This policy language would likely be found in the Housing Element.

- Planning Level Versus Project Level. For transportation-related GHG emissions that local governments can mitigate through land use entitlement authority, the overall community land use strategy and the overall transportation network are the most fruitful areas of focus. The reduction capacity of project-specific mitigation measures is greatly limited if supportive land use and transportation policies are lacking at the community planning level. The regional economic context, of course, provides an important backdrop for land use and transportation policy to address GHG emissions. Within this context, the general plan is the readily available tool for local governments to establish such land use and transportation strategies. This policy language would likely be found in the Land Use and Circulation Elements.

- Shipping Mode Shift. Locate shipping-intensive land uses in areas with rail access. Some modes of shipping are more GHG-intensive than others. Rail, for example, requires only about 15 to 25 percent of the energy used by trucks to ship freight equivalent distances and involves reduced transportation-related GHG emissions. Cities and counties have little direct control over the method of shipment that any business may choose. Nevertheless, as a part of the general planning process, cities and counties can address constraints on the use of rail for transporting goods. This policy language would likely be found in the Land Use and Circulation Elements.

2. Provide a "toolbox" of strategies after the project site has been selected. In addition to the examples of design principles that are built into the community planning process, communities can offer project applicants a range of tools to reduce GHG emissions. Mitigation strategies are elaborated in detail in Chapter 9.

3. Defer to General Plan implementation measure. Develop and implement a GHG Emissions Reduction Plan. Another option for local governments would be development of an implementation measure as a part of the general plan that outlines an enforceable GHG reduction program. Perhaps the most well known example of this approach is the result of California's Attorney General settlement of the lawsuit brought against San

Bernardino County. The County has agreed to create a 1990 GHG inventory and develop measures to reduce such emissions according to the state's overall goals. Other communities have pursued similar programs (i.e., the City of San Diego, Marin County). Along with the inventories, targets, and example reduction measures, these programs would include quantitative standards for new development; targets for reductions from retrofitting existing development; targets for government operations; fee and spending program for GHG reduction programs; monitoring and reporting; and other elements. The local government itself should serve as a model for GHG reduction plan implementation, by inventorying emissions from government operations and achieving emission reductions in accordance with the plan's standards. An optional climate change element could be added to contain goals, policies, and this implementation strategy, or this could belong in an optional air quality element.

Other Project Types

Air District Rules, Regulations and Air Quality Plans

Air district air quality plans, rules and regulations could have the potential to increase or decrease GHG emissions within their respective jurisdiction. In general, air district air quality plans, rules and regulations act to reduce ozone precursors, criteria air pollutant and toxic air contaminant emissions, which would almost always act to reduce GHG emissions simultaneously. However, this may not always be the case.

Air Quality Plans

Air districts will have to include GHG emissions analysis as part of their criteria air pollutant and toxic air contaminant air pollutant analysis when considering the adoption of air quality plans and their subsequent rules and regulations needed to implement the plans. Multiple models and methodologies will be needed to accomplish this analysis.

Regional Transportation Plans

Regional transportation plans would also need to be evaluated on a case-by-case basis to determine if a net increase or decrease in GHG emissions would occur. Complex interactions between the roadway network, operating conditions, alternative transportation availability (such as public transit, bicycle pathways, and pedestrian infrastructure), and many other independent parameters specific to a region should be considered. Regional transportation models exist to estimate vehicular emissions associated with regional transportation plans, which includes the ability to estimate GHG emissions.

Normalization/Service Population Metric

The above methodology would provide an estimate of the mass GHG emissions generated by a proposed project, which could be compared to a mass emission threshold. EDAW developed a methodology that would measure a project's overall GHG efficiency in order to determine if a project is more efficient than the existing statewide average for per capita GHG emissions. The following steps could be employed to estimate the GHG-"efficiency," which may be more directly correlated to the project's ability to help obtain objectives outlined in AB 32, although it relies on establishment of an efficiency-based significance threshold. The subcommittee believes this methodology may eventually be appropriate to evaluate the long-term GHG emissions from a project in the context of meeting AB 32 goals. However, this methodology will need substantially more work and is not considered viable for the interim guidance presented in this white paper.

- Divide the total operational GHG emissions by the Service Population (SP) supported by the project (where SP is defined as the sum of the number of residents and the number of jobs supported by the project). This value should be compared to that of the projected statewide GHG emissions inventory from the applicable end-use sectors (electricity generation, residential, commercial/institutional, and mobile-source) in 1990 divided by the projected statewide SP for the year 2020 (i.e., AB 32 requirements), to determine if the project would conflict with legislative goals.
    - If the project's operational GHG/SP falls below AB 32 requirements, then the project's GHG emissions are less than cumulatively considerable.
    - If the project's operational GHG/SP exceed AB 32 requirements (a substantial contribution), then the project's GHG emissions would conflict with legislative requirements, and the impact would be cumulatively considerable and mitigation would be required where feasible.
- New stationary and area sources/facilities: calculate GHG emissions using the CCAR GRP. All GHG emissions associated with new stationary or area sources should be treated as a net increase in emissions, and if deemed significant, should be mitigated where feasible.
- Road or levee construction projects or other construction-only projects: calculate GHG emissions using the RoadMod, which will be updated to contain GHG emission factors from EMFAC and OFFROAD. All construction-generated GHG emissions should be treated as a net increase, and if deemed significant, should be mitigated to the extent feasible.
- Air District rulemaking or air quality management plan-type projects should be evaluated on a case-by-case basis for secondary impacts of increased GHG emissions generation. In most cases, the types of projects that act to reduce regional air pollution simultaneously act to reduce GHG emissions, and would be beneficial, but should be evaluated for secondary effects from GHG emissions.
- Regional transportation plans should also be evaluated on a case-by-case basis for potential to either reduce or increase GHG emissions from the transportation sector. EMFAC can be utilized to determine the net change in GHG emissions

associated with projected vehicle VMT and from operating speed changes associated with additional or alleviated congestion.

To achieve the goals of AB 32, which are tied to GHG emission rates of specific benchmark years (i.e., 1990), California would have to achieve a lower rate of emissions per unit of population and per unit of economic activity than it has now. Further, in order to accommodate future population and economic growth, the state would have to achieve an even lower rate of emissions per unit than was generated in 1990. (The goal to achieve 1990 quantities of GHG emissions by 2020 means that this will need to be accomplished in light of 30 years of population and economic growth in place beyond 1990.) Thus, future planning efforts that would not encourage new development to achieve its fair share of reductions in GHG emissions would conflict with the spirit of the policy decisions contained in AB 32, thus impeding California's ability to comply with the mandate.

Thus, if a statewide context for GHG emissions were pursued, any net increase in GHG emissions within state boundaries would be considered "new" emissions. For example, a land development project, such as a specific plan, does not necessarily create "new" emitters of GHG, but would theoretically accommodate a greater number of residents in the state. Some of the residents that move to the project could already be California residents, while some may be from out of state (or would 'take the place' of in-state residents who 'vacate' their current residences to move to the new project). Some may also be associated with new births over deaths (net population growth) in the state. The out-of-state residents would be contributing new emissions in a statewide context, but would not necessarily be generating new emissions in a global context. Given the California context established by AB 32, the project would need to accommodate an increase in population in a manner that would not inhibit the state's ability to achieve the goals of lower total mass of emissions.

The average net influx of new residents to California is approximately 1.4 percent per year (this value represents the net increase in population, including the net contribution from births and deaths). With population growth, California also anticipates economic growth. Average statewide employment has grown by approximately 1.1 percent over the last 15 years. The average percentage of population employed over the last 15 years is 46 percent. Population is expected to continue growing at a projected rate of approximately 1.5 percent per year through 2050. Long-range employment projection data is not available from the California Department of Finance (DOF) and can be extrapolated in different ways (e.g., linear extrapolation by percentage rate of change, percentage of population employed, mathematical series expansion, more complex extrapolation based on further research of demographic projections such as age distribution). Further study would be needed to refine accurate employment projections from the present to 2050. For developing this framework, employment is assumed to have a constant proportionate relationship with the state's population. The projected number of jobs is assumed to be roughly 46 percent of the projected population.

In light of the statewide context established by California law, consistency is most important for evaluating GHG emissions from projects. Thus, URBEMIS and the CCAR GRP are the recommended tools for quantification of GHG emissions from most project types in the short term. Over the long term, more sophisticated models that integrate the relationship between GHG emissions and land use, transportation, energy, water, waste, and other resources, and have similar application statewide would have better application to the problem, but may not currently be as accessible or as easily operable. I-PLACE^{3}S and CTG Energetics' Sustainable Communities Model (SCM) are two examples of such models that contain emission factors for GHGs, which could be refined to have applicability statewide and made available to CEQA practitioners. Other models are likely to be developed, given the importance of this issue.

Short-Term and Long-Term Methodologies

The following tools can be used to quantify a project's GHG emissions until tools that are more comprehensive become available statewide:

1. Land development projects: URBEMIS 2007 v. 9.2 and the CCAR GRP v. 2.2 (short-term); further development of I-PLACE^{3}S or CTG's Sustainable Communities Model (long-term).
2. New stationary and area sources/facilities: AP-42 Chapter 4.3, LandGem v. 3.02, and/or CCAR GRP v. 2.2.
3. Road or levee construction projects or other construction-only projects: RoadMod/OFFROAD 2007.

Ideally, I-PLACE^{3}S or CTG's Sustainable Communities Model would be expanded to apply to all regions of the state. These types of models use an integrated approach, which is the best approach for reasonably approximating the emissions that result from interaction between land uses, but neither is available to the public and would create consistency problems in reporting emissions from projects across the state if these were used today. However, a similar model with statewide applicability will likely be developed due to the importance of the issue.Table 10 Summary of Modeling Tools for Estimating GHG Emissions and Project Applicability

Table 10: Summary of Modeling Tools for GHG Emissions

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
URBEMIS 2007	*Public domain -Download (www.urbemis.com) free of charge*	*Land development and construction projects (construction, mobile- and area-source emissions)*	*Local*	*Fairly Easy*	*Land use information, construction and operational data and assumptions (e.g., jurisdiction, acres of land use type, year of operation, etc.)*	*Mobile-source Construction & Operational CO_2 (lb/day or tons/year)*	*-Recommended for land use development and construction projects -Also recommended for net change in land use (zoning changes)*	*-Does not quantify indirect emissions from energy consumption or other GHGs (except methane from mobile-sources) -Free, available to public, and applicable statewide -Widely used for assessment of other air quality impacts*
California Climate Action Registry General Reporting Protocol v. 2.2	*Public guidance document*	*Indirect emissions from land development projects, stationary- and area-source facilities regulated under AB 32*	*State*	*Easy*	*Energy consumption*	*CO_2e (Metric tons/year)*	*-Recommended for indirect emissions from energy consumption for land use development projects, and for new stationary- or area- sources to be regulated*	*-Contains emission factors for CH_4 and N_2O in addition to CO_2 -Does not contain emission factors broken down by utility provider (statewide average grid only)*
Clean Air and Climate Projection (CACP) Software	*Public agencies (members of ICLEI, NACAA, or similar)*	*Local governments used for emissions inventories*	*Local*	*N/A*	*Energy usage, waste generation/disposal transportation*	*CO_2e (tons/year)*	*-Recommended for inventories of local government entities activities (must be a member of affiliated agency or group)*	*-Not available to public*
CTG Sustainable Communities Model	*Custom model*	*Land development*	*Regional, scalable*	*N/A*	*Land use information, operational (mobile, energy, economic, infrastructure) assumptions*	*CO_2e (tons/year)*	*-An integrated and comprehensive modeling tool, but cannot obtain*	*-Not available to public*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
I-PLACE[3]S	*Access fee through local COG* *Only available for eight California counties*	*Land use change*	*Regional, scalable*	*Fairly Easy*	*Parcel information*	*CO_2 (lb/day or tons/year)*	*-Recommended for land use development projects and land use changes* *-Especially good for general plans*	*-Not freely available to public* *-Not applicable statewide* *-Actually provides insight into land use interaction* *-Can include very specific project attributes* *-Trip rates are from behavioral survey data, instead of ITE*
EMFAC 2007	*Public domain*	*On-road mobile-sources*	*Statewide, regional*	*Fairly Easy*	*Vehicle fleet information*	*CO_2 (grams/mile)*	*-Not recommended for most projects (URBEMIS preferred)* *-Could be used for certain Air District Rulemaking applications*	*-Can compare emissions based on speed-distribution* *-Emission factors contained in URBEMIS* *-Not a stand-alone model*
OFFROAD 2007	*Public domain*	*Off-road mobile sources (construction equipment)*	*Statewide, regional*	*Fairly Easy*	*Construction fleet information*	*CO_2 (lb/day)*	*-Not recommended (URBEMIS preferred)* *-could be used for certain Air District Rulemaking applications (re: construction equipment)*	*-Emission factors contained in URBEMIS*
RoadMod (to be updated to include CO_2)	*Public domain*	*Off-road and on-road mobile sources (construction equipment and material haul trucks)*	*Statewide*	*Easy*	*Construction information*	*CO_2 (lb/day or tons/project)*	*-Recommended for construction-only projects (linear in nature; i.e., levees, roads, pipelines)*	*-To be updated to support emissions factors from OFFROAD 2007*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
DTIM	*Public domain*	*On-road mobile-sources*	*Statewide, regional*	*Difficult (consists of a series of three programs and requires input files from traffic and emissions modeling)*	*-EMFAC files* *-Traffic model output files (e.g., link, interzonal, and trip end data)* *-User options file* *-Optional files*	*CO_2 (tons/year)*	*-Not recommended*	*-Not updated to support EMFAC 2007 emission factors* *-Input files include output files from regional transportation models which more accurately reflect VMT*
Southeast Climate Change Partnership Spreadsheet Model (UK)	*Public domain http://www.climatesoutheast.org.uk/*	*UK Local government/ agencies/ organizations used for emissions inventories*	*Local, county, regional*	*Fairly easy*	*Energy usage, waste generation/disposal, transportation*	*CO_2 (tonnes/year)*	*-Not recommended for use in California, but could be a valuable source for building an applicable spreadsheet model*	*-Applicability for UK, but could be updated with CA-specific emission factors*
EPA AP-42; Evaporation Loss Sources Chapter 4.3.5	*Public reference document*	*GHG emissions from waste water treatment facilities*	*Facility level*	*Easy equation; substantial research needed to use*	*Biochemical oxygen demand (BOD) loading, Fraction anaerobically digested*	*CH4 (lb/year)*	*-Recommended for Publicly owned treatment works (POTW) projects*	*-Substantial research needed to determine the "fraction anaerobically digested" parameter, which is dependent on the type of treatment plant/process*
LandGem v. 3.02	*Public domain http://www.epa.gov/ttn/catc/dir1/landgem-v302.xls*	*GHG emissions from anaerobic decomposition associated with landfills*	*Facility Level*	*Moderate*	*Solid waste processing, year of analysis, lifetime of waste in place*	*CO_2, CH_4 (Mega grams/year)*	*-Recommended for landfill emissions*	*-Emission rates change dependent on years of decomposition, waste in place rates of change.* *-Complex decomposition rate equation, but good first approximation*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
CARROT	*Registry members*	*Stationary source emissions, vehicle fleet mobile sources*	*Facility level*	*Moderate*	*Facility-specific information*	*All GHGs*	*-Recommended for reporting facilities under AB 32 and for indirect emissions from energy consumption (CCAR Protocol)*	*-Estimates all GHGs and normalizes to CO_2e* *-Not publicly available*

Notes:

GHG = greenhouse gas; AB = assembly bill; CO_2e = carbon dioxide equivalent; CH_4 = methane; N_2O = nitrous oxide; COG = council of governments ; ITE = Institute of Transportation Engineers; CCAR = California Climate Action Registry

Source: Data compiled by EDAW and the California Air Pollution Control Officers Association in 2007

Introduction

This chapter (and Appendix B) identifies existing and potential mitigation measures that could be applied to projects during the CEQA process to reduce a project's GHG emissions that would be identified using the analytical methodologies included in this white paper. The Subcommittee retained the services of EDAW to assist with this effort. EDAW performed a global search of mitigation measures currently in practice and under study that would reduce GHG emissions.

Table 16 (Appendix B) provides a brief description of each measure along with an assessment of their feasibility (from a standpoint of economical, technological, and logistical feasibility, and emission reduction effectiveness), and identifies their potential for secondary impacts to air quality. During the global search performed, EDAW also took note of GHG reduction strategies being implemented as rules and regulation (e.g., early action items under AB 32), which are summarized in Table 18 (Appendix C). It is important to note that though compliance with such would be required by regulation for some sources, such strategies may be applicable to other project and source types.

The recurring theme that echoes throughout a majority of these measures is the shift toward New Urbanism, and research has consistently shown that implementation of Neotraditional Development techniques reduces VMT and associated emissions. The material reviewed assessed reductions from transportation-related measures (e.g., bicycle, pedestrian, transit, and parking) as a single comprehensive approach to land use. This comprehensive approach focuses on development design criteria conducive to enhancing alternate modes of transportation, including transit, walking, and bicycling. Transportation Demand Management (TDM) programs are viewed as a mechanism to implement specific measures. TDM responsibilities may include offering incentives to potential users of alternative modes of transportation and monitoring and reporting mode split changes.

The comprehensive approach makes it more difficult to assess reductions attributable to each measure. Nevertheless, there is a strong interrelationship between many of the measures, which justifies a combined approach. Consider the relationship between bike parking nonresidential, bike parking residential, endtrip facilities, and proximity to bike path/bike lane measures. In reality, these measures combined act as incentives for one individual to bike to work, while implementation of a single measure without the others reduces effectiveness.

The global nature of GHG emissions is an important feature that enables unique mitigation: abatement. When designing a project subject to CEQA, the preferred practice is first to avoid, then to minimize, and finally to compensate for impacts. Where the impact cannot be mitigated on-site, off-site mitigation is often and effectively implemented in several resource areas, either in the form of offsetting the same impact or preserving the resource elsewhere in the region. Frequently, mitigation fee programs or funds are established, where the proponent pays into the program and fees collected throughout the region or state are used to implement projects that, in turn, proportionately offset the impacts of the projects to the given resource. It may be more cost-effective to reduce as much GHG on-site as feasible (economically and technologically). Then the proponent would pay into a "GHG retrofit fund" to reduce equivalent GHG emissions off-site. In contrast to regional air pollutant offset programs such as the Carl Moyer Program, it matters greatly where reductions of ozone precursors occur, as ozone affects regional air quality. The GHG retrofit fund could be used to provide incentives to upgrade older buildings and make them more energy efficient. This would reduce demand on the energy sector and reduce stationary source emissions associated with utilities. This program has been successfully implemented in the United Kingdom where developments advertise "carbon neutrality." Of course, some GHG emissions occur associated with operation of the development, but the development would offset the remainder of emissions through off-site retrofit. Avoiding emissions that would otherwise continue to occur at existing development would be a unique opportunity for mitigation of GHG emissions. Reduction of GHG emissions also may have important side benefits including reduction of other forms of pollution.

Depending on the significance threshold concept adopted, projects subject to the CEQA process would either qualitatively or quantitatively identify the amount of GHG emissions associated with their project using the analytical methodologies identified in the previous chapter. The analysis would then apply the appropriate number of mitigation measures listed in Appendix B to their project to reduce their GHG emissions below the significance level. Calculating the amount of GHG emission reductions attributable to a given mitigation measure would require additional research. The examples below illustrate how a project would be mitigated using this approach.

Residential Project Example

Project Attributes:

- 68 detached dwelling units
- 15.9 acres
- Located in unincorporated Placer County PCAPCD jurisdiction)
- Assume URBEMIS defaults for a rural project in Placer County, in absence of a traffic study (This is contrary to the recommendations contained under Task 1; a traffic study is necessary to asses project-specific GHG emissions).
- Analysis year 2009

Table 11: Residential Project Example GHG Emissions Estimates with Mitigation

URBEMIS Output (Unmitigated)	Metric Tons/Year CO_2e	URBEMIS Output (Mitigated)	Metric Tons/Year CO_2e	Percent Reduction
Area-source emissions	252	Area-source emissions	215	14.6
Mobile-source emissions	1,047	Mobile-source emissions	916	12.5
Total direct operational emissions (area + mobile)	1,299	Total operational emissions (area + mobile)	1,131	12.9

Notes:
CO_2e = carbon dioxide equivalent

Sources: Data compiled by EDAW in 2007

Using URBEMIS 2007 and assuming the project would implement the mitigation measures listed below, yearly project-generated emissions of CO_2e would be reduced by approximately 13 percent. Implementation of the following mitigation measures is assumed:

- 100 housing units within one-half-mile radius of project's center, including this project's 68 residential units;
- provision of 80 jobs in the study area;
- retail uses present with one-half-mile radius of project's center;
- 10 intersections per square mile;
- 100% of streets with sidewalks on one side;
- 50% of streets with sidewalks on both sides;
- 30% of collectors and arterials with bike lanes, or where suitable, direct parallel routes exist;
- 15% of housing units deed restricted below market rate;
- 20% energy efficiency increase beyond Title 24; and
- 100% of landscape maintenance equipment electrically powered and electrical outlets in front and rear of units.

Example Project Methodology and Mitigation

Table 12 –Residential Projects Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	URBEMIS (EMFAC emission factors)	MM T-3→MM T-8, MM T-10→ MM T-14, MM T-16, MM T-19→ MM T-21 MM D-2→MM D-8, MM D-10→ MM D-15, MM D-17 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	URBEMIS	MM D-13→MM D-15, MM D-17
Indirect Emissions		
Energy Consumption	CCAR GRP & CEC	MM E-1→MM E-8, MM E-10, MM E-12→MM E-23 MM S-1→MM S-2 MM M-1→MM M-2

Table 13 –Commercial Projects Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	URBEMIS (EMFAC emission factors)	MM T-1→MM T-2, MM T-4→ MM T-15, MM T-17→MM T-21 MM D-1→MM D-3, MM D-5→ MM D-6, MM D-10, MM D-12, MM D-14→MM D-17 MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	URBEMIS	MM D-14→MM D-17
Indirect Emissions		
Energy Consumption	CCAR GRP & CEC	MM E-1, MM E-4→MM E-13, MM E-16→MM E-24 MM S-1→MM S-2 MM M-1→MM M-2

Table 14 –Specific Plans Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MM T-1→MM T-21 MM D-1→MM D-12, MM D-18→ MM D-19 MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MM D-13→MM D-19 MM E-1→MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Indirect Emissions		
Energy Consumption	Short-term: CCAR GRP & CEC. Long-term: I-PLACE^{3}S/CTG SCM	

<u>General Plans</u>

- Include a general plan policy to reduce emissions within planning area to a level consistent with legislative requirements.
- Implementation strategies include preparation of a GHG reduction plan.
- Projects consistent with a general plan could be responsible for complying with such a policy.

Table 15 –General Plans Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors).	MS G-1 MM G-15
Mobile Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MS G-1 MS G-2→MS C-7, MS G-9, MS G-12, MS-13→MS-14, MS-16→MS-23
Area Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MS G-1 MS G-8→MS C-11, MS G-134, MS G-12, MS-15, MS-17, MS-22
Indirect Emissions		
Energy Consumption	Short-term: CCAR GRP & CEC. Long-term: I-PLACE^{3}S/CTG SCM	

Other Project Types

Air District Rules and Regulations

Air district rules and regulations could have the potential to increase or decrease GHG emissions within the respective jurisdiction. In general, air district rules and regulations act to decrease criteria air pollutant or toxic air contaminant emissions, which would usually act to reduce GHG emissions simultaneously. However, this may not always be the case and air district rules and regulations could address emissions from a large variety of different source types. Reductions of GHG emissions associated with implementation of applicable mitigation, which could also vary greatly, would need to be evaluated on a case-by-case basis. However, once applicable mitigation measures are identified, percent reductions based on the best available research to date, such as those specified in Table 15, could be applied to determine mitigated emissions.

Air Quality Plans

Similarly to air district rules and regulations, air quality plans could have the potential to increase or decrease GHG emissions because of criteria air pollutant reduction strategies. In general, strategies implemented by air districts to reduce criteria air pollutants also act to reduce GHG emissions. However, this may not always be the case. Reductions of GHG emissions associated with implementation of applicable mitigation would need to be evaluated on a case-by-case basis. The methodology identified above for determining whether the strategies contained within the GHG reduction plan would adhere to the level specified in general plan policy could also be used to determine the reductions associated with CAP strategies.

Regional Transportation Plans

Regional transportation plans and reductions of GHG emissions associated with implementation of applicable mitigation would also need to be evaluated on a case-by-case basis to determine if a net increase or decrease in GHG emissions would occur. Complex interactions between the roadway network, operating conditions, alternative transportation availability (such as public transit, bicycle pathways, and pedestrian infrastructure), and many other independent parameters specific to a region should be considered. EMFAC 2007 can be used with VMT from the RTP to create an inventory of GHG emissions. Reductions associated with implementation of applicable measures contained in Table 16 could be accomplished by accounting for VMT reductions in the traffic model.

Many states, counties, and cities have developed policies and regulations concerning greenhouse gas emissions that seek to require or promote reductions in GHG emissions through standards for vehicle emissions, fuels, electricity production/renewables, building efficiency, and other means. However, we could only identify three public agencies in the United States that are considering formally requiring the analysis of greenhouse gas emissions and climate change for development projects during their associated environmental processes. There may be others, but they were not identified during research conducted during preparation of this paper.

The following is a summary of those three efforts.

Commonwealth of Massachusetts - MEPA Greenhouse Gas Emissions Policy and Protocol

The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) has determined that the phrase "damage to the environment" as used in the Massachusetts Environmental Policy Act (MEPA) includes the emission of greenhouse gases caused by projects subjects to MEPA Review. EEA has published a Greenhouse Gas Emissions Policy (GGEP) to fulfill the statutory obligation to take all feasible measurers to avoid, minimize or mitigate damage to the environment.

The GGEP concerns the following projects only:

- The Commonwealth or a state agency is the proponent;
- The Commonwealth or a state agency is providing financial assistance;
- The project is privately funded, but requires an Air Quality Permit from the department of Environmental Protection;
- The project is privately funded, but will generate:
  - 3,000 or more new vehicle trips per day for office projects;
  - 6,000 or more new vehicle trips per day for mixed use projects that are 25% or more office space; or
  - 10,000 or more new vehicle trips per day for other projects.

As a comparison, the trip generation amounts correspond as follows:

- 3,000 vehicle trips per day = approximately 250,000 square foot office development;
- 6,000 or more new vehicle trips per day for mixed use projects that are 25% or more office space = if 25% office space, then equivalent to approximately 130,000 square feet of office and either 100,000 square feet of retail or 450 single-family residential units or some combination thereof.
- 10,000 or more new vehicle trips per day = approximately 1,000 single family residential units or 250,000 square feet retail.

The draft policy states it is not intended to create a numerical GHG emission limit or a numerical GHG emissions reduction target, but rather to ensure that project proponents and reviewers have considered the GHG emissions impacts of their projects and taken all feasible means and measure to reduce those impacts.

The draft policy notes that some projects within these categories will have little or no greenhouse gas emission and the policy will not apply to such projects. EEA intends to identify in the scoping certificate whether a project falls within this *de minimis* exception.

The GGEP requires qualifying projects to do the following:

- to quantify their GHG emissions;
- identify measures to minimize or mitigate such emissions;
- quantify the reduction in emissions and energy savings from mitigation.

Emissions inventories are intended to focus on carbon dioxide, but analysis of other GHGs may be required for certain projects. EEA will require analysis of direct GGH emissions and indirect (electricity and transportation) emissions. The GGEP references the protocols prepared by the World Resource Institute as guidance for inventory preparation.

The policy is still in draft form, but the comment period closed on August 10, 2007.

King County, Washington - Executive Order on the Evaluation of Climate Change Impacts through the State Environmental Policy Act (SEPA)

On June 27, 2007, the King County Executive Ron Sims directed all King County Departments, as follows:

> *"…effective September 1, 2007 to require that climate impacts, including, but not limited to those pertaining to greenhouse gases, be appropriately identified and evaluated when such Departments are acting as the lead agency in reviewing the environmental impacts of private or public proposals pursuant to the State Environmental Policy Act".*

The Executive Order does not define what a "climate impact" is. Based on statements of the County Deputy Chief of Staff[*]

- County agencies will ask project proponents to supply information on transportation, energy usage and other impacts of proposed projects using the County's existing SEPA checklist.

[*] Marten Law Group: Environmental News, August 1, 2007, "King County (WA) First in Nation to Require Climate Change Impacts to be Considered During Environmental Review of New Projects".

- There is no current plan to require project proponents to take action to mitigate the impacts identifies.
- Development of emissions thresholds and mitigation requirements will be undertaken in connection with the County's upcoming 2008 update of its Comprehensive Plan.

Sacramento Metropolitan Air Quality Management District

The Sacramento Metropolitan Air Quality Management District released an interim guidance on addressing climate change in CEQA documents on September 6, 2007. While very general in nature, the District recommends that CEQA environmental documents include a discussion of anticipated GHG emissions during both the construction and operation phases of the project. This includes assessing the GHG emissions from projects (using readily available models) to determine whether a project may have a significant impact. If so, then the District recommends addressing all of the District's GHG mitigation measures (drawn from comments made by the California Attorney General) – with explanations on how the mitigation will be implemented or providing rationale for why a measure would be considered infeasible. The District provides assistance to agencies in their analysis of GHG emissions and the applicability of specific mitigation measures. The District's guidance can be found at: http://64.143.64.21/climatechange/ClimateChangeCEQAguidance.pdf

Mendocino Air Quality Management District – CEQA Guidelines

The Mendocino AQMD updated its "Guidelines for Use During Preparation of Air Quality Impacts in EIRs or Mitigated Negative Declarations" in May 2007. The guidelines call for preparing estimates of the increased emissions of air contaminations (including GHG) for projects.

The guidelines state that GHG emissions should be presumed to have a significant impact if CO emissions from District-approved modeling exceed either of the following:

- 80% of the level defined as significant for stationary sources in Regulation1, Rule 130 (s2) of the District (which is 550 lbs/day for CO, meaning a threshold of 440 lbs/day for CO for stationary sources); or
- levels established in District Regulation 1 Rule 130 (i2) for indirect sources (which is 690 lbs/day for CO for indirect sources).

If an average passenger vehicle emits 22 grams of CO/mile and 0.8 lb/mile of CO_2, then the 690-lb/day threshold for CO corresponds to approximately 11,400 lb/day CO_2 threshold for passenger vehicle-related emissions. If one assumes that the average passenger vehicle goes 12,500 miles/year (about 35 miles/day), then this is a threshold equivalent to about 420 vehicles. Using an average in California of about 1.77 vehicles/household, this would correspond to about 250 households/dwelling units.

Appendix A

Relevant Citations

Citations from the Public Resources Code (Division 13, §21000 et seq.) as amended through January 1, 2005.

Public Resources Code – Section 21004, MITIGATING OR AVOIDING A SIGNIFICANT EFFECT; POWERS OF PUBLIC AGENCY:
"In mitigating or avoiding a significant effect of a project on the environment, a public agency may exercise only those express or implied powers provided by law other than this division. However, a public agency may use discretionary powers provided by such other law for the purpose of mitigating or avoiding a significant effect on the environment subject to the express or implied constraints or limitations that may be provided by law."

Public Resources Code – Section 21082.2, SIGNIFICANT EFFECT ON ENVIRONMENT; DETERMINATION; ENVIRONMENTAL IMPACT REPORT PREPARATION:
(a) The lead agency shall determine whether a project may have a significant effect on the environment based on substantial evidence in light of the whole record.
(b) The existence of public controversy over the environmental effects of a project shall not require preparation of an environmental impact report if there is no substantial evidence in light of the whole record before the lead agency that the project may have a significant effect on the environment.
(c) Argument, speculation, unsubstantiated opinion or narrative, evidence which is clearly inaccurate or erroneous, or evidence of social or economic impacts which do not contribute to, or are not caused by, physical impacts on the environment, is not substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion supported by facts.
(d) If there is substantial evidence, in light of the whole record before the lead agency, that a project may have a significant effect on the environment, an environmental impact report shall be prepared.
(e) Statements in an environmental impact report and comments with respect to an environmental impact report shall not be deemed determinative of whether the project may have a significant effect on the environment.

Citations from the Guidelines for California Environmental Quality Act, CCR, Title 14, Division 6 (§15000 et seq.) as amended through July 27, 2007.

State CEQA Guidelines – Section 15064, DETERMINING THE SIGNIFICANCE OF THE ENVIRONMENTAL EFFECTS CAUSED BY A PROJECT:

(a) Determining whether a project may have a significant effect plays a critical role in the CEQA process.

(1) If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, the agency shall prepare a draft EIR.

(2) When a final EIR identifies one or more significant effects, the Lead Agency and each Responsible Agency shall make a finding under Section 15091 for each significant effect and may need to make a statement of overriding considerations under Section 15093 for the project.

(b) The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data. An ironclad definition of significant effect is not always possible because the significance of an activity may vary with the setting. For example, an activity which may not be significant in an urban area may be significant in a rural area.

(c) In determining whether an effect will be adverse or beneficial, the Lead Agency shall consider the views held by members of the public in all areas affected as expressed in the whole record before the lead agency. Before requiring the preparation of an EIR, the Lead Agency must still determine whether environmental change itself might be substantial.

(d) In evaluating the significance of the environmental effect of a project, the Lead Agency shall consider direct physical changes in the environment which may be caused by the project and reasonably foreseeable indirect physical changes in the environment which may be caused by the project.

(1) A direct physical change in the environment is a physical change in the environment which is caused by and immediately related to the project. Examples of direct physical changes in the environment are the dust, noise, and traffic of heavy equipment that would result from construction of a sewage treatment plant and possible odors from operation of the plant.

(2) An indirect physical change in the environment is a physical change in the environment which is not immediately related to the project, but which is caused indirectly by the project. If a direct physical change in the environment in turn causes another change in the environment, then the other change is an indirect physical change in the environment. For example, the construction of a new sewage treatment plant may facilitate population growth in the service area due to the increase in sewage treatment capacity and may lead to an increase in air pollution.

(3) An indirect physical change is to be considered only if that change is a reasonably foreseeable impact which may be caused by the project. A change which is speculative or unlikely to occur is not reasonably foreseeable.

(e) Economic and social changes resulting from a project shall not be treated as significant effects on the environment. Economic or social changes may be used, however, to determine that a physical change shall be regarded as a significant effect on the environment. Where a physical change is caused by economic or social effects of a project, the physical change may be regarded as a significant effect in the same manner as any other physical change resulting from the project. Alternatively, economic and social effects of a physical change may be used to determine that the physical change is a significant effect on the environment. If the physical change causes adverse economic or social effects on people, those adverse effects may be used as a factor in determining whether the physical change is significant. For example, if a project would cause overcrowding of a public facility and the overcrowding causes an adverse effect on people, the overcrowding would be regarded as a significant effect.

(f) The decision as to whether a project may have one or more significant effects shall be based on substantial evidence in the record of the lead agency.

(1) If the lead agency determines there is substantial evidence in the record that the project may have a significant effect on the environment, the lead agency shall prepare an EIR (Friends of B Street v. City of Hayward (1980) 106 Cal.App.3d 988). Said another way, if a lead agency is presented with a fair argument that a project may have a significant effect on the environment, the lead agency shall prepare an EIR even though it may also be presented with other substantial evidence that the project will not have a significant effect (No Oil, Inc. v. City of Los Angeles (1974) 13 Cal.3d 68).

(2) If the lead agency determines there is substantial evidence in the record that the project may have a significant effect on the environment but the lead agency determines that revisions in the project plans or proposals made by, or agreed to by, the applicant would avoid the effects or mitigate the effects to a point where clearly no significant effect on the environment would occur and there is no substantial evidence in light of the whole record before the public agency that the project, as revised, may have a significant effect on the environment then a mitigated negative declaration shall be prepared.

(3) If the lead agency determines there is no substantial evidence that the project may have a significant effect on the environment, the lead agency shall prepare a negative declaration (Friends of B Street v. City of Hayward (1980) 106 Cal.App. 3d 988).

(4) The existence of public controversy over the environmental effects of a project will not require preparation of an EIR if there is no substantial evidence before the agency that the project may have a significant effect on the environment.

(5) Argument, speculation, unsubstantiated opinion or narrative, or evidence that is clearly inaccurate or erroneous, or evidence that is not credible, shall not constitute substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion support by facts.

(6) Evidence of economic and social impacts that do not contribute to or are not caused by physical changes in the environment is not substantial evidence that the project may have a significant effect on the environment.

(7) The provisions of sections 15162, 15163, and 15164 apply when the project being analyzed is a change to, or further approval for, a project for which an EIR or negative declaration was previously certified or adopted (e.g. a tentative subdivision, conditional use permit). Under case law, the fair argument standard does not apply to determinations of significance pursuant to sections 15162, 15163, and 15164.

(g) After application of the principles set forth above in Section 15064(f)(g), and in marginal cases where it is not clear whether there is substantial evidence that a project may have a significant effect on the environment, the lead agency shall be guided by the following principle: If there is disagreement among expert opinion supported by facts

over the significance of an effect on the environment, the Lead Agency shall treat the effect as significant and shall prepare an EIR.
(h)(1) When assessing whether a cumulative effect requires an EIR, the lead agency shall consider whether the cumulative impact is significant and whether the effects of the project are cumulatively considerable. An EIR must be prepared if the cumulative impact may be significant and the project's incremental effect, though individually limited, is cumulatively considerable. "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.
(2) A lead agency may determine in an initial study that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and thus is not significant. When a project might contribute to a significant cumulative impact, but the contribution will be rendered less than cumulatively considerable through mitigation measures set forth in a mitigated negative declaration, the initial study shall briefly indicate and explain how the contribution has been rendered less than cumulatively considerable.
(3) A lead agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project will comply with the requirements in a previously approved plan or mitigation program which provides specific requirements that will avoid or substantially lessen the cumulative problem (e.g., water quality control plan, air quality plan, integrated waste management plan) within the geographic area in which the project is located. Such plans or programs must be specified in law or adopted by the public agency with jurisdiction over the affected resources through a public review process to implement, interpret, or make specific the law enforced or administered by the public agency. If there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding that the project complies with the specified plan or mitigation program addressing the cumulative problem, an EIR must be prepared for the project.
(4) The mere existence of significant cumulative impacts caused by other projects alone shall not constitute substantial evidence that the proposed project's incremental effects are cumulatively considerable.

State CEQA Guidelines – Section 15130, DISCUSSION OF CUMULATIVE IMPACTS:
(a)(3). "An EIR may determine that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and thus is not significant. A project's contribution is less than cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact. The lead agency shall identify facts and analysis supporting its conclusion that the contribution will be rendered less than cumulatively considerable.

State CEQA Guidelines – Section 15064.7, THRESHOLDS OF SIGNIFICANCE:
"Each public agency is encouraged to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is an identifiable quantitative, qualitative or performance level

of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which means the effect normally will be determined to be less than significant."

Appendix B

Mitigation Measure Summary

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Transportation								
Bicycle/Pedestrian/Transit Measures								
MM T-1: Bike Parking	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	1%-5%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates combined reductions among individual measures (e.g., 2.5% reduction for all bicycle-related measures and one-quarter of 2.5% for each individual measure) (TIAX 2005, EDAW 2006, SMAQMD 2007). VTPI presents % reductions for showers and combined measures in the TDM encyclopedia (VTPI	Yes: Lockers ($1,200-$2,950, $700/bike on average), Racks ($70-$2,000, $70/bike on average).	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	Caltrans, Portland Bicycle Master Plan (City of Portland 1998), CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Nonresidential projects provide plentiful short- and long-term bicycle parking facilities to meet peak season maximum demand (e.g., one bike rack space per 20 vehicle/employee parking spaces.
MM T-2: End of Trip Facilities	LD (C, M), I, SP, TP, AQP, RR, P/Mobile		Yes	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Nonresidential projects provide "end-of-trip" facilities including showers, lockers, and changing space (e.g., four clothes lockers and one shower provided for every 80 employee parking spaces, separate facilities for each gender for projects with 160 or more employee parking spaces).
MM T-3: Bike-Parking at Multi-	LD (R, M), SP, AQP, RR,		Yes: Lockers ($1,200-	Yes (Caltrans 2005,	Yes (Caltrans	Adverse: No Beneficial:		Long-term bicycle parking is provided at apartment

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16
Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Unit Residential	P/Mobile	2007). JSA bases estimates on CCAP information (JSA 2004).	$2,950, $700/bike on average), Racks ($70-$2,000, $70/bike on average).	Dierkers et al. 2007, VTPI 2007)	2005, Dierkers et al. 2007, VTPI 2007)	CAPs, TACs		complexes or condominiums without garages (e.g., one long-term bicycle parking space for each unit without a garage). Long-term facilities shall consist of one of the following: a bicycle locker, a locked room with standard racks and access limited to bicyclists only, or a standard rack in a location that is staffed and/or monitored by video surveillance 24 hours per day.
MM T-4: Proximity to Bike Path/Bike Lanes	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile		Yes	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Entire project is located within one-half mile of an existing/planned Class I or Class II bike lane and project design includes a comparable network that connects the project uses to the existing offsite facility. Project design includes a designated bicycle route connecting all units, on-site bicycle parking facilities, offsite bicycle facilities, site entrances, and primary building entrances to existing Class I or Class II bike lane(s) within one-half mile. Bicycle route connects to all streets contiguous with project site. Bicycle route has minimum conflicts with automobile parking and circulation

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								facilities. All streets internal to the project wider than 75 feet have Class II bicycle lanes on both sides.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-5: Pedestrian Network	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-10%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates 1% for each individual measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	The project provides a pedestrian access network that internally links all uses and connects to all existing/planned external streets and pedestrian facilities contiguous with the project site. Project design includes a designated pedestrian route interconnecting all internal uses, site entrances, primary building entrances, public facilities, and adjacent uses to existing external pedestrian facilities and streets. Route has minimal conflict with parking and automobile circulation facilities. Streets (with the exception of alleys) within the project have sidewalks on both sides. All sidewalks internal and adjacent to project site are minimum of five feet wide. All sidewalks feature vertical curbs. Pedestrian facilities and improvements such as grade separation, wider sidewalks, and traffic calming are implemented wherever feasible to minimize pedestrian barriers. All site entrances provide pedestrian access.
MM T-6: Pedestrian	LD (R, C, M), I, SP, TP,		Yes	Yes (Dierkers et al. 2007,	Yes (Dierkers et	Adverse: No Beneficial:		Site design and building placement minimize barriers to

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Barriers Minimized	AQP, RR, P/Mobile			VTPI 2007)	al. 2007, VTPI 2007)	CAPs, TACs		pedestrian access and interconnectivity. Physical barriers such as walls, berms, landscaping, and slopes between residential and nonresidential uses that impede bicycle or pedestrian circulation are eliminated.
MM T-7: Bus Shelter for Existing/Planned Transit Service	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-2%/High: CCAP presents these % reductions (Dierkers et al., 2007). SMAQMD assigns from .25%-1%, depending on headway frequency (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes: $15,000-$70,000.	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, City of Calgary (City of Calgary 2004), CA air quality management and control districts, and cities/counties.	Bus or streetcar service provides headways of one hour or less for stops within one-quarter mile; project provides safe and convenient bicycle/pedestrian access to transit stop(s) and provides essential transit stop improvements (i.e., shelters, route information, benches, and lighting).

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-8: Traffic Calming	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-10%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates .25%-1.0% for each individual measure depending on percent of intersections and streets with improvements (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Project design includes pedestrian/bicycle safety and traffic calming measures in excess of jurisdiction requirements. Roadways are designed to reduce motor vehicle speeds and encourage pedestrian and bicycle trips by featuring traffic calming features. All sidewalks internal and adjacent to project site are minimum of five feet wide. All sidewalks feature vertical curbs. Roadways that converge internally within the project are routed in such a way as to avoid "skewed intersections;" which are intersections that meet at acute, rather than right, angles. Intersections internal and adjacent to the project feature one or more of the following pedestrian safety/traffic calming design techniques: marked crosswalks, count-down signal timers, curb extensions, speed tables, raised crosswalks, raised intersections, median islands, tight corner radii, and roundabouts or mini-circles. Streets internal and adjacent to the project feature pedestrian safety/traffic calming measures such as on-street parking, planter strips with street trees,

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Mitigation Measure	Applicable Project/Source Type[1]	Effective: Emissions Reduction/Score[2]	Effective: Cost (Yes/No)[3]	Feasible (Yes/No): Technical[4]	Feasible (Yes/No): Logistical[5]	Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
								and chicanes/chokers (variations in road width to discourage high-speed travel).
Parking Measures								
MM T-9: Paid Parking (Parking Cash Out)	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a range of 1.0%-7.2%, depending on cost/day and distance to transit (TIAX 2005, EDAW 2006, SMAQMD 2007). Shoupe presents a 21% reduction [$5/day for commuters to downtown LA, with elasticity of -0.18 (e.g., if price increases 10%, then solo driving goes down by 1.8% more)] (Shoupe 2005). Urban Transit Institute	Yes: Vary by location and project size.	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Project provides employee and/or customer paid parking system. Project must have a permanent and enforceable method of maintaining user fees for all parking facilities. The facility may not provide customer or employee validations. Daily charge for parking must be equal to or greater than the cost of a transit day/monthly pass plus 20%.

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		presents a range of 1%-10% reduction in trips to central city sites, and 2%-4% in suburban sites (VTPI 2007).						
MM T-10: Minimum Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a maximum of 6% (Nelson/Nygaard Consulting Associates, 2005, TIAX 2005, EDAW 2006).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007), Note that in certain areas of the state, the minimum parking required by code is greater than the peak period parking demand for most land uses. Simply meeting minimum code requirements in these areas would not result in an emissions reduction.	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, Governor's Office of Smart Growth (Annapolis, Maryland) (Zimbler), CA air quality management and control districts, and cities/counties.	Provide minimum amount of parking required. Once land uses are determined, the trip reduction factor associated with this measure can be determined by utilizing the ITE parking generation publication. The reduction in trips can be computed as shown below by the ratio of the difference of minimum parking required by code and ITE peak parking demand to ITE peak parking demand for the land uses multiplied by 50%. Percent Trip Reduction = 50 * [(min parking required by code – ITE peak parking demand)/ (ITE peak parking demand)]

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MM T-11: Parking Reduction Beyond Code/Shared Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a maximum of 12% (Nelson/Nygaard, 2005, TIAX 2005, EDAW 2006).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Provide parking reduction less than code. This measure can be readily implemented through a shared parking strategy, wherein parking is utilized jointly among different land uses, buildings, and facilities in an area that experience peak parking needs at different times of day and day of the week.
MM T-12: Pedestrian Pathway Through Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-4%/Moderate: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates 0.5% reduction for this measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Provide a parking lot design that includes clearly marked and shaded pedestrian pathways between transit facilities and building entrances.

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MM T-13: Off - Street Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-4%/Moderate: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates a range of 0.1%-1.5% for this measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Parking facilities are not adjacent to street frontage.
MM T-14: Parking Area Tree Cover	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	Annual net CO_2 reduction of 3.1 kg/m^2 canopy cover/Moderate (McPherson 2001).	Yes: $19 per new tree for CA, cost varies for maintenance, removal and replacement (McPherson 2001).	Yes	Yes	Adverse: VOCs Beneficial: CAPs, TACs	AG, State of CA Department of Justice (Goldberg 2007) and cities/counties (e.g., parking lot ordinances in Sacramento, Davis, and Los Angeles, CA).	Provide parking lot areas with 50% tree cover within 10 years of construction, in particular low emitting, low maintenance, native drought resistant trees. Reduces urban heat island effect and requirement for air conditioning, effective when combined with other measures (e.g., electrical maintenance equipment and reflective paving material).
MM T-15: Valet Bicycle Parking	LD (C, M), SP, AQP, TP, RR, P/Mobile	NA/Low	Yes	Yes	Yes: Raley Field (Sacramento, CA)	Adverse: No Beneficial: CAPs, TACs	Raley Field (Sacramento, CA).	Provide spaces for the operation of valet bicycle parking at community event "centers" such as amphitheaters, theaters, and stadiums.
MM T-16: Garage Bicycle Storage	LD (R, M), SP, AQP, TP, RR, P/Mobile	NA/Low	Yes: Less than $200/multiple bike rack.	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	City of Fairview, OR	Provide storage space in one-car garages for bicycles and bicycle trailers.

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MM T-17: Preferential Parking for EVs/CNG Vehicles	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	USGBC, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Provide preferential parking space locations for EVs/CNG vehicles.
MM T-18: Reduced/No Parking Fee for EVs/CNG Vehicles	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	Hotels (e.g., Argonaut in San Francisco, CA)	Provide a reduced/no parking fee for EVs/CNG vehicles.

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Miscellaneous Measure								
MM T-19: TMA Membership	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-28%/High: CCAP presents a range of 3%-25% for TDMs with complementary transit and land use measures (Dierkers et al. 2007). VTPI presents a range of 6%-7% in the TDM encyclopedia (VTPI 2007). URBEMIS offers a 2%-10% range in reductions for a TDM that has 5 elements that are pedestrian and transit friendly and 1%-5% for 3 elements. SMAQMD presents a reduction of 5% (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Include permanent TMA membership and funding requirement. Funding to be provided by Community Facilities District or County Service Area or other nonrevocable funding mechanism. TDMs have been shown to reduce employee vehicle trips up to 28% with the largest reductions achieved through parking pricing and transit passes. The impact depends on the travel alternatives.
MM T-20: ULEV	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes: Higher than corresponding gasoline models.	Yes	Yes: Fueling stations might not be readily available depending on location. More than 900 E85 fueling	Adverse: No Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Use of and/or provide ULEV that are 50% cleaner than average new model cars (e.g., natural gas, ethanol, electric).

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					stations in the U.S., 5 in CA. Vehicles available in select regions only			
MM T-21: Flex Fuel Vehicles	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	5466.97 lb GHG/year/Low (DOE Fuel Economy)	Yes: E85 costs less than gasoline per gallon, but results in lower fuel economy.	Yes	Yes: More than 900 E85 fueling stations in the U.S., 5 in CA. Vehicles available in select regions only	Adverse: Yes Issues with the energy intensive ethanol production process (e.g., wastewater treatment requirements). Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., SJVAPCD).	Use of and/or provide vehicles that utilize gasoline/ethanol blends (e.g., E85).
Design								
Commercial & Residential Building Design Measures								
MM D-1: Office/Mixed Use Density	LD (C, M), SP, TP, AQP, RR, P/Mobile	0.05%-2%/Moderate: This range is from SMAQMD, depending	Yes	Yes (VTPI 2007)	Yes (VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties	Project provides high density office or mixed-use proximate to transit. Project must provide

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Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
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		on FAR and headway frequencies (Nelson/Nygaard Consulting Associates 2005, EDAW 2006, SMAQMD 2007).					(e.g., SMAQMD).	safe and convenient pedestrian and bicycle access to all transit stops within one-quarter mile.
MM D-2: Orientation to Existing/Planned Transit, Bikeway, or Pedestrian Corridor	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	0.4%-1%/Moderate: CCAP attributes a 0.5% reduction per 1% improvement in transit frequency (Dierkers et al. 2007). SMAQMD presents a range of 0.25%-5% (JSA 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007)	Yes (Dierkers et al. 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project is oriented towards existing transit, bicycle, or pedestrian corridor. Setback distance between project and existing or planned adjacent uses is minimized or nonexistent. Setback distance between different buildings on project site is minimized. Setbacks between project buildings and planned or existing sidewalks are minimized. Buildings are oriented towards existing or planned street frontage. Primary entrances to buildings are located along planned or existing public street frontage. Project provides bicycle access to any planned bicycle corridor(s). Project provides pedestrian access to any planned pedestrian corridor(s).
MM D-3: Services Operational	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	0.5%-5%/Moderate	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides on-site shops and services for employees.

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MM D-4: Residential Density (Employ Sufficient Density for New Residential Development to Support the Use of Public Transit)	LD (R, M), SP, TP, AQP, RR, P/Mobile	1%-40%/High: #7, EPA presents a range of 32%-40% (EPA 2006). SMAQMD presents a range of 1%-12% depending on density and headway frequencies (Nelson/Nygaard Consulting Associates 2005, JSA 2005, EDAW 2006, SMAQMD 2007). Nelson/Nygaard presents a trip reduction formula: Trip Reduction = 0.6*(1-(19749*((4.814+ households per residential acre)/(4.814+7.14))^-06.39)/25914).	Yes	Yes (VTPI 2007, Holtzclaw 2007)	Yes (VTPI 2007, Holtzclaw 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides high-density residential development. Transit facilities must be within one-quarter mile of project border. Project provides safe and convenient bicycle/pedestrian access to all transit stop(s) within one-quarter mile of project border.
MM D-5: Street Grid	LD (R, C, M), I, SP, TP, AQP, RR,	1%/Moderate: SMAQMD presents this % reduction (JSA	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007,	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties	Multiple and direct street routing (grid style). This measure only applies to projects

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	P/Mobile	2005, EDAW 2006, SMAQMD 2007).			VTPI 2007)		(e.g., SMAQMD).	with an internal CF >/= 0.80, and average of one-quarter mile or less between external connections along perimeter of project. [CF= # of intersections / (# of cul-de-sacs + intersections)]. Cul-de-sacs with bicycle/pedestrian through access may be considered "complete intersections" when calculating the project's internal connectivity factor. External connections are bike/pedestrian pathways and access points, or streets with safe and convenient bicycle and pedestrian access that connect the project to adjacent streets, sidewalks, and uses. If project site is adjacent to undeveloped land; streets, pathways, access points, and right-of-ways that provide for future access to adjacent uses may count for up to 50% of the external connections. Block perimeter (the sum of the measurement of the length of all block sides) is limited to no more than 1,350 feet. Streets internal to the project should connect to streets external to the project whenever possible.

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MM D-6: NEV Access	LD (R, C, M), SP, TP, AQP, RR, P/Mobile	0.5%-1.5%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (Litman 1999, Sperling 1994)	Yes (Litman 1999, Sperling 1994)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Make physical development consistent with requirements for neighborhood electric vehicles. Current studies show that for most trips, NEVs do not replace gas-fueled vehicles as the primary vehicle.
MM D-7: Affordable Housing Component	LD (R, M), SP, TP, AQP, RR, P/Mobile	0.4%-6%/Moderate: SMAQMD presents this % reduction (Nelson/Nygaard Consulting Associates 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Residential development projects of five or more dwelling units provide a deed-restricted low-income housing component on-site (or as defined in the code). Developers who pay into In-Lieu Fee Programs are not considered eligible to receive credit for this measure. The award of emission reduction credit shall be based only on the proportion of affordable housing developed on-site because in-lieu programs simply induce a net increase in development. Percentage reduction shall be calculated according to the following formula:

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								% reduction = % units deed-restricted below market rate housing * 0.04
MM D-8: Recharging Area	LD (R, M), SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Provide residential buildings with a "utility" room or space for recharging batteries, whether for use in a car, electric lawnmower, other electric landscaping equipment, or even batteries for small items such as flashlights.
Mixed-Use Development Measures								
MM D-9: Urban Mixed-Use	LD (M), SP, TP, AQP, RR, P/Mobile	3%-9%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Development of projects predominantly characterized by properties on which various uses, such as office, commercial, institutional, and residential, are combined in a single building or on a single site in an integrated development project with functional interrelationships and a coherent physical design.
MM D-10: Suburban Mixed-Use	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	3%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Have at least three of the following on site and/or offsite within one-quarter mile: Residential Development, Retail Development, Park, Open Space, or Office.
MM D-11: Other Mixed-Use	LD (R, M), SP, TP, AQP, RR, P/Mobile	1%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	All residential units are within one-quarter mile of parks, schools or other civic uses.

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		2006, SMAQMD 2007).						
MM D-12: Infill Development	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	3%-30%/High: Infill development reduces vehicle trips and VMT by 3% and 20%, respectively (Fehr & Peers 2007). CCAP identifies a site level VMT reduction range of 20%-30% (Dierkers et al. 2007).	Yes	Yes (Dierkers et al. 2007)	Yes (Dierkers et al. 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project site is on a vacant infill site, redevelopment area, or brownfield or greyfield lot that is highly accessible to regional destinations, where the destinations rating of the development site (measured as the weighted average travel time to all other regional destinations) is improved by 100% when compared to an alternate greenfield site.
Miscellaneous Measures								
MM D-13: Electric Lawnmower	LD (R, M), SP, AQP, RR, P/Area	1%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Provide a complimentary electric lawnmower to each residential buyer.

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MM D-14: Enhanced Recycling/Waste Reduction, Reuse, Composting	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Low	Yes	Yes	Yes: Association with social awareness.	Adverse: No Beneficial: CAPs, TACs	CIWMB	Provide infrastructure/education that promotes the avoidance of products with excessive packaging, recycle, buying of refills, separating of food and yard waste for composting, and using rechargeable batteries.
MM D-15: LEED Certification	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Moderate	Yes: Receive tax rebates, incentives (e.g., EDAW San Diego office interior remodel cost $1,700,000 for 32,500 square feet) (USGBC 2007)	Yes	Yes: More than 700 buildings of different certifications in CA (USGBC 2007).	Adverse: No Beneficial: CAPs, TACs	USGBC, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.
MM D-16: Retro-Commissioning	LD (C, M), I, SP, AQP, RR, P/Stationary & Area	8%-10% reduction in energy usage/Moderate: (Mills et al. 2004)	Yes: Average $0.28/square feet, varies with building size (Haasl and Sharp 1999).	Yes	Yes: 27 projects underway in CA, 21 more to be completed in 2007, mostly state buildings owned by DGS (DGS 2007).	Adverse: No Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	The process ensures that all building systems perform interactively according to the contract documents, the design intent and the owner's operational needs to optimize energy performance.
MM D-17 Landscaping	LD (R, C, M), I, SP, AQP, RR,	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	Alliance for the Chesapeake Bay, EPA Green Landscaping	Project shall use drought resistant native trees, trees with low emissions and high carbon

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	P/Stationary & Area						Resources	sequestration potential. Evergreen trees on the north and west sides afford the best protection from the setting summer sun and cold winter winds. Additional considerations include the use of deciduous trees on the south side of the house that will admit summer sun; evergreen plantings on the north side will slow cold winter winds; constructing a natural planted channel to funnel summer cooling breezes into the house. Neighborhood CCR's not requiring that front and side yards of single family homes be planted with turf grass. Vegetable gardens, bunch grass, and low-water landscaping shall also be permitted, or even encouraged.
MM D-18: Local Farmers' Market	LD (M), SP/Mobile, Stationary, &	NA/Low	Yes	Yes	Yes: Associated with social	Adverse: No Beneficial: CAPs, TACs	Cities/counties (e.g., Davis, Sacramento)	Project shall dedicate space in a centralized, accessible location for a weekly farmers' market.

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	Area				choice and public awareness.			
MM D-19: Community Gardens	LD (M), SP/Mobile, Stationary, & Area	NA/Low	Yes	Yes	Yes: Associated with social choice and public awareness.	Adverse: No Beneficial: CAPs, TACs	Cities/counties (e.g., Davis)	Project shall dedicate space for community gardens.
Energy Efficiency/Building Component								
MM E-1: High-Efficiency Pumps	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Project shall use high-efficiency pumps.
MM E-2: Wood Burning Fireplaces/Stoves	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low: EDAW 2006	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project does not feature fireplaces or wood burning stoves.
MM E-3: Natural Gas Stove	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low: EDAW 2006	Yes: Cost of stove—$350 (gas) and $360 (electric) same brand, total yearly cost of $42.17 as opposed to $56.65 for electric (Saving Electricity 2006).	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project features only natural gas or electric stoves in residences.

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MM E-4: Energy Star Roof	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	0.5%-1%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes: 866 Energy Star labeled buildings in California (Energy Star 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project installs Energy Star labeled roof materials.
MM E-5: On-site Renewable Energy System	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	1%-3%/Moderate: SMAQMD presents this % reduction (USGBC 2002 and 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides onsite renewable energy system(s). Nonpolluting and renewable energy potential includes solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies. When applying these strategies, projects may take advantage of net metering with the local utility.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM E-6: Exceed Title 24	LD (R, C, M), I, GSP, AQP, RR, P/Stationary & Area	1%/Moderate: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (PG&E 2002, SMUD 2006)	Yes (PG&E 2002, SMUD 2006)	Adverse: No Beneficial: CAPs, TACs	PG&E, SMUD, CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project exceeds title 24 requirements by 20%.
MM E-7: Solar Orientation	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	0.5%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project orients 75% or more of homes and/or buildings to face either north or south (within 30° of N/S). Building design includes roof overhangs that are sufficient to block the high summer sun, but not the lower winter sun, from penetrating south facing windows. Trees, other landscaping features and other buildings are sited in such a way as to maximize shade in the summer and maximize solar access to walls and windows in the winter.
MM E-8: Nonroof Surfaces	LD (R, C, M), I, GSP, AQP, RR, P/Stationary & Area	1.0%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Provide shade (within 5 years) and/or use light-colored/high-albedo materials (reflectance of at least 0.3) and/or open grid pavement for at least 30% of the site's nonroof impervious surfaces, including parking lots, walkways, plazas, etc.; OR place a minimum of 50% of parking spaces underground or covered by structured parking; OR use an open-grid pavement system (less than 50% impervious) for a minimum of

Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								50% of the parking lot area. The mitigation measure reduces heat islands (thermal gradient differences between developed and undeveloped areas to minimize impact on microclimate and human and wildlife habitats. This measure requires the use of patented or copyright protected methodologies created by the ASTM. The SRI is a measure of the constructed surface's ability to reflect solar heat, as shown by a small rise in temperature. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is "0" and a standard white (reflectance 0.80, emittance 0.90) is 100. To calculate SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980-01. Reflectance is measured

Table 16 Mitigation Measure Summary

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Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371. Default values for some materials will be available in the LEED-NC v2.2 Reference Guide.
MM E-9: Low-Energy Cooling	LD (C, M), I, SP, AQP, RR, P/Stationary & Area	1%-10%/Low: EDAW presents this percent reduction range (EDAW 2006).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project optimizes building's thermal distribution by separating ventilation and thermal conditioning systems.
MM E-10: Green Roof	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	1.0%/Moderate: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: Increased Water Consumption Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Install a vegetated roof that covers at least 50% of roof area. The reduction assumes that a vegetated roof is installed on a least 50% of the roof area or that a combination high albedo and vegetated roof surface is installed that meets the following standard: (Area of SRI Roof/0.75)+(Area of vegetated roof/0.5) >= Total Roof Area. Water consumption reduction measures shall be considered in the design of the green roof.
MM E-11: EV Charging Facilities	LD (C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: $500-$5000/ vehicle site (PG&E 1999)	Yes	Yes: 381 facilities in CA (Clean Air Maps 2007).	Adverse: No Beneficial: CAPs, TACs	DOE, EERE, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Project installs EV charging facilities.
MM E-12:	LD (R, C, M),	NA/Low: Increasing	Yes: Light	Yes	Yes: Apply	Adverse: No		Project provides light-colored

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Light-Colored Paving	I, SP, AQP, RR, P/Stationary & Area	the albedo of 1,250 km of pavement by 0.25 would save cooling energy worth $15M per year.	colored aggregates and white cement are more expensive than gray cement. Certain blended cements are very light in color and may reflect similarly to white cement at an equivalent cost to normal gray cement.		natural sand or gravel colored single surface treatments to asphalt (EOE 2007).	Beneficial: CAPs, TACs		paving (e.g., increased albedo pavement).
MM E-13: Cool Roofs	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: 0.75–1.5/square feet coating (EPA 2007a)	Yes	Yes: Over 90% of the roofs in the United States are dark colored	Adverse: No Beneficial: CAPs, TACs	CEC	Project provides cool roofs. Highly reflective, highly emissive roofing materials that stay 50-60°F cooler than a normal roof under a hot summer sun. CA's Cool Savings

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Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
					(EPA 2007a).			Program provided rebates to building owners for installing roofing materials with high solar reflectance and thermal emittance. The highest rebate went to roofs on air conditioned buildings, while buildings with rooftop ducts and other nonresidential buildings were eligible for slightly less. The program aimed to reduce peak summer electricity demand and was administered by the CEC.
MM E-14: Solar Water Heaters	LD (R, M), SP, AQP, RR, P/Stationary & Area	20%–70% reduction in cooling energy needs/Moderate	Yes: $1675/20 square feet, requires a 50 gallon tank, annual operating cost of $176 (DOE 2007).	Yes	Yes: Based on solar orientation, building codes, zoning ordinances.	Adverse: No Beneficial: CAPs, TACs	Europe	Project provides solar water heaters.
MM E-15: Electric Yard Equipment Compatibility	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: $75–$250/outlet from existing circuit (Cost Helper 2007).	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Project provides electrical outlets at building exterior areas.
MM E-16: Energy Efficient Appliance Standards	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: Varies for each appliance—higher capital costs, lower operating costs (Energy	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Project uses energy efficient appliances (e.g., Energy Star).

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
			Star 2007).					
MM E-17: Green Building Materials	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low: 25-30% more efficient on average.	Yes	Yes: BEES software allows users to balance the environmental and economic performance of building products; developed by NIST (NIST 2007).	Yes	Adverse: No Beneficial: CAPs, TACs		Project uses materials which are resource efficient, recycled, with long life cycles and manufactured in an environmentally friendly way.
MM E-18: Shading Mechanisms	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: Up to $450 annual energy savings (Energy Star 2007).	Yes: Higher capital costs, lower operating and maintenance costs (Energy Star 2007).	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing shading mechanisms for windows, porch, patio and walkway overhangs.

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Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM E-19: Ceiling/Whole-House Fans	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: 50% more efficient than conventional fans (Energy Star 2007).	Yes: $45-$200/fan, installation extra (Lowe's 2007).	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing ceiling/whole-house fans.
MM E-20: Programmable Thermostats	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: $100 annual savings in energy costs (Energy Star 2007).	Yes: $60/LCD display and 4 settings for typical residential use (Lowe's 2007).	Yes	Yes: Major retail stores.	Adverse: Yes, Mercury Beneficial: CAPs, TACs		Install energy-reducing programmable thermostats that automatically adjust temperature settings.
MM E-21: Passive Heating and Cooling Systems	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low	Yes: $800 (wall heaters) to $4,000+ (central systems)	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing passive heating and cooling systems (e.g., insulation and ventilation).
MM E-22: Day Lighting Systems	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low	Yes: $1,300 to $1,500 depending upon the kind of roof (Barrier 1995), installation extra.	Yes	Yes: Work well only for space near the roof of the building, little benefit in multi-floor buildings.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing day lighting systems (e.g., skylights, light shelves and interior transom windows).
MM E-23: Low-Water Use Appliances	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: Avoided water agency cost for using water-efficient kitchen pre-rinse spray valves of $65.18 per acre-foot.	Yes: Can return their cost through reduction in water consumption,	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Require the installation of low-water use appliances.

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Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
			pumping, and treatment.					
MM E-24: Goods Transport by Rail	LD (C, M), I, SP, AQP, RR, P/Mobile	NA/Moderate	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	ARB Goods Movement Plan (ARB 2007)	Provide a spur at nonresidential projects to use nearby rail for goods movement.
Social Awareness/Education								
MM S-1: GHG Emissions Reductions Education	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Mobile	NA/Low	Yes	Yes	Yes: Similar programs currently exist in CA.	Adverse: No Beneficial: CAPs, TACs		Provide local governments, businesses, and residents with guidance/protocols/information on how to reduce GHG emissions (e.g., energy saving, food miles).
MM S-2: School Curriculum	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Mobile	NA/Low	Yes	Yes	Yes: Similar programs currently exist in CA.	Adverse: No Beneficial: CAPs, TACs		Include how to reduce GHG emissions (e.g., energy saving, food miles) in the school curriculum.
Construction								
MM C-1: ARB-Certified Diesel Construction Equipment	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes: Oxidation Catalysts, \$1,000-	Yes	Yes	Adverse: Yes, NO_x Beneficial: CAPs, TACs	AG, EPA, ARB, and CA air quality management and pollution control districts.	Use ARB-certified diesel construction equipment. Increases CO_2 emissions when trapped CO and carbon particles

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
			$2,000. DPF, $5000-$10,000; installation extra (EPA 2007b).					are oxidized (Catalyst Products 2007, ETC 2007).
MM C-2: Alternative Fuel Construction Equipment	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: Yes, THC, NO_x Beneficial: CO, PM, SO_x	AG, EPA, ARB, and CA air quality management and pollution control districts.	Use alternative fuel types for construction equipment. At the tailpipe biodiesel emits 10% more CO_2 than petroleum diesel. Overall lifecycle emissions of CO_2 from 100% biodiesel are 78% lower than those of petroleum diesel (NREL 1998, EPA 2007b).
MM C-3: Local Building Materials	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes: Depends on location of building material manufacture sites.	Adverse: No Beneficial: CAPs, TACs		Use locally made building materials for construction of the project and associated infrastructure.
MM C-4: Recycle Demolished Construction Material	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Recycle/Reuse demolished construction material. Use locally made building materials for construction of the project and associated infrastructure.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Miscellaneous								
MM M-1: Off-Site Mitigation Fee Program	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile & Area	NA/Moderate-High: Though there is currently no program in place, the potential for real and quantifiable reductions of GHG emissions could be high if a defensible fee program were designed.	Yes	Yes	No: Program does not exist in CA, but similar programs currently exist (e.g., Carl Moyer Program, SJVAPCD Rule 9510, SMAQMD Off-Site Construction Mitigation Fee Program).	Adverse: No Beneficial: CAPs, TACs		Provide/Pay into an off-site mitigation fee program, which focuses primarily on reducing emissions from existing development and buildings through retro-fit (e.g., increased insulation).
MM M-2: Offset Purchase	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Area	NA/Low	Yes	Yes	No: ARB has not adopted official program, but similar programs	No		Provide/purchase offsets for additional emissions by acquiring carbon credits or engaging in other market "cap and trade" systems.

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		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
					currently exist.			
Regional Transportation Plan Measures								
MM RTP-1: Dedicate High Occupancy Vehicle (HOV) lanes prior to adding capacity to existing highways.	RTP		Yes	Yes	Yes	Adverse: possible local CO Beneficial: regional CAPs, TACs	Caltrans, local government	Evaluate the trip reduction (and GHG reduction) potential of adding HOV lanes prior to adding standard lanes.
MM RTP-2: Implement toll/user fee programs prior to adding capacity to existing highways.	RTP		Yes	Yes	Yes	Adverse: possible local CO. Beneficial: regional CAPs, TACs	Caltrans	Evaluate price elasticity and associated trip reduction (and GHG reduction) potential with adding or increasing tolls prior to adding capacity to existing highways.

Note:
[1] Where LD (R, C, M) =Land Development (Residential, Commercial, Mixed-Use), I=Industrial, GP=General Plan, SP=Specific Plan, TP=Transportation Plans, AQP=Air Quality Plans, RR=Rules/Regulations, and P=Policy. It is important to note that listed project types may not be directly specific to the mitigation measure (e.g., TP, AQP, RR, and P) as such could apply to a variety of source types, especially RR and P.
[2] This score system entails ratings of high, moderate, and low that refer to the level of the measure to provide a substantive, reasonably certain (e.g., documented emission reductions with proven technologies), and long-term reduction of GHG emissions.
[3] Refers to whether the measure would provide a cost-effective reduction of GHG emissions based on available documentation.
[4] Refers to whether the measure is based on currently, readily available technology based on available documentation.
[5] Refers to whether the measure could be implemented without extraordinary effort based on available documentation.
[6] List is not meant to be all inclusive.
Source: Data complied by EDAW in 2007

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-1: Adopt a GHG reduction plan	GP/ Mobile, Stationary, & Area	City of San Bernardino	- Adopt GHG reduction targets for the planning area, based on the current legislation providing direction for state-wide targets, and update the plan as necessary. -The local government agency should serve as a model by inventorying its GHG emissions from agency operations, and implementing those reduction goals.
Circulation			
MS G-2: Provide for convenient and safe local travel	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Create a gridded street pattern with small block sizes. This promotes walkability through direct routing and ease of navigation. -Maintain a high level of connectivity of the roadway network. Minimize cul-de-sacs and incomplete roadway segments. -Plan and maintain an integrated, hierarchical and multi-modal system of roadways, pedestrian walks, and bicycle paths throughout the area. -Apply creative traffic management approaches to address congestion in areas with unique problems, particularly on roadways and intersections in the vicinity of schools in the morning and afternoon peak hours, and near churches, parks and community centers. -Work with adjacent jurisdictions to address the impacts of regional development patterns (e.g. residential development in surrounding communities, regional universities, employment centers, and commercial developments) on the circulation system. -Actively promote walking as a safe mode of local travel, particularly for children attending local schools. -Employ traffic calming methods such as median landscaping and provision of bike or transit lanes to slow traffic, improve roadway capacity, and address safety issues.
MS G-3: Enhance the regional transportation network and maintain effectiveness	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage the transportation authority to reduce fees for short distance trips. -Ensure that improvements to the traffic corridors do not negatively impact the operation of local roadways and land uses.

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General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			-Cooperate with adjacent jurisdictions to maintain adequate service levels at shared intersections and to provide adequate capacity on regional routes for through traffic. -Support initiatives to provide better public transportation. Work actively to ensure that public transportation is part of every regional transportation corridor. - Coordinate the different modes of travel to enable users to transfer easily from one mode to another. -Work to provide a strong paratransit system that promotes the mobility of all residents and educate residents about local mobility choices. - Promote transit-oriented development to facilitate the use of the community's transit services.
MS G-4: Promote and support an efficient public transportation network connecting activity centers in the area to each other and the region.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Promote increased use of public transportation and support efforts to increase bus service range and frequency within the area as appropriate. -Enhance and encourage provision of attractive and appropriate transit amenities, including shaded bus stops, to encourage use of public transportation. -Encourage the school districts, private schools and other operators to coordinate local bussing and to expand ride-sharing programs. All bussing options should be fully considered before substantial roadway improvements are made in the vicinity of schools to ease congestion.
MS G-5: Establish and maintain a comprehensive system, which is safe and convenient, of pedestrian ways and bicycle routes that provide viable options to travel by automobile.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Improve area sidewalks and rights-of-way to make them efficient and appealing for walking and bicycling safely. Coordinate with adjacent jurisdictions and regional agencies to improve pedestrian and bicycle trails, facilities, signage, and amenities. -Provide safe and convenient pedestrian and bicycle connections to and from town centers, other commercial districts, office complexes, neighborhoods, schools, other major activity centers, and surrounding communities. -Work with neighboring jurisdictions to provide well-designed pedestrian and bicycle crossings of major roadways. -Promote walking throughout the community. Install sidewalks where missing and make improvements

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			to existing sidewalks for accessibility purposes. Particular attention should be given to needed sidewalk improvement near schools and activity centers. -Encourage businesses or residents to sponsor street furniture and landscaped areas. - Strive to provide pedestrian pathways that are well shaded and pleasantly landscaped to encourage use. - Attract bicyclists from neighboring communities to ride their bicycles or to bring their bicycles on the train to enjoy bicycling around the community and to support local businesses. - Meet guidelines to become nationally recognized as a Bicycle-Friendly community. - Provide for an education program and stepped up code enforcement to address and minimize vegetation that degrades access along public rights-of-way. -Engage in discussions with transit providers to increase the number of bicycles that can be accommodated on buses
MS G-6: Achieve optimum use of regional rail transit.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Support regional rail and work with rail authority to expand services. - Achieve better integration of all transit options. -Work with regional transportation planning agencies to finance and provide incentives for multimodal transportation systems. - Promote activity centers and transit-oriented development projects around the transit station.
MS G-7: Expand and optimize use of local and regional bus and transit systems.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage convenient public transit service between area and airports. -Support the establishment of a local shuttle to serve commercial centers. -Promote convenient, clean, efficient, and accessible public transit that serves transit-dependent riders and attracts discretionary riders as an alternative to reliance on single-occupant automobiles.

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			- Empower seniors and those with physical disabilities who desire maximum personal freedom and independence of lifestyle with unimpeded access to public transportation. -Integrate transit service and amenities with surrounding land uses and buildings.
Conservation, Open Space			
MS G-8: Emphasize the importance of water conservation and maximizing the use of native, low-water landscaping.	GP/Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Reduce the amount of water used for landscaping and increase use of native and low water plants. Maximize use of native, low-water plants for landscaping of areas adjacent to sidewalks or other impermeable surfaces. -Encourage the production, distribution and use of recycled and reclaimed water for landscaping projects throughout the community, while maintaining urban runoff water quality objectives. -Promote water conservation measures, reduce urban runoff, and prevent groundwater pollution within development projects, property maintenance, area operations and all activities requiring approval. -Educate the public about the importance of water conservation and avoiding wasteful water habits. -Work with water provider in exploring water conservation programs, and encourage the water provider to offer incentives for water conservation.
MS G-9: Improve air quality within the region.	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Integrate air quality planning with area land use, economic development and transportation planning efforts. -Support programs that reduce air quality emissions related to vehicular travel. -Support alternative transportation modes and technologies, and develop bike- and pedestrian-friendly neighborhoods to reduce emissions associated with automobile use. -Encourage the use of clean fuel vehicles. -Promote the use of fuel-efficient heating and cooling equipment and other appliances, such as water

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	**Source Type[1]**	**Agency/Organization[2]**	**Description/Comments**
			heaters, swimming pool heaters, cooking equipment, refrigerators, furnaces, and boiler units. - Promote the use of clean air technologies such as fuel cell technologies, renewable energy sources. UV coatings, and alternative, non-fossil fuels. -Require the planting of street trees along streets and inclusion of trees and landscaping for all development projects to help improve airshed and minimize urban heat island effects. - Encourage small businesses to utilize clean, innovative technologies to reduce air pollution. - Implement principles of green building. - Support jobs/housing balance within the community so more people can both live and work within the community. To reduce vehicle trips, encourage people to telecommute or work out of home or in local satellite offices.
MS G-10: Encourage and maximize energy conservation and identification of alternative energy sources.	GP/ Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage green building designs for new construction and renovation projects within the area. -Coordinate with regional and local energy suppliers to ensure adequate supplies of energy to meet community needs, implement energy conservation and public education programs, and identify alternative energy sources where appropriate. -Encourage building orientations and landscaping that enhance natural lighting and sun exposure. -Encourage expansion of neighborhood-level products and services and public transit opportunities throughout the area to reduce automobile use. - Incorporate the use of energy conservation strategies in area projects. - Promote energy-efficient design features, including appropriate site orientation, use of light color roofing and building materials, and use of evergreen trees and wind-break trees to reduce fuel consumption for heating and cooling.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	**Source Type[1]**	**Agency/Organization[2]**	**Description/Comments**
			-Explore and consider the cost/benefits of alternative fuel vehicles including hybrid, natural gas, and hydrogen powered vehicles when purchasing new vehicles. -Continue to promote the use of solar power and other energy conservation measures. - Encourage residents to consider the cost/benefits of alternative fuel vehicles. - Promote the use of different technologies that reduce use of non-renewable energy resources. -Facilitate the use of green building standards and LEED in both private and public projects. -Promote sustainable building practices that go beyond the requirements of Title 24 of the California Administrative Code, and encourage energy-efficient design elements, as appropriate. -Support sustainable building practices that integrate building materials and methods that promote environmental quality, economic vitality, and social benefit through the design, construction, and operation of the built environment. - Investigate the feasibility of using solar (photovoltaic) street lights instead of conventional street lights that are powered by electricity in an effort to conserve energy. - Encourage cooperation between neighboring development to facilitate on-site renewable energy supplies or combined heat and power co-generation facilities that can serve the energy demand of contiguous development.

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-11: Preserve unique community forests, and provide for sustainable increase and maintenance of this valuable resource.	GP/Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Develop a tree planting policy that strives to accomplish specific % shading of constructed paved and concrete surfaces within five years of construction. -Provide adequate funding to manage and maintain the existing forest, including sufficient funds for tree planting, pest control, scheduled pruning, and removal and replacement of dead trees. -Coordinate with local and regional plant experts in selecting tree species that respect the natural region in which Claremont is located, to help create a healthier, more sustainable urban forest. - Continue to plant new trees (in particular native tree species where appropriate), and work to preserve mature native trees. -Increase the awareness of the benefits of street trees and the community forest through a area wide education effort. -Encourage residents to properly care for and preserve large and beautiful trees on their own private property.
Housing			
MS G-12: Provide affordability levels to meet the needs of community residents.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage development of affordable housing opportunities throughout the community, as well as development of housing for elderly and low and moderate income households near public transportation services. -Ensure a portion of future residential development is affordable to low and very low income households.
Land Use			
MS G-13: Promote a visually-cohesive urban form and establish connections between the urban core and outlying portions of the	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Preserve the current pattern of development that encourages more intense and higher density development at the core of the community and less intense uses radiating from the central core. -Create and enhance landscaped greenway, trail and sidewalk connections between neighborhoods and to commercial areas, town centers, and parks.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	**Source Type[1]**	**Agency/Organization[2]**	**Description/Comments**
community.			-Identify ways to visually identify and physically connect all portions of the community, focusing on enhanced gateways and unifying isolated and/or outlying areas with the rest of the area. -Study and create a diverse plant identity with emphasis on drought-resistant native species.
MS G-14: Provide a diverse mix of land uses to meet the future needs of all residents and the business community.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Attract a broad range of additional retail, medical, and office uses providing employment at all income levels. -Support efforts to provide beneficial civic, religious, recreational, cultural and educational opportunities and public services to the entire community. -Coordinate with public and private organizations to maximize the availability and use of parks and recreational facilities in the community. -Support development of hotel and recreational commercial land uses to provide these amenities to local residents and businesses.
MS G-15: Collaborate with providers of solid waste collection, disposal and recycling services to ensure a level of service that promotes a clean community and environment.	GP/ Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Require recycling, composting, source reduction and education efforts throughout the community, including residential, businesses, industries, and institutions, within the construction industry, and in all sponsored activities.
MS G-16: Promote construction, maintenance and active use of publicly- and privately-operated parks, recreation programs, and a community center.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Work to expand and improve community recreation amenities including parks, pedestrian trails and connections to regional trail facilities. -As a condition upon new development, require payment of park fees and/or dedication and provision of parkland, recreation facilities and/or multi-use trails that improve the public and private recreation system. -Research options or opportunities to provide necessary or desired community facilities.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	**Source Type[1]**	**Agency/Organization[2]**	**Description/Comments**
MS G-17: Promote the application of sustainable development practices.	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Encourage sustainable development that incorporates green building best practices and involves the reuse of previously developed property and/or vacant sites within a built-up area. - Encourage the conservation, maintenance, and rehabilitation of the existing housing stock. -Encourage development that incorporates green building practices to conserve natural resources as part of sustainable development practices. -Avoid development of isolated residential areas in the hillsides or other areas where such development would require significant infrastructure investment, adversely impact biotic resources. - Provide land area zoned for commercial and industrial uses to support a mix of retail, office, professional, service, and manufacturing businesses.
MS G-18: Create activity nodes as important destination areas, with an emphasis on public life within the community.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide pedestrian amenities, traffic-calming features, plazas and public areas, attractive streetscapes, shade trees, lighting, and retail stores at activity nodes. -Provide for a mixture of complementary retail uses to be located together to create activity nodes to serve adjacent neighborhoods and to draw visitors from other neighborhoods and from outside the area.
MS G-19: Make roads comfortable, safe, accessible, and attractive for use day and night.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide crosswalks and sidewalks along streets that are accessible for people with disabilities and people who are physically challenged. -Provide lighting for walking and nighttime activities, where appropriate. -Provide transit shelters that are comfortable, attractive, and accommodate transit riders.
MS G-20: Maintain and expand where possible the system of neighborhood connections that attach neighborhoods to larger roadways.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Provide sidewalks where they are missing, and provide wide sidewalks where appropriate with buffers and shade so that people can walk comfortably. -Make walking comfortable at intersections through traffic-calming, landscaping, and designated crosswalks.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	**Source Type[1]**	**Agency/Organization[2]**	**Description/Comments**
			-Look for opportunities for connections along easements & other areas where vehicles not permitted.
MS G-21: Create distinctive places throughout the area.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide benches, streetlights, public art, and other amenities in public areas to attract pedestrian activities. -Encourage new developments to incorporate drought tolerant and native landscaping that is pedestrian friendly, attractive, and consistent with the landscaped character of area. -Encourage all new development to preserve existing mature trees. -Encourage streetscape design programs for commercial frontages that create vibrant places which support walking, bicycling, transit, and sustainable economic development. -Encourage the design and placement of buildings on lots to provide opportunities for natural systems such as solar heating and passive cooling. - Ensure that all new industrial development projects are positive additions to the community setting, provide amenities for the comfort of the employees such as outdoor seating area for breaks or lunch, and have adequate landscape buffers.
MS G-22: Reinvest in existing neighborhoods and promote infill development as a preference over new, greenfield development	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Identify all underused properties in the plan area and focus development in these opportunity sites prior to designating new growth areas for development. - Implement programs to retro-fit existing structures to make them more energy-efficient. -Encourage compact development, by placing the desired activity areas in smaller spaces.

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
Public Safety			
MS G-23: Promote a safe community in which residents can live, work, shop, and play.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Foster an environment of trust by ensuring non-biased policing, and by adopting policies and encouraging collaboration that creates transparency. - Facilitate traffic safety for motorists and pedestrians through proper street design and traffic monitoring.

Note:
[1] Where GP=General Plan.
[2] List is not meant to be all inclusive.
Source: Data complied by EDAW in 2007

Appendix C

Rule and Regulation Summary

Table 18 Rule and Regulation Summary					
Rule/Regulation	**Reduction**	**Implementation Date**	**Agency**	**Description**	**Comments**
Low Carbon Fuel Standard	10-20 MMT CO_2e by 2020	January 1, 2010	ARB	This rule/regulation will require fuel providers (e.g., producers, importers, refiners and blenders) to ensure that the mix of fuels they sell in CA meets the statewide goal to reduce the carbon intensity of CA's transportation fuels by at least 10% by the 2020 target.	ARB Early Action Measure
Reduction of HFC-134a Emissions from Nonprofessional Servicing of Motor Vehicle Air Conditioning Systems	1-2 MMT CO_2e by 2020	January 1, 2010	ARB	This rule/regulation will restrict the use of high GWP refrigerants for nonprofessional recharging of leaky automotive air conditioning systems.	ARB Early Action Measure
Landfill Gas Recovery	2-4 MMT CO_2e by 2020	January 1, 2010	IWMB, ARB	This rule/regulation will require landfill gas recovery systems on small to medium landfills that do not have them and upgrade the requirements at landfills with existing systems to represent best capture and destruction efficiencies.	ARB Early Action Measure
Vehicle Climate Change Standards (AB 1493 Pavley, Chapter 200, Statutes of 2002)	30 MMT CO_2e by 2020	2009	ARB	This rule/regulation will require ARB to achieve the maximum feasible and cost effective reduction of GHG emissions from passenger vehicles and light-duty trucks.	ARB Early Action Measure
Reduction of PFCs from the Semiconductor Industry	0.5 MMT CO_2e by 2020	2007–2009	ARB	This rule/regulation will reduce GHG emissions by process improvements/source reduction, alternative chemicals capture and beneficial reuse, and destruction technologies	Underway or to be initiated by CAT members in 2007-2009 period

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Table 18 Rule and Regulation Summary					
Rule/Regulation	**Reduction**	**Implementation Date**	**Agency**	**Description**	**Comments**
Restrictions on High GWP Refrigerants	9 MMT CO_2e by 2020	2010	ARB	This rule/regulation will expand and enforce the national ban on release of high GWP refrigerants during appliance lifetime.	ARB Early Action Measure
Cement Manufacture	<1 MMT CO_2e per year (based on 2004 production levels)	2010	Caltrans	This rule/regulation will allow 2.5% interground limestone concrete mix in cement use.	CAT Early Action Measure
Hydrogen Fuel Standards (SB 76 of 2005)	TBD	By 2008	CDFA	This rule/regulation will develop hydrogen fuel standards for use in combustion systems and fuel cells.	CAT Early Action Measure
Regulation of GHG from Load Serving Entities (SB 1368)	15 MMT CO_2e by 2020	May 23, 2007	CEC, CPUC	This rule/regulation will establish a GHG emission performance standard for baseload generation of local publicly owned electric utilities that is no higher than the rate of emissions of GHG for combined-cycle natural gas baseload generation.	CAT Early Action Measure
Energy Efficient Building Standards	TBD	In 2008	CEC	This rule/regulation will update of Title 24 standards.	CAT Early Action Measure
Energy Efficient Appliance Standards	TBD	January 1, 2010	CEC	This rule/regulation will regulate light bulb efficiency	CAT Early Action Measure
Tire Efficiency (Chapter 8.7 Division 15 of the Public Resources Code)	<1 MMT CO_2e by 2020	January 1, 2010	CEC & IWMB	This rule/regulation will ensure that replacement tires sold in CA are at least as energy efficient, on average, as tires sold in the state as original equipment on these vehicles.	CAT Early Action Measure
New Solar Homes Partnership	TBD	January 2007	CEC	Under this rule/regulation, approved solar systems will receive incentive funds based on system performance above building standards.	CAT Early Action Measure

Table 18 Rule and Regulation Summary					
Rule/Regulation	**Reduction**	**Implementation Date**	**Agency**	**Description**	**Comments**
Water Use Efficiency	1 MMT CO_2e by 2020	2010	DWR	This rule/regulation will adopt standards for projects and programs funded through water bonds that would require consideration of water use efficiency in construction and operation.	CAT Early Action Measure
State Water Project	TBD	2010	DWR	This rule/regulation will include feasible and cost effective renewable energy in the SWP's portfolio.	CAT Early Action Measure
Cleaner Energy for Water Supply	TBD	2010	DWR	Under this rule/regulation, energy supply contracts with conventional coal power plants will not be renewed.	CAT Early Action Measure
IOU Energy Efficiency Programs	4 MMT CO_2e by 2020	2010	CPUC	This rule/regulation will provide a risk/reward incentive mechanism for utilities to encourage additional investment in energy efficiency; evaluate new technologies and new measures like encouraging compact fluorescent lighting in residential and commercial buildings	CAT Early Action Measure
Solar Generation	TBD	2007–2009	DGS	3 MW of clean solar power generation implemented in CA last year, with another 1 MW coming up. The second round is anticipated to total additional 10 MW and may include UC/CSU campuses and state fairgrounds.	Underway or to be initiated by CAT members in 2007-2009 period

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Table 18 Rule and Regulation Summary					
Rule/Regulation	**Reduction**	**Implementation Date**	**Agency**	**Description**	**Comments**
Transportation Efficiency	9 MMT CO_2e by 2020	2007–2009	Caltrans	This rule/regulation will reduce congestion, improve travel time in congested corridors, and promote coordinated, integrated land use.	Underway or to be initiated by CAT members in 2007-2009 period
Smart Land Use and Intelligent Transportation	10 MMT CO_2e by 2020	2007–2009	Caltrans	This rule/regulation will integrate consideration of GHG reduction measures and energy efficiency factors into RTPs, project development etc.	Underway or to be initiated by CAT members in 2007-2009 period
Cool Automobile Paints	1.2 to 2.0 MMT CO_2e by 2020	2009	ARB	Cool paints would reduce the solar heat gain in a vehicle and reduce air conditioning needs.	ARB Early Action Measure
Tire Inflation Program	TBD	2009	ARB	This rule/regulation will require tires to be checked and inflated at regular intervals to improve fuel economy.	ARB Early Action Measure
Electrification of Stationary Agricultural Engines	0.1 MMT CO_2e by 2020	2010	ARB	This rule/regulation will provide incentive funding opportunities for replacing diesel engines with electric motors.	ARB Early Action Measure
Desktop Power Management	Reduce energy use by 50%	2007–2009	DGS, ARB	This rule/regulation will provide software to reduce electricity use by desktop computers by up to 40%.	Currently deployed in DGS
Reducing CH_4 Venting/Leaking from Oil and Gas Systems (EJAC-3/ARB 2-12)	1 MMT CO_2e by 2020	2010	ARB	This rule/regulation will reduce fugitive CH_4 emissions from production, processing, transmission, and distribution of natural gas and oil.	ARB Early Action Measure
Replacement of High GWP Gases Used in Fire Protection Systems with Alternate Chemical (ARB 2-10)	0.1 MMT CO_2e by 2020	2011	ARB	This rule/regulation will require the use of lower GWP substances in fire protection systems.	ARB Early Action Measure
Contracting for Environmentally Preferable Products	NA	2007–2009	DGS	New state contracts have been or are being created for more energy and resource efficient IT goods, copiers, low mercury fluorescent lamps, the CA Gold Carpet Standard and office furniture.	Underway or to be initiated by CAT members in 2007-2009 period
Hydrogen Fuel Cells	NA	2007–2009	DGS	This rule/regulation will incorporate clean hydrogen fuel cells in stationary applications	Underway or to be initiated by CAT members in 2007-2009

Table 18 Rule and Regulation Summary					
Rule/Regulation	**Reduction**	**Implementation Date**	**Agency**	**Description**	**Comments**
				at State facilities and as back-up generation for emergency radio services.	period
High Performance Schools	NA	2007–2009	DGS	New guidelines adopted for energy and resource efficient schools; up to $100 million in bond money for construction of sustainable, high performance schools.	Underway or to be initiated by CAT members in 2007-2009 period
Urban Forestry	1 MMT CO_2e by 2020	2007–2009	Calfire, CUFR	This rule/regulation will provide five million additional trees in urban areas by 2020.	Underway or to be initiated by CAT members in 2007-2009 period
Fuels Management/Biomass	3 MMT CO_2e by 2020	2007–2009	Calfire	This rule/regulation will provide biomass from forest fuel treatments to existing biomass utilization facilities.	Underway or to be initiated by CAT members in 2007-2009 period
Forest Conservation and Forest Management	10 MMT CO_2e by 2020	2007–2009	Calfire, WCB	This rule/regulation will provide opportunities for carbon sequestration in Proposition 84 forest land conservation program to conserve an additional 75,000 acres of forest landscape by 2010.	Underway or to be initiated by CAT members in 2007-2009 period
Afforestation/Reforestation	2 MMT CO_2e by 2020	2007–2009	Calfire	This rule/regulation will subsidize tree planting.	Underway or to be initiated by CAT members in 2007-2009 period
Dairy Digesters	TBD	January 1, 2010	CDFA	This rule/regulation will develop a dairy digester protocol to document GHG emission reductions from these facilities.	ARB Early Action Measure

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Table 18
Rule and Regulation Summary

Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Conservation Tillage and Enteric Fermentation	1 MMT CO_2e by 2020	2007–2009	CDFA	This rule/regulation will develop and implement actions to quantify and reduce enteric fermentation emissions from livestock and sequester soil carbon using cover crops and conservation tillage.	Underway or to be initiated by CAT members in 2007-2009 period
ULEV	TBD	2007–2009	DGS	A new long term commercial rental contract was released in March 2007 requiring a minimum ULEV standard for gasoline vehicles and requires alternative fuel and hybrid-electric vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Flex Fuel Vehicles	370 metric tons CO_2, 0.85 metric tons of CH_4, and 1.14 metric tons of N_2O	2007–2009	DGS	Under this rule/regulation, DGS is replacing 800 vehicles with new, more efficient vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Climate Registry	TBD	2007–2009	DGS	Benchmarking and reduction of GHG emissions for state owned buildings, leased buildings and light duty vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Municipal Utilities Electricity Sector Carbon Policy	Included in SB 1368 reductions	2007–2009	CEC, CPUC, ARB	Under this rule/regulation, GHG emissions cap policy guidelines for CA's electricity sector (IOUs and POUs).	Underway or to be initiated by CAT members in 2007-2009 period
Alternative Fuels: Nonpetroleum Fuels	TBD	2007–2009	CEC	State plan to increase the use of alternative fuels for transportation; full fuel cycle assessment.	Underway or to be initiated by CAT members in 2007-2009 period
Zero Waste/High Recycling Strategy	5 MMT CO_2e by 2020	2007–2009	IWMB	This rule/regulation will identify materials to focus on to achieve GHG reduction at the lowest possible cost; Builds on the success of 50% Statewide Recycling Goal.	Underway or to be initiated by CAT members in 2007-2009 period
Organic Materials Management	TBD	2007–2009	IWMB	This rule/regulation will develop a market incentive program to increase organics diversion to the agricultural industry.	Underway or to be initiated by CAT members in 2007-2009 period
Landfill Gas Energy	TBD	2007–2009	IWMB	Landfill Gas to Energy & LNG/biofuels	Underway or to be initiated by CAT members in 2007-2009 period

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Rule and Regulation Summary

Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Target Recycling	TBD	2007–2009	IWMB	This rule/regulation will focus on industry/public sectors with high GHG components to implement targeted commodity recycling programs.	Underway or to be initiated by CAT members in 2007-2009 period
Accelerated Renewable Portfolio Standard	Included in SB 1368 reductions	2007–2009	CPUC	This rule/regulation will examine RPS long term planning and address the use of tradable renewable energy credits for RPS compliance.	Underway or to be initiated by CAT members in 2007-2009 period
CA Solar Initiative	1 MMT CO_2e by 2020	2007–2009	CPUC	Initiative to deliver 2000 MWs of clean, emissions free energy to the CA grid by 2016.	Underway or to be initiated by CAT members in 2007-2009 period
Carbon Capture and Sequestration	TBD	2007–2009	CPUC	Proposals for power plants with IGCC and/or carbon capture in the next 18 months.	Underway or to be initiated by CAT members in 2007-2009

Source: Data complied by EDAW in 2007

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Exhibit H

Exhibit H

Audubon California * California Wilderness Coalition * Defenders of Wildlife
Desert Protective Council * Mojave Desert Land Trust
Natural Resources Defense Council * Sierra Club * The Nature Conservancy
The Wilderness Society * The Wildlands Conservancy

Renewable Siting Criteria for California Desert Conservation Area

Environmental stakeholders have been asked by land management agencies, elected officials, other decision-makers, and renewable energy proponents to provide criteria for use in identifying potential renewable energy sites in the California Desert Conservation Area (CDCA). Large parts of the California desert ecosystem have survived despite pressures from mining, grazing, ORV, real estate development and military uses over the last century. Now, utility scale renewable energy development presents the challenge of new land consumptive activities on a potentially unprecedented scale. Without careful planning, the surviving desert ecosystems may be further fragmented, degraded and lost.

The criteria below primarily address the siting of solar energy projects and would need to be further refined to address factors that are specific to the siting of wind and geothermal facilities. While the criteria listed below are not ranked, they are intended to inform planning processes and were designed to provide ecosystem level protection to the CDCA (including public, private and military lands) by giving preference to disturbed lands, steering development away from lands with high environmental values, and avoiding the deserts' undeveloped cores. They were developed with input from field scientists, land managers, and conservation professionals and fall into two categories: 1) areas to prioritize for siting and 2) high conflict areas. The criteria are intended to guide solar development to areas with comparatively low potential for conflict and controversy in an effort to help California meet its ambitious renewable energy goals in a timely manner.

Areas to Prioritize for Siting

- Lands that have been mechanically disturbed, i.e., locations that are degraded and disturbed by mechanical disturbance:
  - Lands that have been "type-converted" from native vegetation through plowing, bulldozing or other mechanical impact often in support of agriculture or other land cover change activities (mining, clearance for development, heavy off-road vehicle use).[1]
- Public lands of comparatively low resource value located adjacent to degraded and impacted private lands on the fringes of the CDCA:[2]
  - Allow for the expansion of renewable energy development onto private lands.
  - Private lands development offers tax benefits to local government.
- Brownfields:
  - Revitalize idle or underutilized industrialized sites.
  - Existing transmission capacity and infrastructure are typically in place.
- Locations adjacent to urbanized areas:[3]
  - Provide jobs for local residents often in underserved communities;
  - Minimize growth-inducing impacts;

    - Provide homes and services for the workforce that will be required at new energy facilities;
    - Minimize workforce commute and associated greenhouse gas emissions.
- Locations that minimize the need to build new roads.
- Locations that could be served by existing substations.
- Areas proximate to sources of municipal wastewater for use in cleaning.
- Locations proximate to load centers.
- Locations adjacent to federally designated corridors with existing major transmission lines.[4]

High Conflict Areas

In an effort to flag areas that will generate significant controversy the environmental community has developed the following list of criteria for areas to avoid in siting renewable projects. These criteria are fairly broad. They are intended to minimize resource conflicts and thereby help California meet its ambitious renewable goals. The criteria are not intended to serve as a substitute for project specific review. They do not include the categories of lands within the California desert that are off limits to all development by statute or policy.[5]

- Locations that support sensitive biological resources, including: federally designated and proposed critical habitat; significant[6] populations of federal or state threatened and endangered species,[7] significant populations of sensitive, rare and special status species,[8] and rare or unique plant communities.[9]
- Areas of Critical Environmental Concern, Wildlife Habitat Management Areas, proposed HCP and NCCP Conservation Reserves.[10]
- Lands purchased for conservation including those conveyed to the BLM.[11]
- Landscape-level biological linkage areas required for the continued functioning of biological and ecological processes.[12]
- Proposed Wilderness Areas, proposed National Monuments, and Citizens' Wilderness Inventory Areas.[13]
- Wetlands and riparian areas, including the upland habitat and groundwater resources required to protect the integrity of seeps, springs, streams or wetlands.[14]
- National Historic Register eligible sites and other known cultural resources.
- Locations directly adjacent to National or State Park units.[15]

EXPLANATIONS

604259.1

[1] Some of these lands may be currently abandoned from those prior activities, allowing some natural vegetation to be sparsely re-established. However, because the desert is slow to heal, these lands do not support the high level of ecological functioning that undisturbed natural lands do.

[2] Based on currently available data.

[3] Urbanized areas include desert communities that welcome local industrial development but do not include communities that are dependent on tourism for their economic survival.

[4] The term "federally designated corridors" does not include contingent corridors.

[5] Lands where development is prohibited by statute or policy include but are not limited to:
National Park Service units; designated Wilderness Areas; Wilderness Study Areas; BLM National Conservation Areas; National Recreation Areas; National Monuments; private preserves and reserves; Inventoried Roadless Areas on USFS lands; National Historic and National Scenic Trails; National Wild,

Scenic and Recreational Rivers; HCP and NCCP lands precluded from development; conservation mitigation banks under conservation easements approved by the state Department of Fish and Game, U.S. Fish and Wildlife Service or Army Corps of Engineers a; California State Wetlands; California State Parks; Department of Fish and Game Wildlife Areas and Ecological Reserves; National Historic Register sites.

[6] Determining "significance" requires consideration of factors that include population size and characteristics, linkage, and feasibility of mitigation.

[7] Some listed species have no designated critical habitat or occupy habitat outside of designated critical habitat. Locations with significant occurrences of federal or state threatened and endangered species should be avoided even if these locations are outside of designated critical habitat or conservation areas in order to minimize take and provide connectivity between critical habitat units.

[8] Significant populations/occurrences of sensitive, rare and special status species including CNPS list 1B and list 2 plants, and federal or state agency species of concern.

[9] Rare plant communities/assemblages include those defined by the California Native Plant Society's Rare Plant Communities Initiative and by federal, state and county agencies.

[10] ACECs include Desert Tortoise Desert Wildlife Management Areas (DWMAs). The CDCA Plan has designated specific Wildlife Habitat Management Areas (HMAs) to conserve habitat for species such as the Mohave ground squirrel and bighorn sheep. Some of these designated areas are subject to development caps which apply to renewable energy projects (as well as other activities).

[11] These lands include compensation lands purchased for mitigation by other parties and transferred to the BLM and compensation lands purchased directly by the BLM.

[12] Landscape-level linkages provide connectivity between species populations, wildlife movement corridors, ecological process corridors (e.g., sand movement corridors), and climate change adaptation corridors. They also provide connections between protected ecological reserves such as National Park units and Wilderness Areas. The long-term viability of existing populations within such reserves may be dependent upon habitat, populations or processes that extend outside of their boundaries. While it is possible to describe current wildlife movement corridors, the problem of forecasting the future locations of such corridors is confounded by the lack of certainty inherent in global climate change. Hence the need to maintain broad, landscape-level connections. To maintain ecological functions and natural history values inherent in parks, wilderness and other biological reserves, trans-boundary ecological processes must be identified and protected. Specific and cumulative impacts that may threaten vital corridors and trans-boundary processes should be avoided.

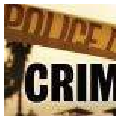
[13] Proposed Wilderness Areas: lands proposed by a member of Congress to be set aside to preserve wilderness values. The proposal must be: 1) introduced as legislation, or 2) announced by a member of Congress with publicly available maps. Proposed National Monuments: areas proposed by the President or a member of Congress to protect objects of historic or scientific interest. The proposal must be: 1) introduced as legislation or 2) announced by a member of Congress with publicly available maps. Citizens' Wilderness Inventory Areas: lands that have been inventoried by citizens groups, conservationists, and agencies and found to have defined "wilderness characteristics." The proposal has been publicly announced.

[14] The extent of upland habitat that needs to be protected is sensitive to site-specific resources. For example: the NECO Amendment to the CDCA Plan protects streams within a 5-mile radius of Townsend big-eared bat maternity roosts; aquatic and riparian species may be highly sensitive to changes in groundwater levels.

[15] Adjacent: lying contiguous, adjoining or within 2 miles of park or state boundaries. (Note: lands more than 2 miles from a park boundary should be evaluated for importance from a landscape-level linkage perspective, as further defined in footnote 12).

Exhibit I

Exhibit I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AIR POLLUTION: Battle still on for clean air

Amid mounting research detailing the harm of bad air, the Inland region still fails to meet federal health standards

BY DAVID DANELSKI / STAFF WRITER

Published: Sept. 5, 2013 Updated: 6:36 p.m.

STAN LIM, STAFF PHOTOGRAPHER

People who have lived for decades in the Inland region describe summer days in the 1960s and â70s when burning eyes and painful lungs were routine, the price paid for living in what was then one of the most polluted regions in the nation.

Few dwelled on the long-term harm of breathing toxic air.

Air quality has improved dramatically since the 1970s, but still, on more than 100 days a year, Southern California is failing to meet clean air standards â" and Inland residents are getting the biggest dose of pollution.

Children appear to suffer the most.

New avenues of discovery show that air pollution not only harms hearts, lungs and sinuses, it also penetrates the bodyâs natural defenses to invade brains and other vital tissues, laying the groundwork for multiple health problems.

Several studies focusing on the consequences of air pollution for Inland children have documented reduced lung function, a greater incidence of asthma and increased medical costs.

Even air considered clean under federal benchmarks may be causing harm.

âAt the current levels we are still seeing health effects,â said Ed Avol, a preventive medicine professor at the University of Southern California medical school. âEverybody breathes, so in terms of the number of people who are affected, we are talking about millions and millions of people.â

LOCAL VIDEO


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Favorite Sherlock Holmes version?

- Basil Rathbone
- Peter Cushing
- Benedict Cumberbatch
- Jonny Lee Miller
- Robert Downey Jr.

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Trending


RIVERSIDE: Former King High star Kawhi Leonard is NBA Finals MVP

The expanding list of serious health consequences is especially troubling in the Inland region, where civic and business leaders struggle to breathe life into an economy crushed in the Great Recession. Inland unemployment is about 11 percent, worse than the stateâs 8.7 percent and nationâs 7.4 percent.

unhealthful.days.chart

Some business and local government leaders say warehouses are the best answer, because of the regionâs location, its freeways and rail lines, its cheap land and its vast need for jobs that can be filled by workers without a college education. Moreno Valley, with ample land available, has made warehouse construction one of its main economic development goals.

The down side is that warehouses bring diesel truck traffic.

Diesel trucks, ships, locomotives and other cargo-handling equipment account for about half the ozone and fine-particle pollution in the Inland region â" and 93 percent of the regionâs cancer risk from air pollution, according to the South Coast Air Quality Management District.

air.fallingshortvideo

The Inland region is hit especially hard by pollution because of weather patterns and topography. Emissions from ships, trucks, cars, construction equipment, power plants, refineries, manufacturing, dry cleaners, paint, lawnmowers and other sources throughout Southern California blow east with sea breezes. Blocked by the San Bernardino Mountains, the airborne muck collects over the Inland area, cooking in the sunlight to become more harmful.

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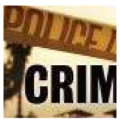

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In 2012, the annual averages for fine-particle pollution, a category that includes diesel soot, exceeded the federal clean air standards at monitoring stations in Mira Loma and Rubidoux in northwest Riverside County and Fontana and Ontario in western San Bernardino County.

Ozone, a corrosive gas, exceeded the federal standard 111 times somewhere within Southern Californiaâs sea-to-mountains air basin in 2012. The most violations were in Riverside and San Bernardino counties, including 80 unhealthful days in Redlands, 47 in Jurupa Valley and 46 in Perris.

People living closest to freeways, busy streets and rail yards get the worst of it. Because of the increased health risks, air district officials recommend that homes and schools be located at least 500 feet from freeways and other heavy traffic areas.

The science documenting the harm of air pollution is vast.

Itâs not just lungs that are affected. Like a Trojan horse, pollution carried inside the body in the simple, constant and necessary act of breathing is penetrating natural defenses and triggering an array of consequences

In children, pollution can sabotage the biochemistry vital to the development of growing organs. In the womb, pollution is a suspected factor in miscarriage, birth defects and autism. And in a childâs formative years, breathing difficulties can develop and other diseases may take root in the brain and elsewhere.

Learning deficits have been found in children living in polluted areas. And new research finds that pregnant women exposed to certain pollution are more likely to have children who become obese, a condition with its own disease complications.

Children hurt by air pollution can face chronic illnesses, such as asthma, and a shorter lifespan than their own genes might have predicted.

Adults can suffer lung damage, cancer, heart disease, heart attacks, strokes and other illnesses.

freeway.graphic

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RAIL YARD REALITY

Increasing volumes of cargo flowing from the sea ports in Los Angeles have put more trucks on the freeways and more trains on rails â" major veins in the nationâs commerce network. Some 80 freight trains pass through the Inland area daily, and the number is expected to increase as the economy improves.

Researchers from USC and Loma Linda University have visited Inland schools and homes over the years, taking medical histories and measuring lung function. Their conclusions: Asthma and reduced lung capacity afflict a greater percentage of children in areas with higher concentrations of air pollution.

In southwest San Bernardino, a team put together by Loma Linda University ran tests last year on nearly 500 school children who live in a neighborhood that shares property lines with a BNSF Railway cargo-transfer yard.

It had been a locomotive repair and maintenance station yard that was revamped in 1995 to be a hub for cargo transfers between trains and trucks. In 2008, a state analysis found that diesel pollution from trucks, trains and yard equipment exposed the neighboring community to the highest cancer risk of all the rail yards in the state.

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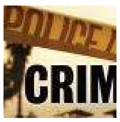

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Almost half the children examined had symptoms of asthma or had been diagnosed with it â" twice the rate of children who lived five miles away in Fontana. By comparison, San Bernardino Countyâs childhood asthma rate is about 15 percent; the national rate is about 9 percent.

During a public presentation earlier this year, Rhonda Spencer-Hwang, an assistant professor at the Loma Linda University public health school who helped conduct the study, said she was alarmed by the findings, especially since many of the children were not being treated.

The study is pending publication in a scientific journal.

BNSF, which has questioned the researchersâ findings and methods, has invested more than $24.5 million to reduce air pollution at the San Bernardino yard and elsewhere in California.

The yard uses the newest and cleanest switch engines, the light-duty locomotives used to move rail cars to assemble freight trains.

The company has deployed its newest, cleanest locomotives to California at a cost of $1.8 billion, said Lena Kent, a BNSF spokeswoman.

The railroad also put new, lower-emissions diesel engines in 12 cranes used to lift 40-foot steel cargo containers as theyâre moved to trucks or freight trains.

BNSF has invested millions more making changes to reduce the amount of time trucks spend idling in the rail yard; training employs in more efficient practices; and taking other pollution-cutting measures, Kent said.

The changes have slashed pollution from the yard by 54 percent since 2005, Kent said.

Residents of the neighborhood believe the air is still making them sick.

Unhealthy.air.chart

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Today's Poll

What's this?

Are legendary In-N-Out hamburgers overrated?

- No. The chain serves superb hamburgers worthy of their fame.
- Yes. They are overrated. With their small patties, they are mediocre at best.
- Don't know. Never eat them.

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Trending RECOMMENDED FOR YOU

LAKE ELSINORE: Motorcyclist


RIVERSIDE: Former King High star Kawhi Leonard is NBA Finals MVP, June 14

... crashed in Lake Elsinore. According ...

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Cecila Hernandez, 52, is raising her son, Fernando, 12, and a grandchild, Daniella, 5, in a mobile home a half block from the rail yardâs fence.

The children take medications for cold-like symptoms that never seem to go away, she said.

âDaniella just keeps sneezing and sneezing, and her nose runs like water,â Hernandez said in Spanish. âThey say it is the environment, that it is the contamination in the air.â

Fernando said he often avoids playing outdoors, because he gets the urge to sneeze and starts to feel ill when he is outside the familyâs home.

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LAKE ELSINORE: Motorcyclist dies in crash

A man died Saturday afternoon, June 14 after his motorcycle crashed in Lake Elsinore. According ...

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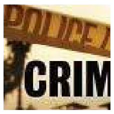

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A few doors down, Soledad Serapio,13, said she takes medication for chronically burning eyes and coughing. Her mother, Nohemi Hernandez, lamented that many trucks idle on a dirt lot next to the trailer park.

TOUGH BUSINESS ENVIRONMENT

It is up to elected officials, with input from experts and the public, to weigh the risks and benefits of warehouses and decide what is right for the Inland region. Warehouses already have proliferated along freeways in western San Bernardino and Riverside counties and on former dairy land in Jurupa Valley.

Trucking, railroad and warehouse industry officials say air pollution reduction efforts threaten a necessary and job-creating sector of the economy.

California, for instance, has set an aggressive schedule for diesel truck owners to switch to newer models or retrofit their vehicles with special filters to cut diesel pollution. The rules cost the stateâs trucking industry about $1 billion a year, said Michael D. Shaw, vice president of external affairs for the California Trucking Association.

Truckers have been forced to give up older trucks that are still strong road warriors or pay $10,000 to $20,000 to retrofit them, he said.

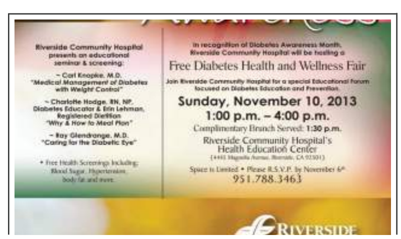
âWe are very willing to do our part to reduce emissions and clean up the air,â Shaw said. âTrucks are 98 percent cleaner than they were 30 years ago.â

Truckers serving the Los Angeles County ports now must drive a 2007 model or newer.

In Moreno Valley, developer Iddo Benzeevi has said he welcomes input from air district officials on how make his proposed 41.6-million-square-foot warehouse complex as environmental friendly as possible.

Plans under consideration would allow only newer trucks to serve the World Logistics Center, as his project is known. He also plans to provide natural-gas fueling facilities and other clean-air measures.

Industry officials say they are frustrated that air pollution rules keep getting tougher every time the U.S. Environmental Protection Agency revises health standards for various pollutants.



Inland economist John Husing blames such regulations for driving manufacturers out of Southern California. He contends that such regulations and community opposition now threaten the transportation and warehousing industries that the Inland region needs to provide thousands of jobs for workers without college educations.

Dora Barilla, an assistant professor at Loma Linda Universityâs school of public health, said the Inland region needs a balanced approached as it looks for ways to reduce air pollution.

Warehouses may attract polluting big-rig trucks, but they also provide jobs to help move people out of poverty, said Barilla, who has asthma. Poverty leads to poorer community health, she said.

âWe need to bring together the different factions and have a rational discussion on how improve the environment as well as provide job growth,â Barilla said in an interview.

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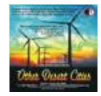

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International City Theatre, Long Beach

Farnell Newton - Jill Scott BUY
Wednesday, Jun 25, 7:00 pm
Fox Performing Arts Center, Riverside

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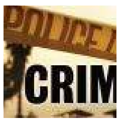

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She added that a big part of the equation is improving education among the poor.

VULNERABLE BRAINS

A decade ago in Mexico City, Lilian CalderÃ³n-GarciдueÃ±as , a neuropathologist-toxicologist, started investigating the effects of Mexico Cityâs severe pollution on the brains of young dogs. She found that microscopic particles were able to move through the snouts of canines and into their brains â" penetrating a defensive line called the blood-brain barrier.

She next began looking at childrenâs brains, through brain scans or by examining the brains of children who had died accidentally. She concluded that the brains of children exposed to high levels of pollution showed some of the same changes observed in the brains of people in the early stages of Alzheimerâs and Parkinsonâs diseases.

Pollution may cause problems in childrenâs brains as the gray and white matter is growing, CalderÃ³n-GarciдueÃ±as said in an interview earlier this year with Montana Public Radio.

âIf anything goes wrong with these children at that period, you will have serious health effects later on,â said CalderÃ³n-GarciдueÃ±as, an assistant professor at the University of Montanaâs medical school.

She said the children exposed to high pollution levels could face intelligence and attention deficits.

In a 2012 article in âFrontiers in Psychology,â CalderÃ³n-GarciдueÃ±as and co-author Ricardo Torres-JardÃ³n advocate for a concerted effort to take better care of children, especially poor children, through better education, improved nutrition and less pollution in their environments.

âUnfortunately, while we wait for governmental sectors to address these endemic issues, there are no coverings for our childrenâs noses, nor for their lungs, hearts or vulnerable brains,â she wrote.

LOCAL VIDEO


EASTVALE: Mother of hit-run victim talks about arrest


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FOOTBALL: USC Head Coach Steve Sarkisian Talks To Players at The Kumite


FOOTBALL: USC Head Coach Steve Sarkisian at the Prime Time Polynesian "Kumite"


BASEBALL: CIF-SS Baseball Finals Recap

Trending


RIVERSIDE: Former King High star Kawhi Leonard is NBA Finals MVP

Many researchers have focused on freeway pollution.

Official air-monitoring stations are deliberately placed away from busy roadways, where pollution is highest, so that an areaâs ambient pollution isnât skewed by traffic emissions that tend to disperse within a few hundred yards.

In one study, rats exposed to freeway pollution in Riverside showed the earliest signs of brain tumors. The brains cells of the animals started producing genes associated with tumors. Whatâs not known is whether the bodyâs immune system can stop the tumors from developing, said Michael Kleinman, a UC Irvine environmental toxicology professor and co-author of the study.

kidssickvideo

Several recent studies have linked a womanâs exposure to pollution during pregnancy to a higher risk of having an autistic child.

The disorder strikes an estimated 1 in 50 children and, depending on the severity, can bring heartache for families and elevated costs for schools.

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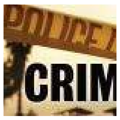

NEWS

AIR POLLUTION: Battle still on for clean air

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Published: Sept. 5, 2013 Updated: 6:36 p.m.

UCLA public health researchers studied records of more than 7,000 women in Los Angeles County. Those exposed to higher estimated air pollution levels during their pregnancies had a 12 to 15 percent greater chance of having an autistic child, according to the study published in March.

The results substantiated an earlier USC study that found children born to mothers living within about 300 yards of a freeway appeared to be twice as likely to have a child who developed autism.

In June, Harvard University researchers provided even more evidence supporting a link between air pollution and autism.

Based on a nationwide study, Harvard scientists found that women who live in areas with polluted air have as much as twice the chance of giving birth to an autistic child than those living in communities with cleaner air.

FAT CHILDREN

One of the newest avenues of study is air pollutionâs possible role in obesity. Like autism, itâs a condition that has multiple causes and an array of related problems. In California, about 17 percent of low-income preschoolers are obese, according to a recent analysis by the U.S. Centers for Disease Control and Prevention.

Researchers with Columbia University's Mailman School of Public Health found that when pregnant women exposed to higher levels of a type of air pollution called polycyclic aromatic hydrocarbons, or PAHs, their children were about twice as likely to become obese.

PAHs are hydrocarbons released when fuel burns.

The researchers followed 763 non-smoking African-American and Hispanic women whose children were born in the Bronx or Northern Manhattan between 1998 and 2006.

Each participant wore a small backpack containing a portable air monitor during her third trimester. They kept the monitors at their bedsides when they slept.

When the children reached their seventh birthdays, one-fourth of them were obese â" the children exposed to higher pollution levels were twice as likely as the others to be obese.

âHigher prenatal PAH exposures were significantly associated with higher childhood body size,â said a paper published last year in the American Journal of Epidemiology.

The authors said laboratory studies have shown that PAHs interfere with the process of lipolysis, the breaking down of fats inside the body. The less fat a person can break down, the more it stays in the body.

Air pollutionâs possible role in obesity and diabetes is an emerging area of discovery, and much more study is needed before itâs certain pollution causes or contributes to such health problems, said Avol, the USC scientist.

But its link to heart disease, lung cancer and other illness is well established.

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A goup of property owners, builders and others say the coastal California gnatcatcher is plentiful in Mexico, and doesn't need to be protected.

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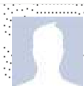

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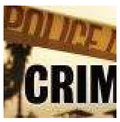

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AIR POLLUTION: Battle still on for clean air

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Published: Sept. 5, 2013 Updated: 6:36 p.m.

When the EPA last year set a more stringent health standard for fine-particle pollution, its official statement said that âthousand of studies show particle pollution can harm human health.â

The agency summarized the volumes of research by saying that particle pollution shortens lives by impeding the function of blood vessels, leading to heart attacks, stroke and congestive heart failure.

In children and adults alike, the EPA said, it aggravates chronic respiratory diseases and causes short-term bouts of coughing, wheezing and shortness of breath.

LIFE AMONG WAREHOUSES

The literal fallout of poor public planning â" decision-making that put residents in the path of harmful pollution â" is plainly evident in a neighborhood called Mira Loma Village in northwest Riverside County.

The villageâs 101 homes, built in the late 1950s and early 1960s, are surrounded by a 15-square-mile warehouse district that grew up around them in the Jurupa Valley, Ontario and Fontana.

The people who live there talk about illnesses and irritations they blame on the soot that invades the neighborhood.

Shortly after President Richard Nixon signed the Clean Air Act in 1970, maintenance worker Gene Proctor bought a small home in the neighborhood and started raising a family. For Proctor, the landmark law has been an empty promise.

He and many of his neighbors say their air quality actually got worse during the past 20 years as they watched the farm fields and dairies around their homes disappear, to be replaced by warehouses. Mira Loma Village does not have an air-monitoring station, but the regionâs air quality district confirms that truck traffic degraded the air in Riverside County between 1998 and 2005.

Diesel trucks hauling cargo to and from the warehouses incessantly roll up and down Etiwanda Avenue just outside the block wall surrounding the tract. Highway 60 is a block to the south, and Interstate 15 is a mile and half to the west.

The diesel soot leaves a fine black film that residents wipe from clothes lines and hose off of patios and cars.

For Proctor, now 72, retirement in 2006 from his job in Fullerton meant giving up jogging, since he could no longer run in the much cleaner air near the Kimberly-Clark factory where he worked.

Running at home was out of the question.

âIf youâre able to run a seven-minute mile, here it takes you nine minutes,â he said, leaning on a chain link fence outside his home. âYou feel a weight. My lungs would tighten up. And my heart would feel like it was going to jump out of my chest.â

Respiratory ailments have many causes, and itâs difficult to say with certainty that air pollution is to blame for a particular personâs illness. But some in Mira Loma Village believe the diesel fumes are making them sick.

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Published: Sept. 5, 2013 Updated: 6:36 p.m.

Norma Rivera, who lives five doors from Proctor, said in Spanish that she, her husband and 12-year-old daughter all have breathing problems.

âAs traffic went up, our symptoms went up,â Rivera said.

She worries about Miguel Jr., her 4-year-old son.

âHe gets really bad allergies,â she said. âThey (doctors) give him medication.â

His symptoms have taken away some of the simple joys of childhood.

âWhen he runs around too much, he starts coughing. I canât let him go out too often,â his mother said.

The boy loved to jump on a trampoline. âI had to take it away because he would be coughing a lot,â she said.

Another resident, Socorro Ledezma, said she moved from Orange County about 18 years ago.

âIt was more open and much quieter, and less people,â she said in Spanish. âBut now, with all the warehousing, the traffic exhaust has been awful.

âWhen it is foggy and the cars get wet, you see the black stuff on the cars and on the concrete. â¦ It is black when you wash off the car or the patio.â

Allergies worsened as truck traffic increased, and now she frequently feels ill

âIt started about 15 years ago,â she said. She used to get by with medications she could buy over the counter, but no longer. âNow I have to see the doctor to get prescription drugs for the allergies. I have eye drops for my eyes. And I have the nose spray. And I take pills.â

Her voice broke as she described how the ailments have changed her daily life. Itâs difficult to do housework, or visit people or go to parties because of her constantly running nose and other symptoms.

Sometimes she feels better. âBut it just keeps coming back again.â

DEVELOPMENT ON A ROLL

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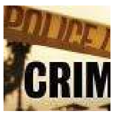

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Published: Sept. 5, 2013 Updated: 6:36 p.m.

Cleaner air is an elusive goal for Mira Loma Village. Warehouses canât function without the trucks that serve them. And more warehouses are on the way.

Already approved is Mira Loma Commerce Center, a complex of 1.1 million square feet of warehouse and industrial space on 65 acres just northeast of Mira Loma Village. It is expected to generate 1,500 truck trips a day.

air.warehousevideo

A settlement this year of a lawsuit over the projectâs environmental reviews requires the developer to pay $1,700 per home to install air filtering systems in every home in the tract.

The residents at least will have safe indoor air, said Penny Newman, executive director of the Center for Community Action and Environment Justice, which helped negotiate the settlement. Just as important, she added, are plans under review by Jurupa Valley city officials to route trucks away from the neighborhood.

Proctor said he has mixed emotions about the air filters. âI think they (warehouse developers) are just throwing us a bone. What are the kids going to do? Are they going to spend 24-7 indoors?â

Proctor, who said he hasnât smoked in more than 40 years, said he has had trouble breathing and visited a doctor recently. Lung X-rays indicated he may have emphysema, a disease caused by damage to lung tissue. He has been putting off follow-up medical exams.

âI donât want to face the music,â he said. âIt is too late for me.â

Rachel Lopez of Jurupa Valley provided Spanish interpreting for this article.

This report was produced in part with a grant from the Lucile Packard Foundation for Children's Health Journalism Fund, awarded by The California Endowment Health Journalism Fellowships at the USC Annenberg School of Journalism.

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Today's Poll What's this?

Are legendary In-N-Out hamburgers overrated?

- No. The chain serves superb hamburgers worthy of their fame.
- Yes. They are overrated. With their small patties, they are mediocre at best.
- Don't know. Never eat them.

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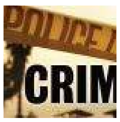

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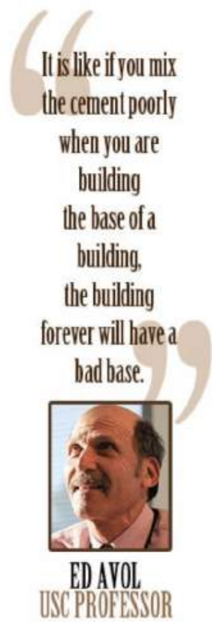
HEALTH: Children are more vulnerable to air pollution effects

Children breathe more air per pound of body weight than adults

BY DAVID DANELSKI / STAFF WRITER
Published: Sept. 5, 2013 Updated: 3:36 p.m.

STAN LIM, STAFF PHOTOGRAPHER

Biologically speaking, âchildren are not just little adults,â says Ed Avol, a USC preventive medicine professor and member of national science committee that advises the U.S. Environmental Protection Agency on outdoor air health standards.



Because their brains and other organs are still developing, the toxic effects of pollution can cause damage that has the potential to affect them for the rest of their lives.

âIt is like if you mix the cement poorly when you are building the base of a building, the building forever will have a bad base,â Avol said.

Â

Children also get a bigger dose of whatever is in the air:

Compared with adults, they breathe more air per pound of body weight.

They also spend more time outside and are more physically active, which further increases their exposure to air pollution.

Their internal air passageways are smaller, which means more lung tissue surface is exposed per volume of air.

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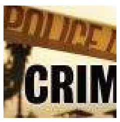

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POLLUTION: Microscopic particles can cause internal havoc

Tiny bits of soot can invade tissues, triggering a series of defenses that can lead to inflammation and disease

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Favorite Indiana Jones movie?

- "Temple of Doom"
- "The Last Crusade"
- "Raiders of the Lost Ark"
- "Kingdom of the Crystal Skull"

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BY DAVID DANELSKI / STAFF WRITER

Published: Sept. 5, 2013 6:38 p.m.

STAN LIM, STAFF PHOTOGRAPHER

Between the moment when a microscopic piece of soot flies out of a tailpipe or smokestack and enters a personâs lungs, it undergoes an array of complex chemical reactions.

It essentially becomes an airborne vessel make of black âelementalâ carbon that can carry hundreds of varieties of toxic compounds.

As the soot travels with sea breezes and churns above streets, homes, campuses, workplaces and shopping centers, it reacts with other pollutants in a process aided by sunlight, said Michael Kleinman, environmental toxicology professor at UC Irvine.

Kleinman has been studying the journeys and transformations of airborne particles for decades. He spent many of the Cold War years probing the behavior of radioactive fallout for the federal government.

AIR OF RISK A PRESS-ENTERPRISE PE.com SPECIAL REPORT BACK TO MAIN INDEX

When soot particles encounter ozone â" an invisible gas created when other pollutants combine in sunlight â" one of the outcomes is the creation of especially toxic oxygen-containing compounds called quinones, he said.

An epic battle begins when the particles are inhaled. The invaders are so small that they penetrate the bodyâs first lines of defense â" the nasal passage and the lungs, which normally send in a bath of fluids to help a person cough or snort out harmful substances.

They are so tiny they pass through lung tissue and enter the bloodstream, a highway that carries them to other tissues and organs, including the brain.

The bodyâs immune system rallies to fight back.

âThe inflammatory cells now come out,â Kleinman said. âIt is almost like an army. These guys will attack anything that is foreign.â

Cells called macrophages come first. They try to engulf and digest the intruders. Then the body sends in the second line of defenders: the more aggressive neutrophils, white blood cells on a suicide mission to stop the invasion. The neutrophils make âoxygenated and nitrogen compounds that can literally burn a pathogen and destroy it,â Kleinman said.

The cellular battle, however, generates collateral damage.

The invaders may be neutralized, but free radicals â" unstable atoms or molecules created during inflammation to help destroy the invading particles â" can begin attacking and harming healthy cells. The process can trigger a chain reaction of cell injury.

âFree radicals are associated with cancer and heart disease, and brain disease,â Kleinman said.

Free radicals can damage fat cells and create plaque in blood vessels. Too much plaque leads to heart attacks and stroke.

The best defenses for people who canât avoid air pollution are common-sense: minimize exposure as much as possible â" avoid diesel fumes; donât exercise when pollution levels are higher; and maintain a healthful lifestyle by eating wisely, exercising and not smoking.

This report was produced in part with a grant from the Lucile Packard Foundation for Children's Health Journalism Fund, awarded by The California Endowment Health Journalism Fellowships at the USC Annenberg School of Journalism.

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CLEAN AIR: A promise still elusive for Inland region

The federal Clean Air Act of 1970 prompted changes that led to dramatic air quality improvements, but some Inland communities still don't meet standards

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BY DAVID DANELSKI / STAFF WRITER

Published: Sept. 5, 2013 6:39 p.m.

FILE PHOTO

Guaranteeing healthful air for all Americans was a political no-brainer for Congress back in 1970.

The Clean Air Act spurred a new era of tailpipe and smokestack regulations and had bipartisan support unheard of today. It sailed through the House and Senate with just one dissenting vote. President Richard Nixon signed it eagerly.

âThis is the most important piece of legislation, in my opinion, dealing with the problem of clean air that we have this year and the most important in our history,â Nixon said at the bill signing ceremony.

Nixon had created the U.S. Environmental Protect Agency earlier that year.

At the time, public attention focused on smog-choked Southern California, on Midwest rivers so polluted that they caught fire, and on the devastating effects of pesticides like DDT on eagles and other wildlife

Nixon felt that a strong federal role in cleaning up the environment was a political inevitability, so he embraced it, said S. David Freeman, who was an attorney in the Nixon administration and later served as the head of the Los Angeles Department of Water and Power.

Nixonâs motives also were political, Freeman said an interview. The president feared that if he didnât take strong actions to protect the environment, Democrats would seize the issue and use it against him in the 1972 election.

quote

The Clean Air Act set health standards, which are essentially legal limits, for various pollutants in all regions of the nation.

President Jimmy Carter later amended the act by requiring the EPA to review scientific studies on air pollution health effects every five years and then adjust the health standards for each major pollutant as needed to protect people.

One of the most persistent air pollutants in Southern California is ozone, a lung-irritating, corrosive gas that forms when airborne emissions cook in the summer heat. The current health standard for ozone â" .075 parts per million parts of air averaged over eight hours â" was set by the George W. Bush administration in 2008.

President Barack Obama angered environmentalists in 2011 by delaying the EPAâs plan to impose a tougher ozone standard recommended by the agencyâs science advisers. The panel of scientists from around the nation reviewed scientific research and concluded that the Bush standard didnât sufficiently protect people.

Obama said in 2011 that he wanted to wait until this year to give the economy time to improve. Now the EPA isnât expected to propose a new standard until sometime next year.

So far in 2013, ozone levels in Southern California have surpassed the current ozone standard on 83 days. The smog season got off to a fast start â" in June, only two days met the federal ozone standard in the air basin between the Pacific Ocean and the San Bernardino Mountains.

project_bar

Riverside as seen from Box Springs Mountain. Ozone levels in Southern California have surpassed the current standard of 83 days so far this year.

The region faces a 2024 deadline to meet the ozone standard every day.

The most recent data also shows that the average levels of fine-particle pollution still exceed the federal standard in Mira Loma, Rubidoux, Fontana, Ontario, South Central Los Angeles and parts of the San Gabriel Valley. Fine particles are linked to heart attacks, brain ailments and shorter lives, among other harm.

We have a long way to go before we realize the vision of the Clean Air Act, Freeman said.

Failure to meet health standards means that some people are getting sick and dying from the air they breathe, Freeman said in an address to health and environmental journalists last year at USC.

A Massachusetts Institute of Technology study released this month estimated that more than 200,000 people die each year because of air pollution.

âThe house is still burning down,â Freeman said, yet âThere is no sense of urgency.â

This report was produced in part with a grant from the Lucile Packard Foundation for Children's Health Journalism Fund, awarded by The California Endowment Health Journalism Fellowships at the USC Annenberg School of Journalism.

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NEWS

CLEAN AIR: Reducing air pollution extends lives

Researchers have seen measurable improvements in longevity when fine-particle pollution dropped

BY DAVID DANELSKI / STAFF WRITER

Published: Sept. 5, 2013 4:09 p.m.


STAN LIM, STAFF PHOTOGRAPHER

Air quality improvements can be measured in human health.

Douglas Dockery, epidemiology department chair at Harvard Universityâs School of Public Health, was among the researchers who discovered that more people die on days when fine-particle pollution is high. The finding, made in the 1990s, helped persuade the Clinton administration to set clean-air standards for fine particles, despite industry objections about the potential costs.

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In a recent interview, Dockery said he is upbeat about how overall health is improving as fine-particle levels drop in the nationâs urban areas.

In a paper published this year in the journal âEpidemiology,â Dockery and his colleagues found that people are living longer because of the reductions.

The researchers analyzed lifespan and pollution data from 2000 and 2007 gathered from 545 counties throughout the nation. They accounted for other factors such as cigarette smoking, demographics and socioeconomic status.

People on average lived four months longer when fine-particle pollution dropped by 10 micrograms per cubic meter of air. Since particle pollution is decreasing in Southern California, residents are enjoying longer lives, Dockery said.

Based on data from the South Coast Air Quality Management District and Dockeryâs finding, Inland area residents could be living four to six months longer than the population did a decade ago.

Further pollution reductions would bring additional benefit, Dockery added.

His data also showed that when pollution levels dropped in areas that already meet federal health standards, people in those places lived longer, too.

One study found that cutting air pollution, in addition to improving health and longevity, also produced economic benefits.

In 2003, pollution controls were installed at coal-fired power plants in the East that greatly reduced nitrogen oxide emissions.

A collaboration among UC Santa Barbara and Massachusetts Institute of Technology economists tracked the air quality and various statistics, discovering that the improvements made a noticeable difference.

After five years, the number of days of unhealthful ozone pollution in 18 Eastern states declined by about 25 percent, and spending on prescription drugs dropped in those states by $900 million annually, the study found. Most of the savings were the result of lower demand for heart and respiratory medications.

They also found that people lived longer, boosting the Eastern statesâ economies by $900 million annually.

This report was produced in part with a grant from the Lucile Packard Foundation for Children's Health Journalism Fund, awarded by The California Endowment Health Journalism Fellowships at the USC Annenberg School of Journalism.

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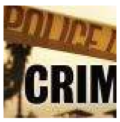

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- "Scarface"
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Trending

RIVERSIDE: Former King High star Kawhi Leonard is NBA Finals MVP

BY DAVID DANELSKI / STAFF WRITER

Published: Sept. 6, 2013 Updated: Sept. 7, 2013 2:01 a.m.

STAN LIM, STAFF PHOTOGRAPHER

Jose Rodriguez cared for calves at Inland dairies for about 20 years, until an exodus of the farms from Chino, Ontario and Jurupa Valley left him looking for work.

After some construction jobs, he saw a chance for a new career. In 2001, he spent about $2,000 for training to become commercial driver and soon was hired by a trucking company.

He saved his money and, in 2004, bought a truck â" a 2000 model Peterbilt tractor with a flatbed trailer â" and went into business for himself. He has since added a second truck, providing work for a cousin and his son, Roberto, who is a student at Cal State San Bernardino.

âThis is better,â Rodriguez, 53, said of his trucking business. On this day, he was headed east from Los Angeles on Highway 60, on his way to Phoenix with a load of heavy machinery strapped to his flatbed.

âI make more money, and I can sometimes take two or three days off,â he said.

Rodriguez can attest that the flow of goods through the Inland region provides job opportunities. He also knows that cutting air pollution from trucks is a priority â" and, in some cases, a hardship.

He has until Jan. 1 to retrofit his Peterbilt with a state-approved particle trap that will greatly cut the truckâs soot emissions.

As he navigated late-afternoon traffic in the San Gabriel Valley, he said he didnât know whether it be would better for him to invest in a new truck or buy the particle trap.

He eventually opted for the filter, which will cost him about $15,000, said his son, Roberto. âWe are going to have to finance it. We have to have working capital.â

The particle traps are required under California AirResource Board rules approved in 2008. They call for a phase-in of truck and bus particle traps or replacement of older vehicles; the goal is a 90 percent reduction in toxic diesel soot emissions by 2023.

project_bar

Jose Rodriguez prepares his truck for a job. California Air Resource Board rules call for a phase-in of costly truck and bus particulate traps or replacement of older vehicles.

State officials estimated the new rules would cost the California trucking industry $5.5 billion by 2023, but the California Trucking Association said the cost would be much higher, as much as $1 billion a year.

The resulting pollution cuts are expected to save about 9,400 lives in California between 2010 and 2025 and at least $48 billion in illness-related costs, according to air board estimates.

Jose Rodriguez has little trouble staying busy, a testament to the tremendous volume of goods that need to be moved through Southern California every day.

During one week earlier this year, he picked up a load of pipe in Rialto and hauled it to Idaho. After making the delivery, he took on a shipment of composite decking material in Meridian, Idaho, and by Thursday, he had delivered it to a Home Depot warehouse in La Mirada.

Then it was off to Long Beach to load up and secure several tarp-shrouded heavy machines from China. Getting the machines on board and tied down took about three hours.

With extra room left on flatbed, he headed to Fullerton, intending to retrieve additional cargo.

He changed direction, however, when Roberto, his son, advised him by cell phone of a better opportunity. By checking Internet listings of loads available for independents, Roberto Rodriguez found a better-paying load in Los Angeles, where plastic containers of boiler cleaning fluids were destined for Phoenix.

Roberto Rodriguez said he finds loads for others truckers, too, allowing him to earn brokerage fees.

His father had been gone about 12 hours by the time he returned to a truck yard in Jurupa Valley to drop off his rig. After a dinner break, he would head east to Phoenix after dark to make his deliveries. And his son was on a hunt for a load to take back California the next day.

âEconomically, we live better because he works as a truck driver,â his wife, Maria, said in Spanish through an interpreter. âBut it is hard because â¦ he works longer is gone more.â

This report was produced in part with a grant from the Lucile Packard Foundation for Children's Health Journalism Fund, awarded by The California Endowment Health Journalism Fellowships at the USC Annenberg School of Journalism.

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NEWS

AIR POLLUTION: Winning the battle involves government, technology, lifestyle

Cleaning up Southern California's requires an array of changes; in the meantime, residents can protect themselves with healthy choices

BY JANET ZIMMERMAN / STAFF WRITER

Published: Sept. 6, 2013 Updated: 4:57 p.m.

STAN LIM, STAFF PHOTOGRAPHER

Much has been done to improve air quality in recent decades, but more work is needed to reduce levels of the Inlandâs worst pollutants â" nitrogen oxides, ozone and particulate matter â" that threaten residentsâ health, regulators said.

Federal, state and regional air quality officials have imposed rules to reduce emissions from cars, diesel trucks and buses, refineries, power production, factories and even nail polish and fireplaces. In the coming years, there will be further changes to the cars we drive and the way our communities are laid out to facilitate walking and ease congestion.

One of the key measures by the regionâs air pollution control agency, the South Coast Air Quality Management District, is a residential wood-burning ban when air quality reaches unhealthful levels, spokesman Sam Atwood said.

Harmful fine-particle pollution, known as PM2.5, is released when wood is burned in fireplaces; it is similar to the soot from diesel engines. The âCheck Before You Burnâ program took effect in 2011, but rules will be tightened this fall to further limit when residents can light a fire at home between November and February.

The air district is developing its 2015 air quality management plan for ozone. The driving force behind the document is an ambitious vision for the next 20 years and beyond of low- to no-emission standards for just about everything, Atwood said.

Among other efforts:

--The air district is helping develop a one-mile demonstration project for zero-emission truck lanes in the Port of Long Beach and along Interstate 710. In the port, trucks would run on overhead electric catenary lines, like those used to power light-rail trains; they would burn compressed natural gas while on the road.

Bruce MacRae, vice president of government affairs for UPS, introduces the company's new fleet of electric delivery trucks in July. A 2010 study has found that powering cars with electricity instead of gasoline would reduce smog-forming volatile organic compounds by 93 percent and nitrogen oxides by 31 percent.

--Expect a switch from gasoline-powered cars and trucks to more electric vehicles and plug-in hybrids. A 2010 study by the U.S. Department of Energyâs Pacific Northwest National Laboratory found that powering cars with electricity instead of gasoline would reduce smog-forming volatile organic compounds by 93 percent and nitrogen oxides by 31 percent.

--The future will bring increased generation of power from renewable sources such as solar and wind to reduce the burning of fossil fuels in energy production that contribute to emissions of nitrous oxides, ozone and fine particles.

Under state law, utilities are required to have 20 percent of their retail sales from renewable sources by the end of this year, 25 percent by the end of 2016 and 33 percent by the end of 2020.

--In the works is a change in land-use planning that minimizes residentsâ exposure to road and industrial pollution through thoughtful placement of schools, homes and industry.

The Southern California Association of Governments, the policy and planning organization for six counties and 191 cities, is implementing Senate Bill 375, which encourages âmore compact, complete and efficientâ communities to reduce driving.

quote

âReducing air pollution in the region takes a coordinated effort,â said Hasan Ikhrata, the associationâs executive director. âTechnology like zero-emission cars and solar panels are important. But we also need to look at ways to reduce congestion and give people more transportation choices. This involves locating housing closer to employment centers or transit centers, or investing in infrastructure to make sure that the capacity can meet the demand.â

In the meantime, individuals can take steps to protect themselves from the effects of air pollution, such as eating healthy foods and not living or exercising near busy roadways, experts said.

In a study last year, doctors at the Imperial College of London found that vitamin C, an antioxidant, can neutralize free radicals that contribute to cancer and respiratory diseases such as asthma and chronic obstructive pulmonary disorder.

Dr. Lilian Calderon-Garciduenas, an environmental toxicology professor at the University of Montana, has studied children living in highly polluted areas. She found inflammation of the brain, similar to the process involved in developing Alzheimerâs and Parkinsonâs diseases. The children also exhibited cognitive deficits and structural brain abnormalities and had respiratory and cardiovascular damage.

To combat such problems, Calderon-Garciduenas recommends providing children with good quality food, reading and physical exercise to stimulate their brains, and to reduce their exposure to passive activities such as video games.

Elsewhere, she had recommended that people exposed to pollution consume foods high in anti-oxidants, such as broccoli and dark chocolate, she said in an interview with Montana Public Radio.

Exhibit J

Exhibit J

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Copyright © 2010 American Heart Association, Inc. All rights reserved.
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Robert D. Brook, MD, Chair; Sanjay Rajagopalan, MD; C. Arden Pope III, PhD;
Jeffrey R. Brook, PhD; Aruni Bhatnagar, PhD, FAHA; Ana V. Diez-Roux, MD, PhD, MPH;
Fernando Holguin, MD; Yuling Hong, MD, PhD, FAHA; Russell V. Luepker, MD, MS, FAHA;
Murray A. Mittleman, MD, DrPH, FAHA; Annette Peters, PhD; David Siscovick, MD, MPH, FAHA;
Sidney C. Smith, Jr, MD, FAHA; Laurie Whitsel, PhD; Joel D. Kaufman, MD, MPH; on behalf of the
American Heart Association Council on Epidemiology and Prevention, Council on the Kidney in
Cardiovascular Disease, and Council on Nutrition, Physical Activity and Metabolism
Abstract**—**In 2004, the first American Heart Association scientific statement on "Air Pollution and Cardiovascular Disease" concluded that exposure to particulate matter (PM) air pollution contributes to cardiovascular morbidity and mortality. In the interim, numerous studies have expanded our understanding of this association and further elucidated the physiological and molecular mechanisms involved. The main objective of this updated American Heart Association scientific statement is to provide a comprehensive review of the new evidence linking PM exposure with cardiovascular disease, with a specific focus on highlighting the clinical implications for researchers and healthcare providers. The writing group also sought to provide expert consensus opinions on many aspects of the current state of science and updated suggestions for areas of future research. On the basis of the findings of this review, several new conclusions were reached, including the following: Exposure to PM _2.5 _m in diameter (PM2.5) over a few hours to weeks can trigger cardiovascular disease–related mortality and nonfatal events; longer-term exposure (eg, a few years) increases the risk for cardiovascular mortality to an even greater extent than exposures over a few days and reduces life expectancy within more highly exposed segments of the population by several months to a few years; reductions in PM levels are associated with decreases in cardiovascular mortality within a time frame as short as a few years; and many credible pathological mechanisms have been elucidated that lend biological plausibility to these findings. It is the opinion of the writing group that the overall evidence is consistent with a causal relationship between PM2.5 exposure and cardiovascular morbidity and mortality. This body of evidence has grown and been strengthened substantially since the first American Heart Association scientific statement was published. Finally, $PM_{2.5}$ exposure is deemed a modifiable factor that contributes to cardiovascular morbidity and mortality. (***Circulation*****. 2010;121:2331-2378.)**
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http://www.youtube.com/watch?v=MhK39HnP8Yk&feature=youtu.be

Exhibit K

Exhibit K

Nichols • Berman
Environmental Planning
110 East D Street Suite E
Benicia California
9 4 5 1 0

MARIN COUNTYWIDE PLAN UPDATE

Final Environmental Impact Report

COUNTY OF MARIN
COMMUNITY DEVELOPMENT AGENCY

State Clearinghouse No. 2004022076

NOVEMBER 2007

4.3 AIR QUALITY

4.3 AIR QUALITY

Air Quality – Environmental Setting

Existing air quality conditions are described in the *Air Quality Background Report*, April 2002, updated December 2005, which is included in **Appendix 1** to the ~~Draft~~ EIR. This background report is incorporated by reference, and summarized below.

Air quality is described by the concentration of various pollutants in the atmosphere. Units of concentration are generally expressed in parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). The significance of a pollutant concentration is determined by comparing the concentration to an appropriate ambient air quality standard. The standards represent the allowable pollutant concentrations designed to ensure that the public health and welfare are protected, while including a reasonable margin of safety to protect more sensitive individuals in the population.

REGIONAL AIR QUALITY

The ambient air quality in a given area depends on the quantities of pollutants emitted within the area, transport of pollutants to and from surrounding areas, local and regional meteorological conditions, and the surrounding topography of the air basin. Marin County is part of the nine-county San Francisco Bay Air Basin. The federal Clean Air Act, 42 USC 7401 et seq., governs air quality in the United States. In addition to being subject to federal requirements, air quality in California is also governed by more stringent regulations under the California Clean Air Act, Health and Safety Code sections 39000-44385. At the federal level, the United States Environmental Protection Agency (USEPA) administers the Clean Air Act (CAA). The California Clean Air Act is administered by the California Air Resources Board (CARB) at the State level and by the Air Quality Management Districts at the regional and local levels. The Bay Area Air Quality Management District (BAAQMD) regulates air quality at the regional level, which includes the nine-county Bay Area.

AIR QUALITY STANDARDS

The federal and California Clean Air Acts have established ambient air quality standards for several pollutants. National ambient air quality standards are for *criteria pollutants*. Criteria pollutants include Carbon Monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), inhalable particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), and lead (Pb). California established ambient air quality standards as early as 1969 through the Mulford-Carrell Act. Pollutants regulated under the California Clean Air Act are similar to those regulated under the federal Clean Air Act. In many cases, California standards are more stringent than the national ambient air quality standards for criteria pollutants. State and federal ambient air quality standards are shown in **Exhibit 4.3-1**.

Exhibit 4.3-1
Federal and State Ambient Air Quality Standards

Pollutant	Averaging Time	California Standard	Federal Primary Standard	Pollutant Health and Atmospheric Effects	Major Pollutant Sources
Ozone (O_3)	1 hour	0.09 ppm	---	Irritation and possibly permanent lung damage.	Motor vehicles, including refining and gasoline delivery.
	8 hours	0.07 ppm	0.08 ppm		
Carbon Monoxide (CO)	1 hour	20 ppm	35 ppm	Deprives body of oxygen in the blood. Causes headaches and worsens respiratory problems.	Primarily gasoline-powered internal combustion engines.
	8 hours	9 ppm	9.0 ppm		
Nitrogen Dioxide (NO_2)	Annual Avg.	---	0.05 ppm	Irritating to eyes and respiratory tract. Colors atmosphere reddish-brown.	Motor vehicles, petroleum-refining, power plants, aircraft, ships, and railroads.
	1 hour	0.25 ppm	---		
Sulfur Dioxide (SO_2)	Annual Avg.	---	0.03 ppm	Irritates and may permanently injure respiratory tract and lungs. Can damage plants, destructive to marble, iron, and steel. Limits visibility and reduces sunlight.	Fuel combustion, chemical plants, sulfur recovery plants, and metal processing.
	1 hour	0.25 ppm	---		
	24 hours	0.04 ppm	0.14 ppm		
Respirable Particulate Matter (PM_{10})	24 hours	50 ug/m3	150 ug/m^3	May irritate eyes and respiratory tract, is associated with decreased lung capacity, increased cancer and mortality rates. Produces haze and limits visibility.	Industrial and agricultural operations, combustion, atmospheric photochemical reactions, and natural activities (e.g. wind-raised dust and ocean sprays).
	Annual Arithmetic Mean	20 ug/m3	--		
Fine Particulate Matter ($PM_{2.5}$)	24 hours	---	35ug/m^3		
	Annual Arithmetic Mean	12 ug/m3	15 ug/m^3		
Lead (Pb)	Monthly	1.5 ug/m^3	---	Disturbs gastrointestinal system, and causes anemia, kidney disease, and neuromuscular and neurologic dysfunction (in severe cases).	Present source: lead smelters, battery manufacturing & recycling facilities. Past source: combustion of leaded gasoline.
	Quarterly	---	1.5 ug/m^3		
Sulfates (SO_4)	24 hours	25 ug/m^3	---	Similar to sulfur dioxide.	Industrial processes refineries.
Hydrogen Sulfide (H_2S)	1 hour	0.03 ppm (42 ug/m^3)	---	Very pungent odor similar to rotten eggs. Annoying and irritating – high concentrations fatal.	Sources include industrial processes, oil production, and geothermal wells.

Note: ppm = parts per million; ug/m3 = micrograms per cubic meter.

Source: California Air Resources Board, November, 2005.

Ozone is the primary constituent of urban smog. Ozone is considered a secondary pollutant since it is not emitted directly into the atmosphere. Rather, ozone is produced through photochemical reactions of precursor compounds, known as volatile organic compounds (VOC) and nitrogen oxides (NO_x). Because ozone precursors are transported and diffused by wind and have the capacity to form smog miles from their emission source, ozone is regarded as a regional air pollutant. Exposure to ozone smog can cause adverse health impacts.

Carbon monoxide (CO) is an odorless, colorless gas, which can be lethal in high concentrations. The primary source of carbon monoxide is motor vehicles and concentrations of this gas are greatest in areas near the intersections of roadways that carry high volumes of traffic. Residential wood combustion is also a substantial source of CO emissions that can lead to high ambient levels of CO on cold nights where wood burning stoves are popular.

Oxides of Nitrogen (NO_x) are produced through fuel combustion and contribute to the formation of ozone smog. NO_x is shorthand for a class of chemicals that includes nitrogen oxide, nitrogen dioxide (NO_2), dinitrogen pentoxide, peroxyacetylnitrate (PAN), and other compounds. PAN is highly toxic to plants, is a powerful eye irritant, and can persist for long periods. At higher concentrations, NO_2, the red-brown gas in smog, causes eye irritation, shortness of breath, and other temporary and long-term health effects. NO_x also can undergo transformation in the atmosphere into fine respirable particulates.

The use of high sulfur fuels in petroleum refining and electricity generation may result in emissions of sulfur dioxide (SO_2). The sulfur content of fuels is extensively regulated, and controls on stationary sources have brought almost all of California into compliance with federal and State standards.

Particulates that are ten microns in diameter or less are identified as PM_{10}. Likewise, $PM_{2.5}$ is composed of fine particulate that is 2.5 microns or smaller. If inhaled deeply, these particulates can cause adverse health effects. The greatest proportion of suspended particulates originates from combustion, road dust, construction activities, and farming. During the winter, wood smoke from fireplaces can be the most substantial source, contributing up to 40 percent of ambient respirable particulate matter.

Lead has been phased out as a gasoline additive in California, and annual federal and State ambient air quality standards for lead are met in all parts of the state.

TOXIC AIR CONTAMINANTS

Toxic air contaminants (TACs) are another group of pollutants of concern in the Bay Area; however no definitive safe levels of exposure to TACs can be established. Common sources of TACs include industrial processes (e.g., petroleum refining and chrome plating operations), commercial operations (e.g., gasoline stations and dry cleaners), and motor vehicle exhaust. Diesel exhaust particulate matter has been identified as a TAC of concern. Mobile sources such as trucks, buses, automobiles, trains, ships, and farm equipment are the largest source of diesel emissions.

<u>CARB reports that recent air pollution studies have shown that diesel exhaust and other cancer-causing toxic air contaminants emitted from vehicles are responsible for much of the overall cancer risk from TACs in California. Particulate matter emitted from diesel-fueled engines (diesel particulate matter [DPM]) was found to make up much of that risk. In August 1998, CARB formally identified DPM as a TAC. Diesel particulate matter is of particular concern since it can be distributed over large regions, thus leading to widespread public exposure. The particles emitted by diesel engines are</u>

coated with chemicals, many of which have been identified by EPA as hazardous air pollutants and by CARB as TACs. Diesel engines emit particulate matter at a rate about 20 times greater than comparable gasoline engines. The vast majority of diesel exhaust particles (over 90 percent) consists of $PM_{2.5}$, which are the particles that can be inhaled deep into the lung. Like other particles of this size, a portion will eventually become trapped within the lung possibly leading to adverse health effects. While the gaseous portion of diesel exhaust also contains TACs, CARB's August 1998 action was specific to DPM that accounts for much of the cancer-causing potential from diesel exhaust.

Reducing diesel particulate emissions is one of CARB's highest priorities in protecting public health. To address the issue of diesel emissions in California, CARB developed the *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles* (Diesel Risk Reduction Plan) and the *Risk Management Guidance for the Permitting of New Stationary Diesel-Fueled Engines*. The Diesel Risk Reduction Plan was adopted by CARB in September 2000.

In addition to requiring more stringent emission standards for new on-road and non-road mobile sources and stationary diesel-fueled engines to reduce DPM emissions by 90 percent, a significant component of the Diesel Risk Reduction Plan involves application of emission control strategies to existing diesel vehicles and equipment. While the state has already experienced benefits from this plan, CARB's long-term goal is to reduce DPM emissions 85 percent by 2020. Many of the measures of the Diesel Risk Reduction Plan have been approved and adopted, including engine emission standards for new engines and adoption of requirements for ultra-low sulfur fuel throughout the United States and California.

The California diesel fuel regulations are similar to the federal regulations in that they require the maximum sulfur content to be 15 ppm, but they also require reductions in the aromatic content and apply to all diesel engines. Reductions in aromatic content reduce emissions of several toxic substances other than DPM, including benzene and polynuclear aromatic hydrocarbons or PAHs.

In 2004, BAAQMD initiated a community air risk evaluation (CARE) program to evaluate outdoor health risk associated with TACs in the Bay Area. The program, which is expected to take several years, will examine TAC emissions from point sources, area sources, and mobile sources (including both on- and off-road sources). An emphasis will be on diesel exhaust. Mitigation measures will be developed and implemented to reduce TAC emissions in areas with the highest health risk.

SENSITIVE RECEPTORS AND STATIONARY POLLUTANT SOURCES

Some groups of people are more affected by air pollution than others. The State has identified the following people who are most likely to be affected by air pollution: children under 14, the elderly over 65, athletes, and people with cardiovascular and chronic respiratory diseases. These groups are classified as *sensitive receptors*. Locations that may contain a high concentration of these sensitive population groups include residential areas, hospitals, daycare facilities, elder care facilities, elementary schools, and parks.

Children may be more vulnerable to environmental contaminants than adults. The Children's Environmental Health Protection Act (State Senate Bill 25 to amend Sections 39606, 39660, and 40451 of, to add Section 39617.5 to, to add Part 3 (commencing with Section 900) to Division 1 of, and to add Article 4.5 [commencing with Section 39669.5] to Chapter 3.5 of Part 2 of Division 26 of, the Health and Safety Code, relating to environmental health protection) established specific requirements to determine if children are adequately protected from the harmful effects of air pollution. The Act requires CARB and the Office of Environmental Health Hazard Assessment

(OEHHA) to review all health based California's Ambient Air Quality Standards to determine whether they adequately protect public health, including infants and children. Those found potentially inadequate undergo full review and possible revision. The Act also requires CARB to determine if the current air monitoring network established to measure air pollution in California adequately reflects the levels of air pollutants that infants and children are breathing. Additionally, the Act also requires that the State's list of Toxic Air Contaminants be reviewed to identify those that might cause infants and children to be especially susceptible to illness and to institute Air Toxic Control Measures (ATCM) necessary to reduce exposures. In 2005, CARB added a new eight-hour ozone standard in response to a review of the air quality standards required by this Act.

EXISTING LEVELS OF AIR POLLUTANTS

Efforts to combat air pollution began in the Bay Area in 1955 with the formation of the Bay Area Air Pollution Control District which is now known as the Bay Area Air Quality Management District (BAAQMD). State and federal ambient air quality standards cover a wide variety of pollutants. Only a few of these pollutants however, pose health issues in the Bay Area either due to the strength of the emission or the climate of the region. These are ground level ozone and particulate matter (PM_{10} and $PM_{2.5}$), which occasionally are measured at levels above health based standards. For many years, the BAAQMD has operated a multi-pollutant monitoring site in San Rafael that allows analysis of air quality trends. The number of days that air pollutant levels exceeded State or federal standards at San Rafael or the entire Bay Area is reported in **Exhibit 4.3-2**. With the exception of PM_{10}, the San Rafael station has not reported any exceedances of ambient air quality standards over the past five years. Measured exceedances of PM_{10} have occurred on zero to two sampling days per year. Since PM_{10} is measured every sixth day (in accordance with a national sampling schedule), the number of days per year that the standard is exceeded is estimated at up to 12 days.

Exhibit 4.3-2
Summary of Measured Air Quality Exceedances

		Monitoring	Days Exceeding Standard				
Pollutant	**Standard**	**Station**	**2000**	**2001**	**2002**	**2003**	**2004**
Ozone (0_3)	NAAQS 1-hr [a]	San Rafael	0	0	0	0	0
		Bay Area	3	1	2	1	0
	NAAQS 8-hr	San Rafael	0	0	0	0	0
		Bay Area	4	7	7	7	0
	CAAQS 1-hr	San Rafael	0	0	0	0	0
		Bay Area	12	15	16	19	7
Respirable Particulate Matter (PM_{10})	NAAQS 24-hr	San Rafael	0	0	0	0	0
		Bay Area	0	0	0	0	0
	CAAQS 24-hr	San Rafael	0	2	2	0	1
		Bay Area	7	10	6	6	7
Fine Particulate Matter ($PM_{2.5}$)	NAAQS 24-hr	San Rafael	0	---	---	---	---
		Bay Area	1	5	7	0	1
All Other (CO, N02, Lead, S02)	All Other	San Rafael	0	0	0	0	0
		Bay Area	0	0	0	0	0

a This standard was revoked in June 2005.

Source: BAAQMD, Bay Area Air Pollution Summaries 2000-2004.

Air pollutants of concern emitted in Marin County and the Bay Area include ozone, particulate matter (PM_{10}), and toxic air contaminants (TACs).

Currently, the Bay Area is classified as a federal and State nonattainment area for ozone. Ground level ozone, often referred to as smog, is not emitted directly, but is formed in the atmosphere through complex chemical reactions. While there have been no exceedances of federal or State ozone standards in Marin, the Bay Area as a whole has experienced unhealthy ozone levels on seven to 19 days annually. Ozone is not a pollutant that adversely affects Marin County, but emissions from motor vehicle use in the county contribute to high ozone levels in other parts of the Bay Area. Motor vehicles are the largest source of ozone precursors emissions (i.e., nitrogen oxides and reactive organic gases) in the Bay Area.

The county is classified as nonattainment for PM_{10} by CARB. There are many sources of PM_{10} emissions, including combustion, industrial processes, grading and construction, and motor vehicles. The greatest quantity of PM_{10} emissions associated with motor vehicle uses is generated by re-suspended road dust. Reductions in motor vehicle miles traveled are necessary to reduce PM_{10}

emissions, rather than changes to motor vehicle technology. Wood burning in open fireplaces and stoves is another significant source of PM_{10}.

There are no $PM_{2.5}$ monitoring data in Marin County. $PM_{2.5}$ is the very fine particulate fraction of PM_{10}. The Bay Area as a whole is considered *unclassified* in terms of attainment status for the federal standard and *nonattainment* for the State standard.

Carbon monoxide emissions from motor vehicles and stationary sources have been reduced greatly over the last 15 to 20 years, such that the entire Bay Area region has been brought into attainment for both federal and State standards. Carbon monoxide emissions from traffic along major roadway segments with high traffic volumes and poor level of service (LOS) were evaluated. This included county roadway segments operating at LOS of D, E, or F. The traffic-generated emissions of CO were predicted using the Caline4 line source dispersion model. The model requires inputs of geometry, traffic volumes, emission factors and meteorology. Existing traffic volumes for selected roadway segments were used. Emission factors used were calculated using the EMFAC2002 model, developed by the California Air Resources Board, with default assumptions for Marin County during winter that include a temperature of 45 degrees Fahrenheit. Slow speeds of five to 15 miles per hour were used to develop the emission factors. Meteorological conditions indicative of elevated CO levels in the Bay Area were used, which include a low wind speed of one meter per second, worst-case wind angle, and F stability. **Exhibit 4.3-3** shows modeled existing roadside carbon monoxide levels for four roadway segments.

Exhibit 4.3-3
Modeled Existing Roadside Carbon Monoxide Levels

Roadway Segment Description	***Modeled Level [a] (ppm)***	
	1-Hour	***8-hour***
U.S. 101 Puerto Suello Hill	7.4	4.9
1-580 near the Richmond-San Rafael Bridge	5.6	3.6
Sir Francis Drake Blvd. West of U.S. 101	6.8	4.5
State Route 1 near Almonte Blvd.	5.7	3.7
Tiburon Blvd. And Redwood	9.1	6.1
2nd St. and Grand Ave	8.4	5.6
National Ambient Air Quality Standard	35	9.0
California Ambient Air Quality Standard	20	9.0

a Includes background level of four ppm for one-hour and 2.5 ppm for eight-hour

Source: Illingworth & Rodkin

As shown in **Exhibit 4.3-3** existing carbon monoxide concentrations are well below the ambient air quality standards. Carbon monoxide concentrations are expected to decrease further in the future as newer and cleaner vehicles replace older vehicles on the roadway.

The health impacts associated with the exposure to toxic air contaminants are usually expressed in terms of increased risk of contracting cancer by individuals. In Marin County, truck traffic, construction equipment, and ferries are the primary sources of diesel particulate matter. According to

CARB, the overall inhalation cancer risk in the Marin County ranges from very low (less than 50 cases per million) in the western part of the county to a range of 100 to 250 excess cancer cases per million people. [1] Some localized areas in San Rafael show rates slightly greater than 250 cases per million. These risks are considerably lower than the risk in urban areas, which can exceed 1,000 excess cases per million people. The overall risk is predicted to decrease and the decrease could be substantial if CARB goals to achieve a 75 percent reduction in diesel risk are met.

Diesel particulate matter (DPM) emitted from trucks or other diesel fueled vehicles on freeways in Marin County is a toxic air contaminant that affects local air quality. Concentrations of existing diesel particulate matter emissions from trucks on Marin County freeways were modeled and reported in the *Air Quality Background Report*. [2] The modeled concentrations indicate existing risks ranging from 15 to 35 excess cancer cases per million people at a distance of 50 feet from the roadways. These levels of risk are expected to decrease in the future as newer more stringent regulations that target diesel exhaust emissions take effect. CARB's EMFAC2002 motor vehicle emission factor model, which is used to predict DPM emissions, documents this effect. [3]

Other air quality issues of concern in Marin County include nuisance impacts of odors and dust. Common sources of odors would include wastewater treatment plants, landfills, composting facilities, and agricultural activities. Similarly, nuisance dust may be generated by a variety of sources including construction, quarries, travel on unpaved roadways, and agriculture.

AIR QUALITY PLANNING

The BAAQMD along with the other regional agencies (i.e., Association of Bay Area Governments and the Metropolitan Transportation Commission) prepared the *2001 Ozone Attainment Plan* [4] to address the federal standard for ozone. Although the U.S. EPA revoked the 1-hour NAAQS for ozone in 2005, the *2001 Ozone Attainment Plan* is still a valid planning document and element of California's state implementation plan (SIP) for the national Clean Air Act. The on-road emissions budgets from the *2001 Ozone Attainment Plan* are used as surrogate budgets for transportation conformity analyses and findings until a new budget is established with an attainment or maintenance demonstration for the new 8-hour ozone standard. In addition, any commitments made in the *2001 Ozone Attainment Plan* continue to be enforceable commitments and must be implemented.

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1 See CARB website (March 27, 2006): http://www.arb.ca.gov/toxics/cti/hlthrisk/hlthrisk.htm

2 Table 8 in the *Air Quality Background Report* provides a summary of diesel particulate matter cancer risk at distances from 50 to 1,000 feet from Marin County freeways.

3 California Air Resources Board. Emfac2001 version 2.08/Emfac2002 version 2.20 - Calculating emission inventories for vehicles in California, User's Guide.

4 *Revised San Francisco Bay Area Ozone Attainment Plan for the 1-Hour National Ozone Standard*, Metropolitan Transportation Commission, Bay Area Air Quality Management District, and Association of Bay Area Governments, Adopted October 24, 2001.

The *Bay Area 2005 Ozone Strategy* is the most recently approved regional Clean Air Plan.[5] It was adopted in January 2006 to address the more stringent requirements of the California Clean Air Act with respect to ozone. This plan includes a comprehensive strategy to reduce emissions from stationary, area, and mobile sources. The plan's objective is to indicate how the region would attain the stricter State air quality standards, as mandated by the California Clean Air Act. The plan is designed to achieve a region-wide reduction of ozone precursor pollutants through the expeditious implementation of all feasible measures. Air Quality Plans addressing the California Clean Air Act are developed on a triennial basis, with the latest approved plan ~~developed~~ adopted in ~~2000~~ 2006 (~~Bay Area 2000 Clean Air Plan~~ Bay Area 2005 Ozone Strategy).[6] This plan proposes implementation of transportation control measures (TCMs) and programs such as *Spare the Air*. Some of these measures or programs rely on local governments for implementation.

In 2003 the California Legislature enacted Senate Bill 656, to reduce public exposure to PM_{10} and $PM_{2.5}$. SB 656 legislation required BAAQMD to review a list of particulate matter control measures compiled by CARB and identify measures that are most appropriate to the region. BAAQMD reviewed this list and adopted a particulate matter implementation schedule on November 16, 2005. The BAAQMD staff report along with comments on the report focused mainly on wood smoke issues. Of the 103 measures compiled by CARB, BAAQMD proposed implementing four of the measures. Many of the measures were either similar to measures already adopted by BAAQMD or the benefit of the measure would not be significant. Ten measures that target wood burning were identified for further study. These include rulemaking that could prohibit installation of open fireplaces or wood burning stoves that do not meet current EPA standards. One measure could prohibit wood burning on certain nights. BAAQMD identified additional particulate matter reduction efforts that are being implemented immediately. These include efforts aimed at characterizing and controlling wood smoke. BAAQMD plans to enhance monitoring at the neighborhood level and focus more on controlling wood smoke. One measure implemented immediately lowered the forecasted air quality index threshold used to make Spare the Air Tonight alerts and step up enforcement when complaints regarding wood smoke are received. SB 656 requires CARB to prepare a report by 2009 that describes actions taken to fulfill the requirements of the legislation as well as recommendations for further actions to assist in achieving the State particulate matter standards.

A key element in air quality planning is to make reasonably accurate projections of future human activities that are related to air pollutant emissions. Most important is vehicle activity. The BAAQMD uses population projections made by the Association of Bay Area Governments and vehicle use trends made by the Metropolitan Transportation Commission to formulate future air pollutant emission inventories. The basis for these projections comes from cities and counties. In order to provide the best plan to reduce air pollution in the Bay Area, accurate projections from local governments are necessary. When individual projects are not consistent with these projections, they cumulatively reduce the effectiveness of air quality planning in the region.

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5 *Bay Area 2005 Ozone Strategy,* Metropolitan Transportation Commission, Bay Area Air Quality Management District, and Association of Bay Area Governments, January 4, 2006.

6 ~~*Bay Area 2000 Clean Air Plan*, Bay Area Air Quality Management District, December 20, 2000.~~

BUFFER ZONES

The BAAQMD recommends that general plans include buffer zones to separate sensitive receptors from sources of air toxic contaminants and odors. In April 2005, CARB released the final version of the *Air Quality and Land Use Handbook*, [7] which is intended to encourage local land use agencies to consider the risks from air pollution prior to making decisions that approve the siting of new sensitive receptors (e.g., schools, homes or daycare centers) near sources of air pollution. Unlike industrial or stationary sources of air pollution, siting of new sensitive receptors does not require air quality permits, but could create air quality problems. The primary purpose of the handbook is to highlight the potential health impacts associated with proximity to common air pollution sources, so that those issues are considered in the planning process. CARB makes recommendations regarding the siting of new sensitive land uses near freeways, truck distribution centers, dry cleaners, gasoline dispensing stations, and other air pollution sources. These "advisory" recommendations, summarized in **Exhibit 4.3-4**, are based primarily on modeling information and may not be reflective entirely of conditions in Marin County. Siting of new sensitive land uses within these recommendation distances may be possible, but only after site-specific studies are conducted to identify the actual health risks. CARB acknowledges that land use agencies have to balance other siting considerations such as housing and transportation needs, economic development priorities and other quality of life issues.

Exhibit 4.3-4
CARB Recommended Setback Distances for Common Sources of Toxic Air Contaminants

Source Type	*Recommended Buffer Distance*
Freeways and busy arterial roadways	500 feet
Distribution Centers with 100 or more daily truck trips or 40 daily truck trips that use refrigeration units	1,000 feet
Dry cleaners (onsite dry cleaning)	300 feet for any dry cleaning operation. At least 500 feet for operations with two or more machines.
Gasoline stations	50 feet for typical gas stations. Up to 300 feet for large gas stations.

Source: Air Quality and Land Use Handbook: A Community Health Perspective, California Environmental Protection Agency and California Air Resource Board, April 2005.

GREENHOUSE GAS EMISSIONS

As a part of the Countywide Plan Update, Marin County prepared a report on greenhouse gas emissions. Existing greenhouse gas emissions are described in the *Greenhouse Gas Emissions Analysis Report,* June 2003. This report is included in **Appendix 1** to the ~~Draft~~ EIR, incorporated by reference and summarized below.

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7 *Air Quality and Land Use Handbook: A Community Health Perspective*, California Environmental Protection Agency and the California air Resources Board, April 2005.

The greenhouse gases analyzed in this report included carbon dioxide, methane, nitrous oxide, and various hydrofluorcarbons.[8] The levels of the emissions are reported in equivalent carbon dioxide (eCO2) units. Converting all emissions to carbon dioxide units allows for comparison between greenhouse gases of varying strengths. For instance, methane is 21 times more powerful than carbon dioxide in its capacity to trap heat. Therefore, one ton of methane is equal to 21 tons of carbon dioxide.

Exhibit 4.3-5 shows the tons of greenhouse gas emissions in Marin County for 1990 and 2000.

Exhibit 4.3-5
Countywide Greenhouse Gas Emissions

Location	***1990***	***2000***
	Greenhouse Gas Emissions (tons)	
Unincorporated Area	617,562	639,741
Incorporated Area	2,237,162	2,473,825
Total	2,634,003	3,113,565

Source: Marin County Community Development Agency

Greenhouse gas emissions (eCO2) increased approximately 18 percent from 1990 to 2000, from 2.6 million tons to 3.1 million tons. In 2000, the unincorporated area of Marin County accounted for approximately 21 percent of greenhouse gas emissions in the county.

By percentage, the transportation sector is the largest contributor to green house gas emissions, followed by residential and commercial energy use.

[8] The hydrofluorocarbons are HFC-23, HFC-125, HFC-134a, HFC-152a, CF_4, C_2F_6, and SF_6.

Air Quality – Significance Criteria

The Bay Area Air Quality Management District (BAAQMD) has developed guidelines and thresholds of significance for local plans. Inconsistency with the most recently adopted Clean Air Plan (CAP) is considered a significant impact. According to the BAAQMD, the following criteria must be satisfied for a local plan to be determined to be consistent with the CAP and not have a significant air quality impact: [9]

- The local plan must be consistent with the CAP population and Vehicle Miles Traveled (VMT) assumptions. This is demonstrated if the population growth over the planning period will not exceed the values included in the current CAP and the rate of increase in VMT is equal to or lower that the rate of increase in population;

- The local plan demonstrates reasonable efforts to implement the Transportation Control Measures (TCMs) included in the CAP that identify cities as implementing agencies; and

- For local plans to have a less than significant impact with respect to potential odors and / or toxic air contaminants, buffer zones must be established around existing and proposed land uses that would emit these air pollutants. Buffer zones to avoid odors and toxics impacts must be reflected in local plan policies, land use maps, and implementing ordinances.

Additionally, based on the findings of the Initial Study and the County's Appendix N *Criteria for Significance*, the project would have a significant air quality impact if it would:

> Create localized areas where concentrations of air pollutants or contaminants would exceed ambient air quality standards or present a significant risk resulting in exposure of sensitive receptors to substantial pollutant concentrations.

In regard to greenhouse gas emissions the project would have a significant impact if it would:

- Result in an increase in greenhouse gas emissions over existing levels.

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9 *BAAQMD CEQA Guidelines,* Bay Area Air Quality Management District, April 1996 (Revised December 1999).

Air Quality – Impacts and Mitigation Measures

Impact 4.3-1 Inconsistency with Clean Air Plan

The Draft 2005 CWP Update would not be consistent with the BAAQMD Thresholds of Significance since projected VMT in Marin County would increase at a faster rate than population. This would be a significant impact.

A key element in air quality planning is to make reasonably accurate projections of future human activities that are related to air pollutant emissions. When the *Bay Area 2005 Ozone Strategy* [10] was developed for the Bay Area it utilized the most recent projections developed by the Association of Bay Area Governments (ABAG) and vehicle activity projected by the Metropolitan Transportation Commission (MTC). These projections are based on the most recent projections using land use designators developed by cities and counties through the General Plan process. The *Bay Area 2005 Ozone Strategy* is the most recent and most comprehensive plan in terms of attaining and maintaining air quality standards for ozone. The *2001 Ozone Attainment Plan* is based on slightly older regional projections and does not address the more stringent requirements of the California Clean Air Act.

Implementation of clean air planning efforts described above would aid in efforts to reduce PM_{10} and $PM_{2.5}$ throughout the region. In addition, the BAAQMD adopts and enforces rules to reduce particulate matter emissions and develops public outreach programs to educate the public to reduce PM_{10} and $PM_{2.5}$ emissions (e.g., Spare the Air Program). SB 656 requires further action to reduce public exposure to PM_{10} and $PM_{2.5}$. Efforts identified by the BAAQMD in response to SB656 are primarily targeting reductions in wood smoke emissions and adoption of new rules to further reduce NOx and particulate matter from internal combustion engines and reduce particulate matter from commercial charbroiling activities. NOx emissions contribute to ammonium nitrate formation that resides in the atmosphere as particulate matter.

Population and vehicles miles traveled (VMT) projections are shown in **Exhibit 4.3-6**. The population of unincorporated Marin County would grow with development consistent with the *Draft 2005 CWP Update*. While population projections are available for unincorporated portions of Marin County, VMT projections are only available for the entire county. Population projections are based on full buildout of the *Draft 2005 CWP Update* assuming an average household size of 2.35 people. The *Draft 2005 CWP Update* projects 121,847 housing units countywide (see **Exhibit 3.0-14**). This number of housing units would equate to a countywide population of 286,340. [11] ABAG projections indicate a 2030 population of 283,100 people, so the *Draft 2005 CWP Update* would result in population that slightly exceeds ABAG projections. The increase in population from 2005 to 2030 would be 13.0 percent. MTC predicts that VMT associated with the ABAG population projections would increase by 11.6 percent over the existing conditions, which would not exceed the rate of population growth. [12] However, travel forecasts prepared by Marin County for the *Draft 2005 CWP*

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[10] *Bay Area 2005 Ozone Strategy,* Metropolitan Transportation Commission, Bay Area Air Quality Management District, and Association of Bay Area Governments, January 4, 2006.

[11] 121,847 housing units times an average of 2.35 persons per housing unit equals 286,340 people.

[12] The MTC projects average weekday daily VMT for Marin County in 2030 to be 7,405,400. Information accessed online at http://www.mtc.ca.gov/maps_and_data/datamart/stats/vmt.htm, May 2006.

Update indicate a VMT increase of approximately 26 percent [13] for the 2030 population forecasted by the *Draft 2005 CWP Update* and ABAG. [14] This increase in VMT would exceed the rate of population growth in Marin County.

Exhibit 4.3-6
Projected Populations and VMT Growth in Marin County

General Plan Alternative	Total Housing Units	Population	Percent Growth 2005 – 2030	Daily VMT	Percent Growth 2005-2030
Existing	105,690	253,341 [a]	--	7,003,560	
Draft 2005 CWP Update	121,847	286,340 [b]	13.0	Scenario 1 8,809,258 Scenario 2 8,827,123 Scenario 3 8,823,921	25.8 26.0 26.0
No Project (*1994 CWP*)	121,847	286,340	13.0	8,860,900	26,5

a Population estimate for January 1, 2006. State of California, Department of Finance, *E-5 Population and Housing Estimates for Cities, Counties and the State, 2001-2006, with 2000* Benchmark, Sacramento, California, May 2006.

b Future population based on County projection of 2.35 persons per household.

Sources: Marin Travel Model and Nichols•Berman.

The *Draft 2005 CWP Update* contains numerous policies and programs that, if adopted and implemented, would act to help reduce motor vehicle use. This would reduce the rate of vehicle miles traveled from trips in Marin County. In addition, the *Draft 2005 CWP Update* contains other policies that would reduce air pollution associated with energy usage, offsetting air pollution emitted from increased population and vehicle travel in Marin County.

The Atmosphere and Climate section of the Natural Systems & Agriculture Element describe goals, policies and programs with respect to air quality. These policies and programs are intended to reduce air pollution that affects air quality at all levels; i.e., locally, regionally and globally.

Policies and programs supporting Goal **AIR-1** would help improve local and regional air quality. These policies would require that all projects be evaluated in accordance with *BAAQMD CEQA guidelines* and regional agencies are notified for their input on air quality issues. This would allow for agency input into project mitigation measures designed to reduce air pollution and VMT.

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[13] The 2030 VMT would vary slightly between the three *Draft 2005 CWP Update* scenarios.

[14] The VMT increase based on the Marin Travel Model completed for the *Draft 2005 CWP Update* by the Marin County Department of Public Works.

Policies and programs supporting Goal **AIR-3** would implement Clean Air Plan transportation control measures (TCMs) to improve air quality. TCMs are intended to reduce vehicle trips and vehicle travel distances. The *Draft 2005 CWP Update* policies and programs that improve air quality from implementing TCMs are described in greater detail under *Impact 4.3-2 Inconsistency with Clean Air Plan Transportation Control Measures*.

The County would continue to participate in regional air quality programs such as *Spare the Air* and *Cities for Climate Protection*. Spare the Air is a program intended to reduce air pollution emissions, including those from VMT, on days when unhealthy air quality conditions are forecasted. Goals **AIR-4** and **AIR-5** would address greenhouse gas emissions and climate change. Programs supporting these goals would also improve regional air quality. Greenhouse gas emissions would be reduced from energy usage, transportation (including reduced VMT) and agriculture.

Other Elements of the *Draft 2005 CWP Update* include goals and policies that would indirectly improve air quality from future development and redevelopment by reducing VMT. The Built Environment Element contains numerous policies and implementing programs that would encourage development in urban areas served by transit. Policy **CD-1.1** would concentrate urban development in the City-Centered Corridor where infrastructure and facilities (including transit) can be provided most efficiently. Policy **CD-2.3** would establishes a housing overlay designation to encourage construction of housing units to meet the need for workforce housing, low-income housing and special needs housing near commercial and transit. Policy **CD-2.5** would locate housing near activity centers where jobs, services and transit are available. Policies **CD-2.6**, **DES-2.1**, and **HS-3.14** would concentrate and promote commercial and dense residential development in areas with high transit accessibility. Goal **CD-3** would facilitate low-vehicle use employment opportunities by allowing and encouraging the creation of studios and workspaces for artist and craftspeople including live-workspaces (Policy **CD-3.1**) and encouraging businesses and public agencies to offer telecommuting as a work alternative. Policy **DES-3.1** would promote infill by encouraging the development of vacant and underutilized parcels consistent with the neighborhood character and Policy **DES-3.2** would promote green spaces such as high-quality community plazas, gardens and neighborhood parks. Locating homes near jobs, services, recreation, and transit reduces VMT.

Policies supporting Goal **HS-3** would implement "smart" and sustainable development principles to meet the housing needs in the county. This would include a focus of providing workforce housing (Policies **HS-3.2**, **HS-3.3**, and **HS-3.4)**. The addition of workforce housing would reduce VMT associated with worker commute travel.

The Transportation section of the Built Environment Element includes numerous policies to expand pedestrian and bicycle facilities and access. Policies **TR-2.1** through **TR-2.4** would be supported by 14 programs that include incorporation of new facilities and supporting efforts to renovate and reopen train tunnels to accommodate bikes and pedestrians. Policy **TR-3.1** would support expansion of local bus service and Policy **TR-3.2** specifically would promote new rail service (i.e., SMART train) and a multi-use path that would follow that service. Program **TR-2.e** would put a high priority on obtaining funding to complete gaps in the North-South and East-West Bikeways.

The Energy and Green Building section of the Built Environment Element addresses energy conservation and green building standards. Although this would not reduce VMT, it would offset some of the air pollution generated by VMT through reduced emissions from electrical energy production and natural gas usage. Policy **EN-1.1** would integrate energy efficiency and conservation requirements in excess of State standards, while Policies **EN-1.2** and **EN-1.3** (and Policy **HS-2.5**) would encourage and promote energy efficiency and conservation. Policy **EN-1.4** would integrate energy efficiency and conservation into all County functions. Policies **EN-2.2** and **EN-2.3** would promote the use of renewable energy (e.g., through installation of rooftop photovoltaics). Policies **EN-3.1** through Policy **EN-3.4** would integrate green building requirements into new development.

Many of the policies described above would support smart growth [15] and reduce VMT. However, VMT may still increase at a rate greater than population. The emissions of ozone precursor pollutants associated with the increased VMT could affect regional efforts to attain and maintain ambient air quality standards for ozone. Therefore, this would be a significant project impact and the project would make a cumulatively significant contribution to a cumulative air quality impact.

Mitigation Measure 4.3-1 Implement Mitigation Measure 4.2-1 of *Impact 4.2-1 Increase in Vehicle Miles Traveled* to reduce VMT per person

Significance After Mitigation Even with Mitigation Measure 4.2-1 and the *Draft 2005 CWP Update* Policies, VMT may still exceed the rate of population growth, mostly because the predicted rate of VMT growth is so much higher than the rate of population growth. Therefore, this would be a significant unavoidable project and cumulative impact.

Responsibility and Monitoring The Board of Supervisors would be responsible for adopting the new policy and program as described in Mitigation Measure 4.2-1 as part of *Marin Countywide Plan 2005*. The Marin County Community Development Agency and the Marin County Department of Public Works would share responsibility for monitoring implementation.

Impact 4.3-2 Inconsistency with Clean Air Plan Transportation Control Measures

Draft 2005 CWP Update policies would not support all efforts to implement TCMs that are to be implemented by counties. This would be a significant impact.

Exhibit 4.3-7 lists the *Draft 2005 CWP Update* policies that are supportive of the Clean Air Plan Transportation Control Measures (TCMs). A description of each TCM is provided along with a listing of relevant *Draft 2005 CWP Update* policies and programs that would implement each measure.

15 Smart growth is a term that is applied to development that reflects higher densities, mixed use, and a higher proportion of housing and employment growth in urban area, particularly near transit stations and along transit corridors, as well as in town centers. *Projections 2003*, Association of Bay Area Governments, page 40.

Exhibit 4.3-7
Transportation Control Measures(TCMs) Supported by the Draft 2005 CWP Update

Transportation Control Measure	*Description*	*Examples of Relevant Draft 2005 CWP Update Policies / Implementing Programs*
TCM #1 Support Voluntary Employer-Based Trip Reduction Programs	Provide assistance to regional and local ridesharing organizations; advocate legislation to maintain and expand incentives (e.g., tax deductions/credits)	Policy **AIR-3.1**, Program **AIR-3.a** Support Voluntary Employer-Based Trip Reduction by providing assistance to regional and local ridesharing organizations and advocating legislation to maintain and expand employer ridesharing incentives. Policy **AIR-4.1**, Program **AIR-4.b** Reduce Greenhouse Gas Emissions Resulting from Transportation. Increase clean-fuel use, promote transit oriented development and alternative modes of transportation, and reduce travel demand.
TCM #9 Improve Bicycle Access and Facilities	Encourage local jurisdictions to develop safe and convenient bicycle land and route networks, provide secure bike racks and storage, and require bicycle access and amenities as conditions of approval of development projects Explore innovative bicycle programs, such as “station bike” or bike sharing programs at transit stations, downtowns and activity centers	Policy **TR-2.1** would improve the bicycle and pedestrian network Policy **TR-2.2** would require new developments to provide new bicycle and pedestrian facilities, including new trails and pathways. Policy **TR-2.3** and Policy **TR-2.4** would seek funding opportunities to construct new pedestrian and bicycle facilities and connect to urban areas and parklands. Policy **TR-3.5** would support bicycle access to all transit systems and ensure that they provide bicycle storage.
TCM #10 Youth Transportation	Encourage walking and bicycling to school through the Safe Routes to Schools Programs	Policy **CD-2.5** would locate housing near jobs, transit, schools and shopping areas. Policy **TR-2.1** and **TR-2.2** are supported by Programs **TR-2j** and **TR-2k** that would support the Safe Routes to School program through funding or incorporation of new projects to ensure safe walking and bicycling routes to schools.

Transportation Control Measure	***Description***	***Examples of Relevant Draft 2005 CWP Update Policies / Implementing Programs***
TCM #12 Arterial Management Measures	Coordinate the timing of an additional signals and continue updating timing plans	Policy **AIR-3.1** and Program **AIR-3.d** would implement BAAQMD Clean Air Plan TCMs and Program **AIR-3.e** to improve arterial management Policy **TR-3.6** would include efforts to reduce weekend traffic congestion due to park and recreation visitors.
TCM #15 Local Clean Air Policies and Programs	Develop financial and other incentives and technical assistance to encourage innovative parking strategies such as reduced parking, parking fees, parking cash-out, shared parking and other parking programs Pursue legislative changes to remove barriers and provide incentives for smart growth Promote carsharing as a way to reduce parking requirements	Policy **AIR-3.1**, Program **AIR-3.b** would utilize clean vehicle technology by promoting new technologies and other incentives, such as allowing zero or partial zero emissions vehicles in carpool lanes and replacing fleet vehicles with clean vehicles. Program **TR-1.c** of Policies **TR-1.1** through **TR-1.7** would encourage the use of car sharing and provides incentives to employers, commuters, and recreational users to support this alternative. Policy **TR-4.3** would encourage transit operators to switch to zero or low-emission transit vehicles.
TCM #19 Improve Pedestrian Access and Facilities	Review and comment on general/specific plan policies to promote development patterns that encourage walking and circulation policies Emphasize pedestrian travel and encourage amending zoning ordinances to include pedestrian-friendly design standards	See Policies supporting TCM #9. Policy **CD-1.1** would concentrate urban development in City-Centered Corridor Policy **CD-2.3** would encourage construction of housing for the workforce, low-income or special-needs in the City Centered Corridor near transit employment opportunities and services. Policy **CD-2.5** would locate housing near jobs, transit, schools and shopping areas Policy **CD-2.6** and **DES-2.1** would focus intensive (commercial or high-density residential) developments at nodes served by transit and discourages strip development.

Transportation Control Measure	***Description***	***Examples of Relevant Draft 2005 CWP Update Policies / Implementing Programs***
TCM #19 cont. Improve Pedestrian Access and Facilities		Policy **CD-6.1** would seek city review of development proposed adjacent to urban areas Policy **DES-1.1** would address design issues that would encourage walking and bicycling Policy **HS-3.11** would provide incentives for housing development located within easy walking distance of transit stops Policy **HS-3.12** would designate transit oriented housing development locations Policy **HS-3.14** would promote mixed-use developments.
TCM #20 Promote Traffic Calming	Implement traffic calming projects such as: Pedestrian-exclusive streets Residential and neighborhood traffic calming measures Arterial and major route traffic calming measures Include traffic calming strategies in the transportation and land use elements of general and specific plans Encourage area-wide traffic calming plans and programs Include traffic strategies in capital improvement programs	Goal **DES-5** would design automobile use areas to comfortably accommodate travel by pedestrians and bicyclists. Policy **DES-5.1** would ensure that roadways, parking areas, and pedestrian and bike movement are functionally and aesthetically appropriate.

Source: Illingworth & Rodkin, Inc.

The proposed policies and programs generally support and reasonably implement the applicable Clean Air Plan TCMs. However, there is no policy that would directly address parking strategies to reduce vehicle travel (TCM #15). Furthermore, based on criteria described in ***Section 4.0 Environmental Setting, Impacts, and Mitigation Measures*** some of the programs listed in **Exhibit 4.3-7** cannot be relied upon to reduce this impact. [16] Therefore, this would be a significant project impact.

Mitigation Measure 4.3-2(a) Add a new program to the Design Section of the Built Environment Element as follows:

> **DES-2.(new)** Require new office developments with more than 50 parking spaces to offer a *Parking "Cash-Out" Program*. [17] **The County shall consider the feasibility of a parking cash-out program for other new developments located in the City-Centered corridor**.

Mitigation Measure 4.3-2(b) It would be necessary to identify a funding source, make a higher priority or implemented sooner Programs **AIR-3.a** (funding source, higher priority, implement sooner), **AIR-3.d** (higher priority), **AIR-3.e** (higher priority), **TR-2.g** (higher priority, implement sooner), **TR-2.k** (higher priority, implement sooner), and **TR-1.c** (funding sources, higher priority, implement sooner).

Significance After Mitigation Mitigation Measure 4.3-2 together with the *Draft 2005 CWP Update* policies and programs would reasonably implement TCM #15 of the most recent Clean Air Plan. This measure along with other policies and implementing programs would reasonably implement all of the TCMs listed in the Clean Air Plan that cities and counties are listed as implementing agencies. This impact would be reduced to a less-than-significant level.

Responsibility and Monitoring The Board of Supervisors would be responsible for adopting the revised programs and the new program as a part of *Draft Marin Countywide Plan 2005*. The Marin County Community Development Agency would be responsible to monitor its implementation.

Impact 4.3-3 Buffer Zones for Potential Source of Odor/Toxics

Land use maps associated with the Draft 2005 CWP Update do not propose new sources of odors or toxic air contaminants. However, they show sensitive land uses near sources of odors and toxic air contaminants. This would be a significant impact.

According to the *BAAQMD CEQA Guidelines*, for a general plan to have a less-than-significant impact with respect to odors and/or toxic air contaminants buffer zones must be established around

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[16] As described in ***Section 4.0 Environmental Setting, Impacts, and Mitigation Measures***, this Draft EIR assumes that if there is an identified funding source; if it is a medium or high priority; and will be implemented in the immediate-, short-, or medium-term, or is ongoing, that the program would be implemented and could be relied upon to reduce significant impacts to a less-than-significant level. If there is no identified funding source, is a low priority, and only would be implemented in the long-term, then this Draft EIR does not assume that the program will be implemented. In instances where such program would be required to mitigate significant impacts, this Draft EIR recommends, as a mitigation measure, that the program be funded, receive a higher priority, and be implemented in the medium-term or sooner.

[17] Such a program would require employers to have a program that either pays employees for not using their parking spaces or provides benefits, such as vouchers that can be used to purchase transit passes. Information on parking cash-out programs can be obtained from *http://www.arb.ca.gov/planning/tsaq/cashout/cashout.htm.*

existing and proposed land uses that would emit these air pollutants. Buffer zones to avoid odors and toxics impacts must be reflected in local plan policies, land use maps, and implementing ordinances.

The *Draft 2005 CWP Update* includes policies and programs to reduce exposure of existing and future sensitive receptors from existing and future sources of odors and air toxic contaminants. Policy **AIR-2.1** would consider potential air pollution and odor impacts from land uses that may emit pollution and / or odors when locating (a) air pollution point sources, and (b) residential and other pollution-sensitive land uses in the vicinity of air pollution point sources. Program **AIR-2.a** would require a separation between air pollution point sources and other land uses consistent with BAAQMD guidelines.

Policy **AIR-2.1** and Program **AIR-2.a** would only address point sources of air pollution and would not protect sensitive land uses such as residences from mobile source emissions. Trucks, buses and some smaller vehicles using freeways emit diesel particulate matter (DPM), which is a known toxic air contaminant. The only two roadways in Marin County that would have the potential to cause a significant health risk for sensitive land uses are U.S. 101 and Interstate 580. Other roadways in Marin County do not have high enough truck volumes to cause a significant health risk for residents of new housing. New freeways are not proposed in Marin, but new housing or other sensitive land uses may be located close enough to existing freeways to result in unhealthy exposures to DPM.

A screening analysis of future DPM exposure and associated health effects was conducted. The health impacts associated with the DPM exhaust are expressed in terms of increased risk of contracting cancer by individuals who reside for extended periods near the sources, such as freeways. This analysis involved the development of DPM emissions for traffic on U.S. 101 and 1-580 using the EMFAC2002 emission factor model with defaults for Marin County. The EMFAC2002 results were then adjusted to the traffic mix on U.S. 101 and 1-580 reported by Caltrans. [18] Emission factors were input to the Ca13qher dispersion model that is acceptable to the BAAQMD for this type of analysis.

Modeled concentrations were calculated for various distances from the edge of the freeway. The maximum individual cancer risks were computed using the BAAQMD recommended cancer risk factor of 3 x 10^{-4} cancer cases per $\mu g/m^3$ of diesel particulate matter, which are based on "best estimates" of plausible cancer potencies as determined by the California Office of Environmental Health Hazard Assessment. The future cancer risk posed by traffic on freeways in Marin County is expressed in terms of distance from the edge of the travel lanes. A risk of less than ten in one million is considered to be less than significant under current *BAAQMD CEQA Guidelines*. It should be noted, as discussed previously, that emission rates of DPM from traffic are predicted to decrease substantially in the future.

An analysis of existing DPM exposures indicates that significant health risks could occur at distances of up to 500 feet from U.S. 101 and Interstate 580. The actual distance would probably be less since the analysis employed screening meteorological conditions that usually result in higher concentrations. U.S. EPA and the California Air Resources Board (CARB) have required cleaner engine technologies and diesel fuel reformulation that are reducing the DPM emissions from these vehicles. The effect of these lower emissions rates reduces the area near freeways where significant DPM exposures would occur. For sensitive receptors, such as residential uses, a significant impact is considered a ten in one million chance of contracting cancer where the receptor is exposed to the source almost 24 hours per

[18] Based on *2004 Average Annual Daily Truck Traffic on the California State Highway System* – http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/

day for 70 years. **Exhibit 4.3-8** shows the distances where significant exposures to DPM could occur under *Draft 2005 CWP Update* buildout conditions. The procedure used to develop the cancer risk for exposure to DPM is described in the *Air Quality Background Report*.

Exhibit 4.3-8
Summary of Future Cancer Risk along Marin County Freeway Segments

Freeway Segment	***Cancer Risk at Receptor Distance from Freeway Edge (per million persons)***		
	50 ft.	***100 ft.***	***200 ft.***
U.S. 101 Southern Marin	4.9	3.8	2.7
U.S. 101 Central Marin	14.0	10.8	7.6
U.S. 101 Northern Marin	11.8	9.2	6.4
I-580 east of San Rafael	13.9	10.5	7.3

Source: Illingworth and Rodkin, Inc.

Significant cancer risks (i.e., risks >ten in one million) would not extend much beyond the right-of-way of U.S. 101 in southern Marin County, because there would be a relatively low volume of trucks using that freeway. The cancer risk in central and northern Marin County would equal or exceed ten cases in one million at a distance of about 100 to 150 feet from the roadway edge. Residential development planned under the *Draft 2005 CWP Update* could occur within the buffer distances reported above, which could result in significant health risks from DPM exhaust.

The *Draft 2005 CWP Update* defines four environmental corridors and focuses new housing in the City-Centered Corridor. This would put new sensitive receptors closer to sources of toxic air contaminants, primarily DPM from traffic. The Housing Overlay Designation (See **Map 3-2.a** and **Map 3-2b** in *Draft 2005 CWP Update*) indicate the potential for housing near U.S. 101 in three general areas: (1) housing could be located in the Las Gallinas Valley planning area close to U.S. 101 near Lucas Valley Road, (2) housing could be provided in the Richardson Bay planning area at Strawberry Village near U.S. 101, and (3) housing could be located near U.S. 101 in Marin City. Potential housing in the Strawberry Village area and Marin City would likely be exposed to risks that are acceptable (less than ten in one million). Without proper setbacks, new sensitive receptors located near the freeways of central and northern Marin County would be exposed to significant health risks from DPM emitted along U.S. 101.

The exposure of new sensitive receptors to unhealthy levels of DPM would be a significant project impact and the project would make a cumulatively significant contribution to a cumulative impact. The following mitigation would be required to reduce project related and cumulative impacts.

Mitigation Measure 4.3-3(a) Revise Policy **AIR 2-1** of the Natural Systems & Agriculture Element as follows:

> **AIR-2.1** *Buffer Emission Sources and Sensitive Land Uses*. Consider potential air pollution and odor impacts from land uses that may emit pollution and/or odors when locating (a) air pollution ~~point~~ sources, and (b) residential and other pollution-sensitive land users in the vicinity of air pollution ~~point~~ sources (which may include freeways, manufacturing, extraction, hazardous materials storage, landfill food processing, wastewater treatment, and other similar uses).

Mitigation Measure 4.3-3(b) Revise Program **AIR-2.a** of the Natural Systems & Agriculture Element as follows:

> **AIR-2.a** *Require Separation Between* <u>*Air Pollution*</u> *~~Point~~ Sources and Other Land Uses*. Only allow (a) emission ~~point~~ sources or (b) other uses in the vicinity of air pollution or odor ~~point~~ sources if the minimum screening distances between sources and receptors established in the BAAQMD CEQA Guidelines can be met, unless detailed project-specific studies demonstrate compatibility with adjacent uses despite separations that do not meet the screening distance requirements.

Mitigation Measure 4.3-3(c) Add a new program to the Natural Systems & Agriculture Element as follows:

> <u>**AIR-2.(new)** *Health Risk Analysis for Sensitive Receptors*. Require that projects involving sensitive receptors proposed within 150 feet of freeways shall include an analysis of the potential health risks. Mitigation measures which comply with adopted standards of the BAAQMD for control of odor / toxics for sensitive receptors shall be identified to reduce these risks to acceptable levels.</u>

Significance After Mitigation Adoption and implementation of Mitigation Measures 4.3-3(a), 4.3-3(b) and 4.3-3(c) would ensure appropriate buffers between sources of air pollution or odors and sensitive receptors are maintained. The project impact would be reduced to a less-than-significant and the project's contribution to cumulative impacts would be less than cumulatively considerable.

Responsibility and Monitoring The Board of Supervisors would be responsible for adopting the policies and programs described in Mitigation Measures 4.3-3(a), 4.3-(b), and 4.3-(c) as part of the *Draft 2005 CWP Update*. The Marin County Community Development Agency would be responsible for monitoring their implementation.

Impact 4.3-4 Carbon Monoxide Concentrations Along Roadways

Traffic increases under the Draft 2005 CWP Update would result in carbon monoxide concentrations that would be below ambient air quality standards at the most congested intersections. This would be a less-than-significant impact.

Carbon monoxide emissions from traffic would be the pollutant of greatest concern at the local level. Congested intersections with a large volume of traffic have the greatest potential to cause high-localized concentrations of carbon monoxide. Since the early 1990s, carbon monoxide levels have been at healthy levels (i.e., below State and federal standards) in the Bay Area. As a result, the region has been designated as attainment for the standard.

The worst study roadway links and intersections in the county, which include the highest traffic volumes and high levels of congestion, were modeled to assess roadside carbon monoxide concentrations. The traffic-generated emissions of CO were predicted using the Caline4 line source dispersion model, as described above (also see *Air Quality Background Report*). These intersections along with the modeled concentrations are shown in **Exhibit 4.3-9**.

Exhibit 4.3-9
Modeled Carbon Monoxide Levels

Roadway Segment Description	***Existing (2005) Modeled Level*** [a] ***(parts per million [ppm])***		***Future (2030) Modeled Level (parts per million [ppm])***	
	1-Hour	***8-hour***	***1-Hour***	***8-hour***
U.S. 101 n/o I-580	7.4	4.9	4.8	3.1
1-580 near the Richmond-San Rafael Bridge	5.6	3.6	4.3	2.8
Sir Francis Drake Blvd. West of U.S. 101	6.8	4.5	4.4	2.8
State Route 1 near Almonte Blvd.	5.7	3.7	4.3	2.8
Tiburon Blvd. and Redwood	9.1	6.1	4.9	3.1
2nd St. and Grand Ave	8.4	5.6	4.8	3.1
National Ambient Air Quality Standard	35	9.0		
California Ambient Air Quality Standard	20	9.0		

a. Includes background level of 4 ppm for 1-hour and 2.5 ppm for 8-hour.

Source: Illingworth and Rodkin, Inc. 2006.

Traffic generated by land uses and development consistent with the *Draft 2005 CWP Update* would increase carbon monoxide levels along roadways. Roadways and intersections affected by the greatest traffic changes were modeled. Although levels may increase slightly along these roadways, the overall concentrations would be well below health-based ambient air quality standards. Traffic associated with land uses and development consistent with the *Draft 2005 CWP Update* would not cause a significant air quality impact in terms of increase pollutant concentrations along roadways.

The county's worst intersections, in terms of roadside air pollutant concentrations, have levels that are currently below ambient air quality standards. The concentrations are anticipated to decrease substantially in the future with improvements to exhaust systems and reformulated fuels. As a result, the impact on local air quality resulting from implementation of the *Draft 2005 CWP Update* would be less-than-significant and would make a less than cumulatively considerable contribution to cumulative impacts.

Mitigation Measure 4.3-4 None required

Impact 4.3-5 Fugitive Dust Associated with Construction Projects

Construction associated with land uses and development consistent with the Draft 2005 CWP Update would result in emissions of dust and possibly toxic air contaminants. However, existing regulations and air quality policies and programs contained in the Draft 2005 CWP Update would reduce this to a less-than-significant impact.

Construction of individual projects would involve activities that result in air pollutant emissions. Construction activities such as demolition, grading, construction worker travel to and from project sites, delivery and hauling of construction supplies and debris to and from the project site, and fuel combustion by on-site construction equipment would generate pollutant emissions. These construction activities would temporarily create emissions of dust, fumes, equipment exhaust, and other air contaminants. Dust emissions can lead to both nuisance and health impacts. PM_{10} is the pollutant of greatest concern that is emitted from construction, particularly during site preparation and grading. PM_{10} emissions from construction can vary daily, depending on various factors, such as the level of activity, type of construction activity taking place, the equipment being operated, weather conditions, and soil conditions. The BAAQMD has identified a set of feasible PM_{10} control measures for construction activities. According to the *BAAQMD CEQA Guidelines,* [19] if all of these control measures are implemented, then air pollutant emissions from construction activities would be considered a less than significant impact.

In addition, the BAAQMD and CARB have regulations that address the handling of hazardous air pollutants such as lead and asbestos. Lead and asbestos emissions could occur from demolition activities and asbestos emissions could occur from disturbance of soils with naturally occurring asbestos (found in parts of the county). BAAQMD rules and regulations address the both the handling and transport of these contaminants. An air toxic control measure adopted by CARB (California Code of Regulations Title 17, Section 93105) is enforced by the BAAQMD. The measure requires regulated operations engaged in road construction and maintenance activities, construction and grading operations, and quarrying and surface mining operations in areas where naturally occurring asbestos is likely to be found, to employ the best available dust mitigation measures in order to reduce and control dust emissions. The BAAQMD shall be consulted prior to handling materials that contain hazardous contaminants such as lead or asbestos.

Policies **AIR-1.2** and **AIR-1.3** would require that projects meet air quality standards and impacts are mitigated. Specifically, Program **AIR-1.b** would require that new projects are evaluated in accordance with the *BAAQMD CEQA Guidelines* and **AIR-1.g** would require reasonable and feasible control measures for construction and agricultural activities, which include feasible PM_{10} control measures recommended by the BAAQMD. Based on criteria described in ***Section 4.0 Environmental Setting, Impacts, and Mitigation Measures***, Programs **AIR-1.b** and **AIR-1.g** would be implemented in a timely manner and could be relied upon to reduce this impact. [20]

The *Draft 2005 CWP Update* incorporates appropriate measures to control emissions from construction activity. These measures are listed in the *Air Quality Background Report* As a result, air quality impacts associated with construction projects would be less-than-significant and would make a less than cumulatively considerable contribution to cumulative impacts.

Mitigation Measure 4.3-5 None required

[19] *BAAQMD CEQA Guidelines,* Bay Area Air Quality Management District, April 1996 (Revised December 1999), page 14.

[20] As described in **Figure 2-16** Atmosphere and Climate Program Implementation in the *Draft CWP Update*.

Impact 4.3-6 Increase in Greenhouse Gas Emissions

Land uses and development consistent with the Draft 2005 CWP Update would result in an increase in greenhouse gas emissions over existing levels. This would be a significant impact.

Human activities powered by fossil fuels such as coal, oil, and natural gas cause the waste product carbon dioxide (CO_2) to be released into the air. As discussed in the setting section the largest contributors to these emissions in Marin County are vehicular traffic and energy use in buildings. With land uses and development consistent with the *Draft 2005 CWP Update* there would be an increase in greenhouse gas emissions over existing levels. This is in part due to the projected increase in daily vehicle miles (VMT) traveled. As shown in **Exhibit 4.3-6**, daily VMT are expected to increase from an existing 7.0 million to approximately 8.8 million with the buildout of the *Draft 2005 CWP Update*.

Many different types of activities and programs can reduce Marin's carbon dioxide emissions. The most important ways to reduce emissions are through: [21]

- Changes in transportation; and
- Energy efficiency and conservation in both commercial and residential buildings.

The *Draft 2005 CWP Update* target for reducing greenhouse gas emissions countywide is 15 percent by 2015 and for County government sources 15 to 20 percent by 2015. To achieve these targets the *Draft 2005 CWP Update* contains numerous goals, policies and programs that, if adopted and implemented, would act to help minimize carbon dioxide and other greenhouse gas emissions. The Atmosphere and Climate section of the Natural Systems & Agriculture Element describes goals, policies and programs with respect to greenhouse gases. These policies and programs are intended to reduce greenhouse gas emissions countywide. Goal **AIR-4** would aim to prepare policies that promote efficient management and use of resources in order to minimize greenhouse gas emissions. Programs **AIR-4.a**, **AIR-4.b**, **AIR-4.c**, **AIR-4.d** and **AIR-4.e** would all be aimed at directly reducing greenhouse gas emissions resulting from energy use in buildings, from transportation, from waste disposal, from agriculture, and from government contributions.

As discussed in *Impact 4.3-1 Consistency with Clean Air Plan* numerous policies and programs in the *Draft 2005 CWP Update* would reduce the rate of vehicle miles traveled from trips in Marin County. For example, the Built Environment Element contains policies and implementing programs that would encourage development in urban areas served by transit. Policies supporting Goal **HS-3** would implement "smart" and sustainable development principles to meet the housing needs in the county. This would include a focus of providing workforce housing (e.g., Policies **HS-3.2**, **HS-3.3**, and **HS-3.4**). The addition of workforce housing would reduce VMT associated with worker commute travel. The Transportation section of the Built Environment Element includes numerous policies to expand pedestrian and bicycle facilities and access. Other policies and programs would promote energy efficiency and conservation in buildings. The Energy and Green Building section of the Built Environment Element addresses energy conservation and green building standards. Implementation of these policies and programs would reduce carbon dioxide and other greenhouse gases reduced emissions from electrical energy production and natural gas usage.

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[21] *Measuring Marin County's Ecological Footprint*, prepared for the County of Marin Community Development Agency by Justin Kitzes, M.S. and Steve Goldfinger, Ph.D., February 2006.

The *Marin County Greenhouse Gas Reduction Plan* [22] adopted by the Board of Supervisors in October 2006 set out policies to help achieve the County's greenhouse gas emissions targets. The target has been set to reduce greenhouse gas emissions 15 to 20 percent below 1990 levels by the year 2020 for internal government and 15 percent countywide. This target exceeds the State target for greenhouse gas emissions. The *Greenhouse Gas Reduction Plan* describes measures related to building, transportation, waste, and land use. Many of these actions and measures are supported by policies in the *Draft 2005 CWP Update* and some reflect activities that are already underway and could be expanded.

Exhibit 4.3-10 provides a list of various measures that would reduce greenhouse gas emissions in Marin County, some of which are included in the *Marin County Greenhouse Gas Reduction Plan*. The exhibit describes the various types of measure and a link to a specific program in the *Draft 2005 CWP Update*. The exhibit also provides an estimate of the yearly reduction in tons of CO_2 that could be achieved by individual measures.

22 *Marin County Greenhouse Gas Reduction Plan*, Marin County Community Development Agency, October 2006.

Exhibit 4.3-10
Draft 2005 CWP Update Programs to Reduce Greenhouse Gas Emissions

Measure / Program	*Category*	*Draft 2005 CWP Update Programs*	*Emissions Reduction (tons of CO_2)*
Adopt strict residential or commercial energy code requirements	Buildings / Energy	**AIR-4.a**, **EN-1.a**, **EN-1.b**, **EN-1.c**, **EN-1.d**, **EN-3.a**, **EN-3.b**, **EN-3.f**, **EN-3.h**	-
Launch an "energy efficiency challenge" campaign for community residents	Buildings / Energy	**AIR-4.a**, **EN-1.e**	-
Install solar water heating at community swimming pool	Buildings / Energy	**AIR-4.a**, **EN-2.d**	-
Install energy-efficient cogeneration power production facilities	Buildings / Energy	**AIR-4.a**, **ED-2.d**, **EN-2.f**	-
Initiate a community biodiesel purchasing coop or fueling station	Transportation	**EN-2.d**	-
Utilize biodiesel in municipal fleet	Transportation	**AIR-3.b**, **AIR-3.c**, **TR-4.c**	-
Encourage local buses and taxis to convert to alternative fuels by subsidizing fuel conversion equipment costs	Transportation	**AIR-3.b**, **AIR-3.c**, **TR-4.c**	-
Install energy-efficient exit sign lighting	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.f**	-
Improve water pumping energy efficiency	Buildings / Energy	**AIR-4.a**	
Install energy-efficient traffic lights	Buildings / Energy		-
Provide high school students with complementary bus tickets	Transportation	**TR-3.c**	-
Remove or replace woodstoves and fireplaces with EPA rated woodstoves	Buildings / Energy	**AIR-4.a**	-

Measure / Program	***Category***	***Draft 2005 CWP Update Programs***	***Emissions Reduction (tons of CO_2)***
Alternative Program: Carbon credits	Carbon Credits		-
Plant trees For Energy Savings	Land Use	**AIR-4.k**, **BIO-4.I**	-
Institute growth boundaries, ordinances or programs to limit suburban sprawl	Land Use	**AIR-4.l**, **AIR-4.m**, **OS-2.b**, **OS-2.c**, **OS-2.g**, **OS-2.h**, **CD-1.a**, **CD-1.b**	-
Enforce electric vehicle recharging facilities in new large parking facilities	Transportation		-
Produce electricity from agricultural waste	Waste / Recycling	**AIR-4.d**	633
Install new light rail systems	Transportation	**AIR-4.b**	82,000
Implement bus rapid transit or shuttle programs to SF	Transportation	**AIR-4.b**	29,800
Implement environmentally preferable purchasing program recycled paper, etc (energy efficient appliances are ignored here)	Waste / Recycling	**AIR-4.e**, **EC-1.i**, **EC-1.j**	36
Establish/expand recycling programs in municipal facilities	Waste / Recycling	**AIR-4.c**, **AIR-4.e**	48
Encourage telecommuting by community by offering services online or on the phone at reduced rates compared to in-person visits	Transportation	**AIR-4.b**, **TR-1.a**	3
Provide free bicycle loans for municipal staff use	Transportation	**AIR-4.b**	0
Implement green or reflective roofing	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.d**, **EN-2.f**	34
Limit idling of local transit buses and school buses	Transportation		21
Promote participation in a Green Business Program	Buildings / Energy	**EC-1.a**, **EC-1.k**	16

Measure / Program	***Category***	***Draft 2005 CWP Update Programs***	***Emissions Reduction (tons of CO_2)***
Perform energy-efficient lighting retrofits	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.f**	22
Install energy-efficient street lights (e.g., high pressure sodium, LEDS)	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.f**	182
Implement a form of community choice aggregation	Buildings / Energy	**EN-2.g**	294,165
Expand local or regional bus service in range and/or frequency	Transportation	**AIR-4.b**, **TR-3.a**	10,000
Offer a halogen torchiere lamp exchange to community members	Buildings / Energy	**AIR-4.a**	5
Offer an LED Christmas light trade-in to community members	Buildings / Energy	**AIR-4.a**	18
Purchase "green electricity" from solar, geothermal, wind, hydroelectric sources through green tags	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.f**	4,260
Purchase "green electricity" from solar, geothermal, wind, hydroelectric sources through green tags	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.f**	2,840
Purchase "green electricity" from solar, geothermal, wind, hydroelectric sources through green tags	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.f**	1,420
Establish system for reuse or recycling of construction and demolition materials	Waste / Recycling	**EN-3.c**, **PFS-4.b**	30,000
Install solar panels on municipal facilities	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.f**	736
Implement solid waste reduction program through creation of reuse facilities / programs	Waste / Recycling	**AIR-4.c**, **PFS-4.c**, **PFS-4.d**	33,000

Measure / Program	***Category***	***Draft 2005 CWP Update Programs***	***Emissions Reduction (tons of CO_2)***
Encourage community car-sharing (run a program as municipality/ support for-profits that give car-sharing services, e.g., Zipcar)	Transportation	**AIR-4.b**, **TR-1.c**	11,880
Install an anaerobic digester at the wastewater treatment facility	Waste / Recycling	**PFS-4.h**	3,200
Increase gas tax	Transportation		32,000
Promotion/informative campaign on 'How to Get Around'	Transportation	**AIR-4.b**, **TR-2.a**	319
Community energy efficiency rebate program	Buildings / Energy	**AIR-4.a**, **EN-1.e**, **EN-2.e**	830
Expand community bicycle infrastructure (e.g., dedicated bicycle lanes, additional bicycle parking spaces)	Transportation	**TR-2.b**, **TR-2.c**, **TR-2.d**, **TR-2.e**, **TR-2.g**, **TR-2.h**, **TR-2.I**, **TR-2.l**	400
Encourage car-pooling, telecommuting and the use of mass-transit by community members by billboard promotions	Transportation	**AIR-4.b**, **TR-1.a**, **TR-1.c**	159
Decrease average daily time street lights are on	Buildings / Energy		14
Encourage car-pooling or van-pooling by municipal employees	Transportation	**AIR-4.b**, **AIR-4.e**, **TR-1.c**	1,192
Establish/expand recycling programs in the community	Waste / Recycling	**AIR-4.c**, **PFS-4.d**	119,300
Perform heating, cooling and ventilation system retrofits (e.g., chillers, boilers, fans, pumps, belts, fuel-switching from electric to gas heating)	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**	48
Offer incentives for PV installations in the community	Buildings / Energy	**AIR-4.a**, **EN-2.e**	8,411

Measure / Program	***Category***	***Draft 2005 CWP Update Programs***	***Emissions Reduction (tons of CO_2)***
Produce electricity from recovered methane in local landfills	Waste / Recycling	**AIR-4.c**	5,300
Institute a lights-out-at-night policy	Buildings / Energy	**AIR-4.e**	28
Encourage telecommuting by municipal employees	Transportation	**AIR-4.b**, **TR-1.a**	48
Implement Tidal Power Project	Buildings / Energy	**AIR-4.a**, **EN-2.d**	446,408
Develop park and ride facilities	Transportation	**AIR-4.b**	16,400
Improve traffic signal synchronization / decrease stop rate and time	Transportation	**TR-2.k**	16,000
Offer prioritized parking for hybrid Cars	Transportation	**AIR-4.b**	4,615
Allow bikes on trains/busses	Transportation	**AIR-4.b**	191
Install occupancy sensors	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**	28
Expand the "safe routes to school" program	Transportation	**TR-2.b**, **TR-2.j**, **TR-2.k**	239
Foster downtown neighborhood development	Land Use	**CD-2.a**, **CD-2.b**, **CD-2.c**, **CD-2.e**, **CD-2.f**, **CD-2.g**, **CD-2.h**, **CD-3.a**	775
Install ENERGY STAR monitors	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.f**	5
Install ENERGY STAR printers	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.f**	3
Install ENERGY STAR copiers	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.f**	2
Install ENERGY STAR water coolers	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.f**	1
Implement a police on bicycles program	Transportation	**AIR-4.b**, **AIR-4.e**	15

Measure / Program	***Category***	***Draft 2005 CWP Update Programs***	***Emissions Reduction (tons of CO_2)***
Utilize fuel-efficient vehicles (e.g., scooters) for parking enforcement	Transportation	**AIR-4.b**, **AIR-4.e**, **TR-4.c**	31
Install energy-efficient vending machines	Buildings / Energy	**AIR-4.a**, **AIR-4.e**, **EN-1.j**, **EN-2.f**	11
Purchase fuel efficient (e.g., hybrid) and / or smaller fleet vehicles	Transportation	**AIR-4.b**, **AIR-3.c**, **AIR-3.c**, **AIR-4.e**, **TR-4.c**	173
		Total Projected CO_2 Reduction	***1,157,265***

Source: Marin Community Development Agency and International Council for Local Environmental Initiatives.

However, because of uncertainties pertaining to the timely and effective implementation of the proposed Countywide greenhouse gas reduction measures beyond the control of Marin County government this would be a significant project impact and the project would make a cumulatively significant contribution to a cumulative greenhouse gas emissions impact.

Mitigation Measure 4.3-6 In order to reduce project related and cumulative impacts the following mitigation would be required:

Mitigation Measure 4.3-6(a) Revise Program **AIR-4.f** of the Natural Systems & Agriculture Element as follows:

> **AIR-4.f** *Establish a Climate Change Planning Process*. Approve and begin implementation of the *Marin County Greenhouse Gas Reduction Plan*. Integrate *Marin County Greenhouse Gas Reduction Plan* ~~climate change planning and program implementation~~ into long range and current planning functions and other related agencies. Establish and maintain a process to implement, measure, evaluate, and modify implementing programs, using the Cities for Climate Protection Campaign as a model.

Mitigation Measure 4.3-6(b) Implement proposed State programs to reduce greenhouse gas emissions including the Renewable Portfolio Standards, California Fuel Efficiency (CAFÉ) standards and a carbon cap and trade programs.

Significance After Mitigation Implementation of the County's *Greenhouse Gas Reduction Plan*, the goals, policies, and programs of the *Draft 2005 CWP Update* and Mitigation Measures 4.3-6(a) and 4.3-3(b) and 4.3-3(c) should reduce the rate of increase in greenhouse gas emissions. It is uncertain whether greenhouse gas emissions would be reduced countywide to below existing levels within the timeframe of the Countywide Plan. This, therefore, would be a significant unavoidable project and cumulative impact.

Responsibility and Monitoring The Board of Supervisors would be responsible for adopting the program described in Mitigation Measure 4.3-6(a) as part of the *Marin Countywide Plan 2005.* Implementation would be the responsibility of both Marin County and the Marin County incorporated cities and towns. The Marin County Community Development Agency would be responsible for monitoring implementation. For mitigation measure 4.3-6(b), the California State Air Resources Board would be responsible for implementation and monitoring.

Exhibit L

Exhibit L

Draft

Program Environmental Impact Report

Southern California Association of Governments

2012-2035 Regional Transportation Plan/Sustainable Communities Strategy

December 2011 | State Clearinghouse # 2011051018

SOUTHERN CALIFORNIA
ASSOCIATION of GOVERNMENTS

3.2 AIR QUALITY

This section describes current air quality in the SCAG region, discusses the potential impacts of the 2012-2035 Regional Transportation Plan/Sustainable Communities Strategies (2012-2035 RTP/SCS or Plan) on air quality, identifies mitigation measures for the impacts, and evaluates the residual impacts.

This analysis focuses on air pollution from on-road motor vehicles in two perspectives: daily emissions and pollutant concentrations. "Emissions" refer to the quantity of pollutants released into the air, measured in pounds per day (ppd). "Concentrations" refer to the amount of pollutant material per volumetric unit of air, measured in parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). The following discussion identifies the pollutants included in this analysis.

Pollutants and Effects

Health-based air quality standards have been established by California and the federal government for the following criteria pollutants: carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO2), particulate matter 2.5 microns or less in diameter (PM2.5), particulate matter ten microns or less in diameter (PM10), and lead (Pb). California also includes standards for Hydrogen Sulfide, Vinyl Chloride, sulfate and visibility.

The following summarizes the health effects of the criteria pollutants:[1]

Carbon Monoxide (CO). CO is a colorless, odorless, relatively inert gas. It is a trace constituent in the unpolluted troposphere, and is produced by both natural processes and human activities. In remote areas far from human habitation, CO occurs in the atmosphere at an average background concentration of 0.04 ppm, primarily as a result of natural processes such as forest fires and the oxidation of methane. Global atmospheric mixing of CO from urban and industrial sources creates higher background concentrations (up to 0.20 ppm) near urban areas. The major source of CO in urban areas is incomplete combustion of carbon-containing fuels, mainly gasoline. Consequently, CO concentrations are generally highest in the immediate vicinity of major concentrations of vehicular traffic but it disperses rapidly beyond 500 feet of the vicinity.

CO is a primary pollutant, meaning that it is directly emitted into the air, not formed in the atmosphere by chemical reaction of precursors, as is the case with ozone and other secondary pollutants. Ambient concentrations of CO in the region exhibit large spatial and temporal variations due to variations in the rate at which CO is emitted and in the meteorological conditions that govern transport and dilution. Unlike O_3, CO tends to reach high concentrations in the fall and winter months. The highest concentrations frequently occur on weekdays at times consistent with rush hour traffic and late night during the coolest, most stable portion of the day.

Individuals with a deficient blood supply to the heart are the most susceptible to the adverse effects of CO exposure. The effects observed include earlier onset of chest pain with exercise, and electrocardiograph changes indicative of worsening oxygen supply to the heart.

Inhaled CO has no direct toxic effect on the lungs, but exerts its effect on tissues by interfering with oxygen transport by competing with oxygen to combine with hemoglobin present in the blood to form carboxyhemoglobin (COHb). Hence, health conditions requiring an increased demand for oxygen supply can be adversely affected by exposure to CO. Individuals most at risk include patients with diseases involving heart and blood vessels, fetuses (unborn babies), and patients with chronic hypoxemia (oxygen deficiency) as seen in high altitudes.

[1]SCAQMD, *Final EIR for the 2007 Air Quality Management Plan*, June 2007.

Reductions in birth weight and impaired neurobehavioral development have been observed in animals chronically exposed to CO resulting in COHb levels similar to those observed in smokers. Recent studies have found increased risks for adverse birth outcomes with exposure to elevated CO levels. These include pre-term births and heart abnormalities.[2]

Volatile Organic Compounds (VOCs). VOCs are typically formed from combustion of fuels and/or released through evaporation of organic liquids. Some VOCs are also classified by the State as toxic air contaminants. While there are no specific VOC ambient air quality standards, VOC is a prime component (along with NOx) of the photochemical processes by which such criteria pollutants as ozone, nitrogen dioxide, and certain fine particles are formed. These criteria pollutants are thus regulated as "precursors" to formation of ozone.

Ozone (O_3). O_3, a colorless gas with a sharp odor, is a highly reactive form of oxygen. High O_3 concentrations exist naturally in the stratosphere. Some mixing of stratospheric O_3 downward through the troposphere to the earth's surface does occur; however, the extent of O_3 transport is limited. At the earth's surface in sites remote from urban areas, O_3 concentrations are normally very low (0.03-0.05 ppm). For comparison, one- and eight-hour O_3 concentrations in the SCAG region typically range between 0.1 and 0.15 ppm.

While O_3 is beneficial in the stratosphere because it filters out skin-cancer-causing ultraviolet radiation, it is a highly reactive oxidant. It is this reactivity which accounts for its damaging effects on materials, plants, and human health at the earth's surface.

The propensity of O_3 for reacting with organic materials causes it to be damaging to living cells, and ambient O_3 concentrations in the South Coast Air Basin (SCAB) are frequently sufficient to cause health effects. O_3 enters the human body primarily through the respiratory tract and causes respiratory irritation and discomfort, makes breathing more difficult during exercise, and reduces the respiratory system's ability to remove inhaled particles and fight infection.

Individuals exercising outdoors, children, and people with preexisting lung disease, such as asthma and chronic pulmonary lung disease, are considered to be the most susceptible subgroups for O_3 effects. Short-term exposures (lasting for a few hours) to O_3 at levels typically observed in Southern California can result in breathing pattern changes, reduction of breathing capacity, increased susceptibility to infections, inflammation of the lung tissue, and some immunological changes. In recent years, a correlation between elevated ambient O_3 levels and increases in daily hospital admission rates, as well as mortality, has also been reported. An increased risk for asthma has been found in children who participate in multiple sports and live in high O_3 communities. Elevated O_3 levels are also associated with increased school absences.

O_3 exposure under exercising conditions is known to increase the severity of the above-mentioned observed responses. Animal studies suggest that exposures to a combination of pollutants which include O_3 may be more toxic than exposure to O_3 alone. Although lung volume and resistance changes observed after a single exposure diminish with repeated exposures, biochemical and cellular changes appear to persist, which can lead to subsequent lung structural changes.

Nitrogen Dioxide (NO_2). NO_2 is a reddish-brown gas with a bleach-like odor. Nitric oxide (NO) is a colorless gas, formed from the nitrogen (N_2) and oxygen (O_2) in air under conditions of high temperature and pressure which are generally present during combustion of fuels; NO reacts rapidly with the oxygen in air to form NO_2. NO_2 is responsible for the brownish tinge of polluted air. The two gases, NO and NO_2, are referred to collectively as NO_X. In the presence of sunlight, NO_2 reacts to form nitric oxide and an oxygen atom. The oxygen atom can react further to form ozone, via a complex series of chemical reactions involving hydrocarbons. Nitrogen dioxide may also react to form nitric acid (HNO_3) which reacts further to form nitrates, components of PM2.5 and PM10.

[2] SCAQMD, *Final EIR for the 2007 Air Quality Management Plan*, June 2007.

Population-based studies suggest that an increase in acute respiratory illness, including infections and respiratory symptoms in children (not infants), is associated with long-term exposures to NO_2 at levels found in homes with gas stoves, which are higher than ambient levels found in Southern California. Increase in resistance to air flow and airway contraction is observed after short-term exposure to NO_2 in healthy subjects. Larger decreases in lung functions are observed in individuals with asthma and/or chronic obstructive pulmonary disease (e.g., chronic bronchitis, emphysema) than in healthy individuals, indicating a greater susceptibility of these sub-groups. More recent studies have found associations between NO_2 exposures and cardiopulmonary mortality, decreased lung function, respiratory symptoms and emergency room asthma visits.

In animals, exposure to levels of NO_2 considerably higher than ambient concentrations results in increased susceptibility to infections, possibly due to the observed changes in cells involved in maintaining immune functions. The severity of lung tissue damage associated with high levels of ozone exposure increases when animals are exposed to a combination of O_3 and NO_2.

Sulfur Dioxide (SO_2). SO_2 is a colorless gas with a sharp rotten egg odor. It reacts in the air to form sulfuric acid (H_2SO_4), which contributes to acid precipitation, and sulfates, which are components of PM10 and PM2.5. Most of the SO_2 emitted into the atmosphere is produced by burning sulfur-containing fuels.

Exposure of a few minutes to low levels of SO_2 can result in airway constriction in some asthmatics. All asthmatics are sensitive to the effects of SO_2. In asthmatics, increase in resistance to air flow, as well as reduction in breathing capacity leading to severe breathing difficulties, is observed after acute higher exposure to SO_2. In contrast, healthy individuals do not exhibit similar acute responses even after exposure to higher concentrations of SO_2.

Some population-based studies indicate that the mortality and morbidity effects associated with fine particles show a similar association with ambient SO_2 levels. In these studies, efforts to separate the effects of SO_2 from those of fine particles have not been successful. It is not clear whether the two pollutants act synergistically or one pollutant alone is the predominant factor.

Particulate Matter. Of great concern to public health are the particles small enough to be inhaled into the deepest parts of the lung. Respirable particles (PM10, or particulate matter less than about 10 micrometers in diameter) and fine particles (PM2.5, or particulate matter less than 2.5 micrometers in diameter) can accumulate in the respiratory system and aggravate health problems such as asthma, bronchitis and other lung diseases. Children, elderly, exercising adults, and those suffering from asthma, pre-existing respiratory and/or cardiovascular disease are especially vulnerable to adverse health effects of PM10 and PM2.5.

A consistent correlation between elevated ambient particulate matter (PM10 and PM2.5) levels and an increase in mortality rates, respiratory infections, number and severity of asthma attacks and the number of hospital admissions has been observed in different parts of the United States and various areas around the world. Studies have reported an association between long-term exposure to air pollution dominated by fine particles (PM2.5) and increased mortality (especially from lung cancer) and reduction in life-span.

Daily fluctuations in PM2.5 concentration levels have also been related to hospital admissions for acute respiratory conditions, to school and kindergarten absences, to a decrease in respiratory function in normal children and to increased medication use in children and adults with asthma. Studies have also shown lung function growth in children is reduced with long-term exposure to PM10 and PM2.5.[3]

Sulfates. Sulfates are chemical compounds that contain the sulfate ion (SO_4), and are part of the mixture of solid materials that make up PM_{10}. Most of the sulfates in the atmosphere are produced by oxidation of sulfur dioxide. Oxidation of sulfur dioxide yields sulfur trioxide (SO_3) that reacts with water to form sulfuric

[3]SCAQMD, *Final EIR for the 2007 Air Quality Management Plan*, June 2007.

acid, which contributes to acid deposition. The reaction of sulfuric acid with basic substances such as ammonia yields sulfates, a component of PM10 and PM2.5.

Most of the health effects associated with PM2.5 and sulfur dioxide at ambient levels are also associated with sulfates. Thus, both mortality and morbidity effects have been observed with an increase in ambient sulfate concentrations. However, efforts to separate the effects of sulfates from the effects of other pollutants have generally not been successful.

Clinical studies of asthmatics exposed to sulfuric acid suggest that adolescent asthmatics are possibly a subgroup susceptible to acid aerosol exposure. Animal studies suggest that acidic particles such as sulfuric acid aerosol and ammonium bisulfate are more toxic than non-acidic particles like ammonium sulfate. Whether the effects are attributable to acidity or to PM10/PM2.5 remains unresolved.

Lead (Pb). Pb in the atmosphere is present as a mixture of a number of Pb compounds. Leaded gasoline and Pb smelters have been the main sources of Pb emitted into the air. Due to the phasing out of leaded gasoline, there was a dramatic reduction in atmospheric Pb in the SCAB over the past two decades.

Fetuses, infants, and children are more sensitive than others to the adverse effects of Pb exposure. Exposure to low levels of Pb can adversely affect the development and function of the central nervous system, leading to learning disorders, distractibility, inability to follow simple commands, and lower intelligence quotient. In adults, increased Pb levels are associated with increased blood pressure.

Pb poisoning can cause anemia, lethargy, seizures, and death. It appears that there are no direct effects of lead on the respiratory system. Pb can be stored in the bone from early-age environmental exposure, and elevated blood lead levels can occur due to breakdown of bone tissue during pregnancy, hyperthyroidism (increased secretion of hormones from the thyroid gland), and osteoporosis (breakdown of bony tissue). Fetuses and breast-fed babies can be exposed to higher levels of Pb because of previous environmental Pb exposure of their mothers.

Toxic Air Contaminants (TACs). TACs, also referred to as hazardous air pollutants (HAPs), are generally defined as those contaminants that are known or suspected to cause serious health problems, but do not have a corresponding ambient air quality standard. TACs are also defined as an air pollutant that may increase a person's risk of developing cancer and/or other serious health effects; however, the emission of a toxic chemical does not automatically create a health hazard. Other factors, such as the amount of the chemical; its toxicity, and how it is released into the air, the weather, and the terrain, all influence whether the emission could be hazardous to human health. TACs are emitted by a variety of industrial processes such as petroleum refining, electric utility and chrome plating operations, commercial operations such as gasoline stations and dry cleaners, and motor vehicle exhaust and may exist as PM10 and PM2.5 or as vapors (gases). TACs include metals, other particles, gases absorbed by particles, and certain vapors from fuels and other sources.

The emission of toxic substances into the air can be damaging to human health and to the environment. Human exposure to these pollutants at sufficient concentrations and durations can result in cancer, poisoning, and rapid onset of sickness, such as nausea or difficulty in breathing. Other less measurable effects include immunological, neurological, reproductive, developmental, and respiratory problems. Pollutants deposited onto soil or into lakes and streams affect ecological systems and eventually human health through consumption of contaminated food. The carcinogenic potential of TACs is a particular public health concern because many scientists currently believe that there is no "safe" level of exposure to carcinogens. Any exposure to a carcinogen poses some risk of contracting cancer.

The public's exposure to TACs is a significant public health issue in California. The Air Toxics "Hotspots" Information and Assessment Act is a state law requiring facilities to report emissions of TACs to air districts. The program is designated to quantify the amounts of potentially hazardous air pollutants released, the location of the release, the concentrations to which the public is exposed, and the resulting health risks.

The State Air Toxics Program (AB 2588) identified over 200 TACs, including the 188 TACs identified in the federal Clean Air Act. The Unites States Environmental Protection Agency (USEPA) has assessed this expansive list of toxics and identified 21 TACs as Mobile Source Air Toxics (MSATs). MSATs are compounds emitted from highway vehicles and nonroad equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline. USEPA also extracted a subset of these 21 MSAT compounds that it now labels as the six priority MSATs: benzene, formaldehyde, acetaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, and 1,3-butadiene. While these six MSATs are considered the priority transportation toxics, USEPA stresses that the lists are subject to change and may be adjusted in future rules.[4]

The California-specific transportation air quality analysis model, EMFAC, is designed to model MSATs at the project-level. Health effects from MSATs/TACs, i.e., cancer risks and chronic non-cancer risks from on-road traffic, have been associated primarily with diesel PM, benzene, and 1,3-butadiene. EMFAC can be used to estimate diesel particulate matter, benzene, and 1,3-butadiene emissions. In addition to diesel particulate matter (diesel PM), benzene, 1,3-butadiene, acetaldehyde, carbon tetrachloride, hexavalent chromium, paradichlorobenzene, formaldehyde, methylene chloride, and perchloroethylene pose the greatest existing ambient TAC risk, for which data are available, in California.

MSATs/TACs may threaten public health even at low concentrations due to their high toxicity. Therefore, no exposure levels are considered safe for TACs/MSATs. For federal highway projects, FHWA has established the following interim policy for the impact analysis of TACs and MSATs: "Given the emerging state of the science and of project-level analysis techniques, there are no established criteria for determining when MSAT emissions should be considered a significant issue in the NEPA context."

The California Office of Environmental Health Hazard Assessment (OEHHA) has established protocols and methods for performing health risk analyses (HRAs) for stationary sources and some area sources; however, highway sources are mobile sources.

To date, the most comprehensive study of air toxics in the SCAB is the Multiple Air Toxics Exposure Study (MATES-III), conducted by Southern California Air Quality Management District (SCAQMD). The monitoring program measured more than 30 air pollutants, including both gases and particulates. The monitoring study was accompanied by a computer modeling study in which SCAQMD estimated the risk of cancer from breathing toxic air pollution throughout the region based on emissions and weather data. MATES-III found that the cancer risk in the region from carcinogenic air pollutants ranges from about 870 in a million to 1,400 in a million, with an average regional risk of about 1,200 in a million.

Air Dispersion. TACs/MSATs impact those located closest to the emission sources more than those located further away. A California law passed in 2003 (Public Resources Code Section 21151.8) prohibits the siting of a school within 500 feet of a freeway unless, "the school district determines, through analysis based on appropriate air dispersion modeling, that the air quality at the proposed site is such that neither short-term nor long-term exposure poses significant health risks to pupils."

USEPA has issued a number of regulations that will dramatically decrease MSATs through cleaner fuels and cleaner engines. According to an FHWA analysis, even if the number of vehicle miles traveled (VMT) increases by 64 percent, reductions of 57 percent to 87 percent in MSATs are projected from 2000 to 2020. These are national figures, and data for California, the SCAG region, and individual roadways may vary.

[4]FHWA, *Memorandum. Information: Interim Guidance on Air Toxic Analysis in NEPA Documents*, September 30, 2009.

Diesel Particulate Matter (diesel PM). According to the 2006 California Almanac of Emissions and Air Quality, the majority of the estimated health risks from TACs can be attributed to relatively few compounds, the most important being particulate matter from the exhaust of diesel-fueled engines (diesel PM). Diesel PM differs from other TACs in that it is not a single substance, but rather a complex mixture of hundreds of substances.

Diesel exhaust is composed of two phases, gas and particle, and both phases contribute to the health risk. The gas phase is composed of many of the urban hazardous air pollutants, such as acetaldehyde, acrolein, benzene, 1,3-butadiene, formaldehyde and polycyclic aromatic hydrocarbons. The particle phase is also composed of many different types of particles by size or composition. Fine and ultra fine diesel particulates are of the greatest health concern, and may be composed of elemental carbon with adsorbed compounds such as organic compounds, sulfate, nitrate, metals and other trace elements. Diesel exhaust is emitted from a broad range of diesel engines; the on road diesel engines of trucks, buses and cars and the off road diesel engines that include locomotives, marine vessels and heavy duty equipment. Although diesel PM is emitted by diesel-fueled internal combustion engines, the composition of the emissions varies depending on engine type, operating conditions, fuel composition, lubricating oil, and whether an emission control system is present.

The most common exposure to diesel PM is breathing the air that contains diesel PM. The fine and ultra-fine particles are respirable (similar to PM2.5), which means that they can avoid many of the human respiratory system defense mechanisms and enter deeply into the lung. Exposure to diesel PM comes from both on-road and off-road engine exhaust that is either directly emitted from the engines or lingering in the atmosphere.

Diesel exhaust causes health effects from both short-term or acute exposures, and long-term chronic exposures. The type and severity of health effects depends upon several factors including the amount of chemical exposure and the duration of exposure. Individuals also react differently to different levels of exposure. There is limited information on exposure to just diesel PM but there is enough evidence to indicate that inhalation exposure to diesel exhaust causes acute and chronic health effects.

Acute exposure to diesel exhaust may cause irritation to the eyes, nose, throat and lungs, some neurological effects such as lightheadedness. Acute exposure may also elicit a cough or nausea as well as exacerbate asthma. Chronic exposure to diesel PM in experimental animal inhalation studies have shown a range of dose-dependent lung inflammation and cellular changes in the lung and immunological effects. Based upon human and laboratory studies, there is considerable evidence that diesel exhaust is a likely carcinogen. Human epidemiological studies demonstrate an association between diesel exhaust exposure and increased lung cancer rates in occupational settings.[5]

USEPA's National Scale Assessment uses several types of health hazard information to provide a quantitative "threshold of concern" or a health benchmark concentration at which it is expected that no adverse health effects occur at exposures to that level. Health effects information on carcinogenic, short- and long-term non-carcinogenic end points are used to establish selective protective health levels to compare to the modeled exposures levels. Unfortunately the exposure response data in human studies are considered too uncertain to develop a carcinogenic unit risk for USEPA's use. There is a Reference Concentration (RFC) that is used as a health benchmark protective of chronic non-carcinogenic health effects but it is for diesel exhaust and not specifically set for diesel PM. The RFC for diesel exhaust, which includes diesel PM, is 5 $\mu g/m^3$.[6] This value is similar to the National Ambient Air Quality Standard established for fine particulate matter (PM2.5), which is 15 $\mu g/m^3$.

[5]USEPA, Diesel Particulate Matter. Available at *http://www.epa.gov/region1/eco/airtox/diesel.html.*
[6]*Ibid.*

Unlike other TACs, no ambient monitoring data are available for diesel PM because no routine measurement method currently exists. However, California Air Resources Board (ARB) has made preliminary concentration estimates based on a PM exposure method. This method uses the ARB emissions inventory's PM10 database, ambient PM10 monitoring data, and the results from several studies to estimate concentrations of diesel PM.

Diesel PM poses the greatest health risk among these ten TACs mentioned. Based on receptor modeling techniques, SCAQMD estimated that diesel PM accounts for 84 percent of the total risk in the SCAB.[7]

Recent studies of the potential effect of roadway emissions on air quality sensitive receptors. Vehicle emissions contain a number of substances that can be harmful, including TACs such as benzene and diesel PM. A growing body of scientific evidence shows that living or going to school near roadways with heavy traffic volumes is associated with a number of adverse effects. These include increased respiratory symptoms, increased risk of heart and lung disease, and elevated mortality rates.[8]

While most of the initial studies were conducted in Europe, a number of research projects conducted in the United States and California are finding similar results. For example, as of 2005, the Children's Health Study, a ten-year study conducted by the University of Southern California School of Medicine, found strong evidence that exposure to pollutants related to vehicle emissions such as $NO_2$and elemental carbon (or soot) is linked to a slowing of lung function growth. The researchers concluded that the resulting deficits in lung function are likely permanent and may increase the risk for respiratory and other diseases later in life. The study also found that the children in the study who lived nearest to roadways with heavy traffic, such as freeways, showed increased risk for having asthma.[9]

The East Bay Children's Respiratory Health Study. The East Bay Children's Respiratory Health Study, conducted in 2001, included more than 1,100 students between the 3rd and 5th grades.[10] The study included ten neighborhoods with school sites located upwind and downwind from major roads. The San Francisco ay area has strong prevailing winds, and this study found that downwind direction and proximity to major roads was an important determinant of increased exposure to traffic pollutants. This study found higher concentrations of black carbon, oxides of nitrogen, and nitrogen oxide at schools located downwind from freeways as compared with those schools upwind or farther from major traffic sources.

For children residing at their current address for at least one year, investigators found a modest but significant increase of five to eight percent in bronchitis and asthma symptoms in children in neighborhoods with higher concentrations of traffic pollutants.

California Office of Environmental Health Hazard Assessment (OEHHA) School Study. The OEHHA studied public schools in California, various socioeconomic factors, and their proximity to major roads. The study found that about two percent of all the public schools in California, incorporating about 150,000 students, are within 150 meters (500 feet) of a very busy roadway. The study also provided recommendations on ways to mitigate exposure of students to traffic-related pollutants in the event that a school is located near busy roadways. The related fact sheet includes the following:

- Where are people exposed to air pollution from nearby traffic?

  Motor vehicles are part of our everyday lives. We breathe air with higher levels of traffic pollutants while:
  - Driving in heavy traffic, such as on main city streets and on busy highways/freeways.
  - Standing near idling cars, trucks, or buses.

[7]SCAQMD, *Multiple Air Toxics Exposure Study in the South Coast Air Basin*, September 2008.
[8]SCAQMD, *Traffic Pollutants and Health Effects*. May 20, 2005.
[9]*Ibid*.
[10]ARB, *The East Bay Children's Health Study; Traffic-Related Air Pollution Near Busy Roads*, June 7, 2004.

- Spending time at places near roads that have heavy traffic, whether it is at home, school, work, or play. Studies have found that places within 150 meters (500 feet) of main city streets, highways, and freeways generally have higher traffic pollutant levels, especially if the location is "downwind" of the road. ("Downwind" means that the wind generally blows from the road toward your location.)

- If a school is near a street with very heavy traffic, does it mean that children are exposed to high levels of traffic-related air pollution?

  Not necessarily. The prevailing wind direction strongly affects exposure to air pollution from nearby traffic. Locations that are both near and "downwind" of a freeway tend to have higher levels of traffic pollution compared with locations that tend to be "upwind" of a freeway. ("Downwind" means that the wind generally blows from the road toward your location. "Upwind" means that the wind generally blows away from your location, toward the road.)

Air Quality and Land Use Handbook. The studies described in the above paragraphs, along with other similar studies, were considered by the ARB in the preparation of the publication, Air Quality and Land Use Handbook: A Community Health Perspective.[11] In the discussion of traffic emissions and health effects, the key health findings included the following:

- Reduced lung function in children was associated with traffic density, especially trucks, within 1,000 feet and the association was strongest within 300 feet;
- Increased asthma hospitalizations were associated with living within 650 feet of heavy traffic and heavy truck volume;
- Asthma symptoms increased with proximity to roadways and the risk was greatest within 300 feet;
- Asthma and bronchitis symptoms in children were associated with proximity to high levels of traffic in a San Francisco Bay Area community with good overall regional air quality; and
- A San Diego study found increased medical visits in children living within 550 feet of heavy traffic.

The ARB concludes their analysis with the following recommendation: Avoid siting new sensitive land uses within 500 feet of a freeway, urban roads with 100,000 vehicles/day, or rural roads with 50,000 vehicles/day.

Childhood Asthma. A study published in 2006 examined the relationship of residence near a freeway and susceptibility to childhood asthma.[12] This study found residence within 75 meters (245 feet) of a major road was associated with an increased risk of lifetime asthma, prevalent asthma, and wheeze. The higher risk of asthma near a major road decreased to background rates at 150 to 200 meters (490 to 655 feet) from the road. In children with a parental history of asthma and in children moving to the residence after two years of age, there was no increased risk associated with exposure. A similar pattern of effects was observed with traffic-modeled exposure. These results indicate that residence near a major road is associated with asthma.

Traffic and Lung Development. One of the most recent studies was published in February 2007, Effect of Exposure to Traffic on Lung Development from 10 to 18 Years of Age: A Cohort.[13] This study examined the pulmonary function of more than 3,500 children over a period of eight years. The studies were conducted in 12 California communities. Health effects related to distance from freeways were divided into three groups: less than 500 meters (1,640 feet) from the freeway, 500 to 1,500 meters (1,640 to 4,920 feet) from the freeway, and greater than 1,500 meters (4,920 feet) from the freeway.

[11]ARB, *Air Quality and Land Use Handbook: A Community Health Perspective*, April 2005.
[12]McConnell, R., K. Berhane, L. Yao, M. Jerrett, F. Lurmann, F. Gilliland, N. Kunzli, J. Gauderman, E. Avol, D. Thomas, and J. Peters, *Traffic, Susceptibility, and Childhood Asthma*, 2006.
[13]Gauderman, W. J., H. Vora, R. McConnell, K. Berhane, F. Gilliland, D. Thomas, F. Lurmann, E. Avol, N. Kunzli, M. Jerrett, and J. Peters, *Effect of Exposure to Traffic on Lung Development from 10 to 18 Years of Age: A Cohort Study*, The Lancet, Volume 369. February 17, 2007.

The study shows that the residential proximity to freeway traffic is associated with substantial deficits in lung-function development in children. The effects were greater for those children who lived within 500 meters (1,640 feet) of a freeway than for those who lived at least 1,500 meters (4,920 feet) from a freeway. Since lung development is nearly complete by age 18 years, an individual with a deficit at this time will probably continue to have less than healthy lung function for the remainder of his or her life. The study did not find any evidence that traffic effects varied depending on background air quality, which suggests that even in an area with low regional pollution, children living near a major roadway are at increased risk of health effects. The results also suggest that children who live close to a freeway in a high pollution area experience a combination of adverse developmental effects because of both local and regional pollution.

Particulates at a Sacramento School Site. A multi-year study in the Sacramento area, described in a 2006 report, analyzed atmospheric particulate matter at a school site downwind of a busy secondary road.[14] The study was not a health effects study. The study is of interest for the following reasons: (1) The study indicates that exhaust from automobiles may be a greater source of toxic pollutants than diesel exhaust, and (2) a barrier of dense vegetation can be one element in a pollutant mitigation strategy.

The study also emphasizes that the most important mitigation for exposure near roadways is the distance from the road to the receptor. Many of the health studies described above are related to residential exposure, with a few studies occurring all or partially at schools; none were at parks. The school studies are considered most relevant to the Hall Property Community Park analysis because they involve children who would be involved in very active play at schools, similar to many activities at the proposed park, and because exposure time at schools is less than full-time residency, although still more than would be anticipated at the park. The East Bay Children's Respiratory Health Study is of particular interest because it is one of the few studies reporting health effects correlated with upwind or downwind location.

REGULATORY FRAMEWORK

Air quality is regulated at the federal, State, and regional levels. The following summarizes relevant air quality regulations and regulatory agencies.

Federal

United States Environmental Protection Agency (USEPA). The Federal Clean Air Act (CAA) governs air quality in the United States. USEPA is responsible for enforcing the CAA and for establishing the National Ambient Air Quality Standards (NAAQS). NAAQS are required under the 1977 CAA and subsequent amendments. USEPA regulates emission sources that are under the exclusive authority of the federal government, such as aircraft, ships, and certain types of locomotives. USEPA has jurisdiction over emission sources outside state waters (e.g., beyond the outer continental shelf) and establishes various emission standards, including those for vehicles sold in states other than California. Automobiles sold in California must meet stricter emission standards established by the California Air Resources Board (ARB).

As required by the CAA, NAAQS have been established for seven major air pollutants: CO, NO_2, O_3, PM2.5, PM10, SO_2, and Pb. The CAA requires USEPA to designate areas as attainment, nonattainment, or maintenance (previously nonattainment and currently attainment) for each criteria pollutant based on whether the NAAQS have been achieved. The federal and state standards are summarized in **Table 3.2-1**.

[14]Cahill, T. A., *Vehicular Exposures and Potential Mitigations Downwind of Watt Avenue, Sacramento, CA. Report to The Health Effects Task Force, Breathe California of Sacramento-Emigrant Trails*, 2006.

TABLE 3.2-1: STATE AND NATIONAL AMBIENT AIR QUALITY STANDARDS				
Pollutant	**Averaging Period**	**California /a/**	**Federal /b/**	
		Concentration /c/	**Primary /c,d/**	**Secondary /c,e/**
Ozone (O_3)	1-hour	0.09 ppm (180 μg/m^3)	--	Same as Primary Standard
	8-hour	0.070 ppm (137 μg/m^3)	0.075 ppm (147 μg/m^3)	
Respirable Particulate Matter (PM10)	24-hour	50 μg/m^3	150 μg/m^3	Same as Primary Standard
	Annual Arithmetic Mean	20 μg/m^3	--	
Fine Particulate Matter (PM2.5)	24-hour	--	35 μg/m^3	Same as Primary Standard
	Annual Arithmetic Mean	12 μg/m^3	15.0 μg/m^3	
Carbon Monoxide (CO)	8-hour	9.0 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	None
	1-hour	20 ppm (23 mg/m^3)	35 ppm (40 mg/m^3)	
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.030 ppm (57 μg/m^3)	53 ppb (100 μg/m^3)	Same as Primary Standard
	1-hour	0.18 ppm (338 μg/m^3)	100 ppb (190 μg/m^3) /f/	None
Sulfur Dioxide (SO_2)	24-hour	0.04 ppm (105 μg/m^3)	--	--
	3-hour	--	--	0.5 ppm (1300 μg/m^3) /g/
	1-hour	0.25 ppm (655 μg/m^3)	75 ppb (196 μg/m^3)	--
Lead (Pb) /h/	30-day average	1.5 μg/m^3	--	--
	Calendar Quarter	--	1.5 μg/m^3	Same as Primary Standard
	Rolling 3-Month Average /i/	--	0.15 μg/m^3	

TABLE 3.2-1: STATE AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Period	California /a/	Federal /b/	
		Concentration /c/	Primary /c,d/	Secondary /c,e/
Visibility Reducing Particles	8-hour	Extinction coefficient of 0.23 per kilometer — visibility of ten miles or more (0.07 — 30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70 percent. Method: Beta Attenuation and Transmittance through Filter Tape.	No Federal Standards	
Sulfates	24-hour	25 $\mu g/m^3$		
Hydrogen Sulfide	1-hour	0.03 ppm (42 $\mu g/m^3$)		
Vinyl Chloride	24-hour	0.03 ppm (42 $\mu g/m^3$)		

/a/ California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, suspended particulate matter—PM_{10}, $PM_{2.5}$, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.
/b/ National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest eight hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM_{10}, the 24 hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 $\mu g/m^3$ is equal to or less than one. For $PM_{2.5}$, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact USEPA for further clarification and current federal policies.
/c/ Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas
/d/ National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.
/e/ National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
/f/ Reference method as described by the USEPA. An “equivalent method” of measurement may be used but must have a “consistent relationship to the reference method” and must be approved by the USEPA.
/g/ On June 2, 2010, the U.S. EPA established a new 1-hour SO_2 standard, effective August 23, 2010, which is based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations. USEPA also proposed a new automated Federal Reference Method (FRM) using ultraviolet technology, but will retain the older pararosaniline methods until the new FRM have adequately permeated State monitoring networks. The USEPA also revoked both the existing 24-hour SO_2 standard of 0.14 ppm and the annual primary SO_2 standard of 0.030 ppm, effective August 23, 2010. The secondary SO_2 standard was not revised at that time; however, the secondary standard is undergoing a separate review by USEPA. Note that the new standard is in units of parts per billion (ppb). California standards are in units of ppm. To directly compare the new primary national standard to the California standard the units can be converted to ppm. In this case, the national standard of 75 ppb is identical to 0.075 ppm.
/h/ The ARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.
/i/ National lead standard, rolling 3-month average: final rule signed October 15, 2008.
SOURCE: ARB, *Ambient Air Quality Standards*, and *Attainment Status*, September 8, 2010.

Most of the SCAG region is classified as non-attainment for some criteria pollutants. The boundaries of the SCAG region federal non-attainment/maintenance areas are:

- Ventura County Portion of the South Central Coast Air Basin (SCCAB) - The entire county is a non-attainment area for 8-hour ozone.
- South Coast Air Basin (SCAB) - The entire basin is a non-attainment area for PM10, PM2.5 and 8-hour ozone and a maintenance area for CO and NO_2.
- Antelope Valley and Victor Valley portion of Mojave Desert Air Basin (MDAB) - Non-attainment areas for 8-hour ozone.
- San Bernardino County Portion of MDAB – Part of the basin is a non-attainment area for 8-hour ozone, PM10, and PM2.5.
- The Riverside County Portion of Salton Sea Air Basin (SSAB) - The entire Riverside County portion of SSAB (Coachella Valley) is a non-attainment area for PM_{10} and 8-hour ozone.

- Portions of Imperial County within SSAB – Portions of Imperial County within SSAB are designated as non-attainment for PM10, and PM2.5. The entire portion is maintenance for 8-hour ozone.

The 1970 Amendments to the CAA included a provision to address air toxics. Under Title III of the CAA, USEPA establishes and enforces National Emissions Standards for Hazardous Air Pollutants (NESHAPs), which are nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title I, Section 112(c) of the CAA further directed USEPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date, USEPA has listed 174 categories and developed a schedule for the establishment of emission standards.[15] Rather than promulgating NESHAPs for each pollutant, the CAA directs USEPA to set source category, technology based, standards requiring companies to sharply reduce emissions of toxic air contaminants. These standards require industries to install Maximum Achievable Control Technology (MACT), which is defined as the control technology achieving the maximum degree of reduction in the emission of HAPs, taking into account cost and other factors. USEPA is required to establish and phase in specific performance based standards for all of the industries that emit one or more of the pollutants in significant quantities

State Implementation Plans/Air Quality Management Plans. To comply with the CAA in achieving the National Ambient Air Quality Standards (NAAQS), the California Air Resources Board (ARB) develops State Implementation Plans (SIPs) for federal non-attainment and maintenance areas. In California, SIP development is a joint effort of the local air agencies and ARB working with federal, State, and local agencies (including the MPOs). Local Air Quality Management Plans (AQMPs) are prepared in response to federal and State requirements. Since the CCAA does not specify attainment dates but rather requires meeting the California standards the earliest practicable date, SIPs in California typically serve as the control strategy to meet the more stringent State standards.

In California, all SIPs have to go through three steps: air district action, ARB action, and finally, USEPA action. Each air district submits its respective AQMPs/SIPs to ARB. ARB is the official State agency that submits the SIPs to USEPA for all federal non-attainment and maintenance areas in California.

Transportation Conformity. Transportation conformity is required under CAA section 176(c) to ensure that federally supported highway and transit project activities are consistent with ("conform to") the purpose and requirements of the SIP. Conformity currently applies to areas that are designated non-attainment, and those re-designated to attainment after 1990 ("maintenance areas" with plans developed under CAA section 175A) for the following transportation-related criteria pollutants: ozone, particulate matter (PM2.5 and PM10), CO, and NO_2. Conformity to the purpose of the SIP means that transportation activities will not cause new air quality violations, worsen existing violations, or delay timely attainment of the relevant NAAQS. The transportation conformity regulation is found in 40 CFR Part 93.

Conformity requires reporting on the timely implementation of Transportation Control Measures (TCMs)[16] in ozone nonattainment areas designated as serious or worse, thus reinforcing the link between AQMP/SIPs and the transportation planning process. TCMS are expected to be given funding priority and to be implemented on schedule and, in the case of any delays, any obstacles to implementation have been or are being overcome. In the SCAG Region, there are two areas for which the ozone SIPS contain TCMs: SCAB and the Ventura County portion of SCCAB. (It is noted that the Ventura County SIP does not claim emission

[15] USEPA, Office of Compliance, Office of Enforcement and Compliance Assurance, *EPA Office of Compliance Sector Notebook Project: Air Transportation Industry*, October 1998.

[16] A TCM is any measure that is specifically identified and committed to in the applicable implementation plan, including a substitute or additional TCM that is incorporated into the applicable SIP through the process established in CAA section 176(c)(8), that is either one of the types listed in CAA section 108, or any other measure for the purpose of reducing emissions or concentrations of air pollutants from transportation sources by reducing vehicle use or changing traffic flow or congestion conditions. Notwithstanding the first sentence of this definition, vehicle technology-based, fuel-based, and maintenance-based measures which control the emissions from vehicles under fixed traffic conditions are not TCMs for the purposes of this subpart.

reduction credits from TCM projects. They have been included to assist transportation and air quality agencies to identify projects that have the potential of reducing vehicle emissions, vehicle trips and vehicle miles traveled.)

State

California Air Resources Board (ARB). In addition to being subject to the requirements of CAA, air quality in California is also governed by more stringent regulations under the California Clean Air Act (CCAA). In California, the CCAA is administered by ARB at the State level and by the air quality management districts and air pollution control districts at the regional and local levels. ARB, which became part of the California Environmental Protection Agency in 1991, is responsible for meeting the State requirements of the CAA, administering the CCAA, and establishing the California Ambient Air Quality Standards (CAAQS). The CCAA, as amended in 1992, requires all air districts in the State to endeavor to achieve and maintain the CAAQS. CAAQS are generally more stringent than the corresponding federal standards and incorporate additional standards for sulfates, hydrogen sulfide, vinyl chloride, and visibility-reducing particles.

Unlike the NAAQS, there are no set attainment deadlines to achieve the CAAQS; however, these standards are to be met as expeditiously as possible. ARB regulates mobile air pollution sources, such as motor vehicles. ARB is responsible for setting emission standards for vehicles sold in California and for other emission sources, such as consumer products and certain off-road equipment. ARB established passenger vehicle fuel specifications, which became effective in March 1996. ARB oversees the functions of local air pollution control districts and air quality management districts, which, in turn, administer air quality activities at the regional and county levels. The State standards are summarized in **Table 3.2-1**.

The CCAA requires ARB to designate areas within California as either attainment or nonattainment for each criteria pollutant based on whether the CAAQS have been achieved. Under the CCAA, areas are designated as nonattainment for a pollutant if air quality data shows that a State standard for the pollutant was violated at least once during the previous three calendar years. Exceedances that are affected by highly irregular or infrequent events are not considered violations of a State standard and are not used as a basis for designating areas as nonattainment. Under the CCAA, the Los Angeles County portion of the SCAB is designated as a nonattainment area for O_3, PM2.5, and PM10.[17]

Toxic Air Contaminants (TACs). ARB's statewide comprehensive air toxics program was established in the early 1980's. The Toxic Air Contaminant Identification and Control Act created California's program to reduce exposure to air toxics. Under the Toxic Air Contaminant Identification and Control Act, ARB is required to use certain criteria in the prioritization for the identification and control of air toxics. In selecting substances for review, ARB must consider criteria relating to "the risk of harm to public health, amount or potential amount of emissions, manner of, and exposure to, usage of the substance in California, persistence in the atmosphere, and ambient concentrations in the community" [Health and Safety Code Section 39666(f)]. the Toxic Air Contaminant Identification and Control Act also requires ARB to use available information gathered from the Air Toxics "Hot Spots" Information and Assessment Act program to include in the prioritization of compounds.

California has established a two-step process of risk identification and risk management to address the potential health effects from air toxic substances and protect the public health of Californians. During the first step (identification), ARB and the Office of Environmental Health Hazard Assessment (OEHHA) determine if a substance should be formally identified as a TAC in California. During this process, ARB and the OEHHA staff draft a report that serves as the basis for this determination. ARB staff assesses the potential for human exposure to a substance and the OEHHA staff evaluates the health effects. After ARB

[17]ARB, Area Designation Maps website, *http://www.arb.ca.gov/desig/adm/adm.htm*, accessed June 2, 2011.

and the OEHHA staff hold several comment periods and workshops, the report is then submitted to an independent, nine-member Scientific Review Panel (SRP), who reviews the report for its scientific accuracy. If the SRP approves the report, they develop specific scientific findings which are officially submitted to ARB. ARB staff then prepares a hearing notice and draft regulation to formally identify the substance as a TAC. Based on the input from the public and the information gathered from the report, the ARB Board decides whether to identify a substance as a TAC. In 1993, the California Legislature amended the Toxic Air Contaminant Identification and Control Act by requiring ARB to identify 189 federal hazardous air pollutants as State TACs.

In the second step (risk management), ARB reviews the emission sources of an identified TAC to determine if any regulatory action is necessary to reduce the risk. The analysis includes a review of controls already in place, the available technologies and associated costs for reducing emissions, and the associated risk.

The Air Toxics "Hot Spots" Information and Assessment Act (Health and Safety Code Section 44360) supplements the Toxic Air Contaminant Identification and Control Act by requiring a statewide air toxics inventory, notification of people exposed to a significant health risk, and facility plans to reduce these risks. The "Hot Spots" Act also requires facilities that pose a significant health risk to the community to reduce their risk through a risk management plan.

California's Diesel Risk Reduction Program. The ARB identified particulate emissions from diesel-fueled engines (diesel PM) as toxic air contaminants (TACs) in August 1998. Following the identification process, the ARB was required by law to determine if there is a need for further control, which led to the risk management phase of the program.

For the risk management phase, the ARB directed staff to form the Diesel Advisory Committee to assist in the development of a risk management guidance document and a risk reduction plan. With the assistance of the Advisory Committee and its subcommittees, the ARB developed the Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles and the Risk Management Guidance for the Permitting of New Stationary Diesel-Fueled Engines. The Board approved these documents on September 28, 2000, paving the way for the next step in the regulatory process: the control measure phase.

During the control measure phase, specific Statewide regulations designed to further reduce diesel PM emissions from diesel-fueled engines and vehicles have and continue to be evaluated and developed. The goal of each regulation is to make diesel engines as clean as possible by establishing state-of-the-art technology requirements or emission standards to reduce diesel PM emissions.

Regional

The SCAG region incorporates four air basins and five air districts. The four air basins are the South Coast Air Basin (SCAB), the Mojave Desert Air Basin (MDAB), the Salton Sea Air Basin (SSAB), and the Ventura County portion of the South Central Coast Air Basin (SCCAB). The five air districts are the South Coast Air Quality Management District (SCAQMD), Mojave Desert Air Quality Management District (MDAQMD), Imperial County Air Pollution Control District (ICAPCD), Antelope Valley Air Pollution Control District (AVAPCD), and the Ventura County Air Pollution Control District (VCAPCD). The geographic boundaries of these air basins, districts and monitoring locations are shown in are shown in **Map 3.2-1** located in Chapter 8 (Maps). Each air district established regional air quality rules and regulations. In addition, the air districts are responsible for regulating stationary sources of air emissions that require permits (e.g., industrial land uses and gas stations).

EXISTING SETTING

This section provides the environmental setting for air quality in the SCAG region, which encompasses a population exceeding 18 million persons in an area of more than 38,000 square miles within the counties of Los Angeles, Orange, San Bernardino, Riverside, Ventura and Imperial. The section includes information on climate and meteorology for the air basins in the SCAG region and existing air quality. As previously discussed, the SCAG region includes four air basins: South Coast, Mojave Desert, Salton Sea and South Central Coast (Ventura County portion). Each air basin generally has similar meteorological and geographical conditions.

Climate and Meteorology

Air quality is a function of both the rate and location of pollutant emissions under the influence of meteorological conditions and topographic features. Atmospheric conditions such as wind speed, wind direction, and air temperature gradients, along with local topography, influence the movement and dispersal of pollutants and thereby provide the link between air pollutant emissions and air quality.

South Coast Air Basin (SCAB). The SCAB incorporates approximately 12,000 square miles, consisting Orange County and the urbanized areas of San Bernardino, Riverside and Los Angeles counties. In May 1996, the boundaries of the SCAB were changed by the ARB to include the Beaumont-Banning area. In addition, the Southeast Desert Air Basin was separated into two areas and renamed as the Mojave Desert Air Basin and the Salton Sea Air Basin. The distinctive climate of the SCAB is determined by its terrain and geographic location. The SCAB is a coastal plain with connecting broad valleys and low hills, bounded by the Pacific Ocean to the southwest and high mountains around the rest of its perimeter. The general region lies in the semi-permanent high-pressure zone of the eastern Pacific, resulting in a mild climate tempered by cool sea breezes with light average wind speeds. The usually mild climatological pattern is interrupted occasionally by periods of extremely hot weather, winter storms, or Santa Ana winds.[18]

The vertical dispersion of air pollutants in the SCAB is hampered by the presence of persistent temperature inversions. High-pressure systems, such as the semi-permanent high-pressure zone in which the SCAB is located, are characterized by an upper layer of dry air that warms as it descends, restricting the mobility of cooler marine-influenced air near the ground surface, and resulting in the formation of subsidence inversions. Such inversions restrict the vertical dispersion of air pollutants released into the marine layer and, together with strong sunlight, can produce worst-case conditions for the formation of photochemical smog. The basin-wide occurrence of inversions at 3,500 feet above sea level or less averages 191 days per year.[19]

The atmospheric pollution potential of an area is largely dependent on winds, atmospheric stability, solar radiation, and terrain. The combination of low wind speeds and low inversions produces the greatest concentration of air pollutants. On days without inversions, or on days of winds averaging over 15 miles per hour, smog potential is greatly reduced.[20]

Mojave Desert Air Basin (MDAB). The MDAB encompasses approximately 21,480 square miles and includes the desert portions of San Bernardino County, Palo Verde Valley, Palmdale and Lancaster in the Antelope Valley. The MDAB is bordered by the SCAB and the Riverside County line to the south, Kern County line to the west, the Arizona and Nevada borders to the north and east, and the eastern portion of Riverside County to the southeast. The Kern County portion of MDAB is not in the SCAG Region.

[18]SCAQMD, *CEQA Air Quality Handbook*, April 1993, p. A8-1.
[19]SCAQMD, *CEQA Air Quality Handbook*, April 1993, p. A8-2.
[20]*Ibid*.

The MDAB is an assemblage of mountain ranges interspersed with long broad valleys that often contain dry lakes.[21] Many of the lower mountains which dot the vast terrain rise from 1,000 to 4,000 feet above the valley floor. Prevailing winds in the MDAB are out of the west and southwest. These prevailing winds are due to the proximity of the MDAB to coastal and central regions and the blocking nature of the Sierra Nevada Mountains to the north; air masses pushed onshore in southern California by differential heating are channeled through the MDAB. The MDAB is separated from the southern California coastal and central California valley regions by mountains (highest elevation approximately 10,000 feet), whose passes form the main channels for these air masses. The Antelope Valley is bordered in the northwest by the Tehachapi Mountains, separated from the Sierra Nevadas in the north by the Tehachapi Pass (3,800 feet elevation). The Antelope Valley is bordered in the south by the San Gabriel Mountains, bisected by Soledad Canyon (3,300 feet). The Mojave Desert is bordered in the southwest by the San Bernardino Mountains, separated from the San Gabriel Mountains by the Cajon Pass (4,200 feet). A lesser channel lies between the San Bernardino Mountains and the Little San Bernardino Mountains (the Morongo Valley).

The Palo Verde Valley portion of the Mojave Desert lies in the low desert, at the eastern end of a series of valleys (notably the Coachella Valley) whose primary channel is the San Gorgonio Pass (2,300 feet) between the San Bernardino and San Jacinto Mountains.

During the summer the MDAB is generally influenced by a Pacific Subtropical High cell that sits off the coast, inhibiting cloud formation and encouraging daytime solar heating. The MDAB is rarely influenced by cold air masses moving south from Canada and Alaska, as these frontal systems are weak and diffuse by the time the reach the desert. Most desert moisture arrives from infrequent warm, moist and unstable air masses from the south. The MDAB averages between three and seven inches of precipitation per year (from 16 to 30 days with at least 0.01 inches of precipitation). The MDAB is classified as a dry-hot desert climate, with portions classified as dry-very hot desert, to indicate at least three months have maximum average temperatures over 100.4° F.

Salton Sea Air Basin (SSAB). The SSAB includes all of Imperial County and the desert portion of Riverside County between the SCAB and the MDAB (known as the Coachella Valley area). Imperial County extends over 4,597 square miles, bordering on Mexico to the south, Riverside County to the north, San Diego County on the west, and the State of Arizona on the east.[22]

The southern portion of the SSAB is a part of the larger physiographic province of the Salton Trough. This province is a very flat basin surrounded by mountains: the Peninsular Ranges to the west, the Chocolate, Orocopia and Cargo Muchaco Mountains to the east. Most of the trough is below sea level, and consists generally of desert, with agricultural land uses located at the north and south of the Salton Sea.

Climatic conditions in the SSAB are governed by the large-scale sinking and warming of air in the semi-permanent subtropical high-pressure center of the Pacific Ocean. The high-pressure ridge blocks out most mid-latitude storms except in the winter when the high is weakest and farthest south. Similarly, the coastal mountains prevent the intrusion of any cool, damp marine air found in California coastal environs. Because of the weakened storms and the orographic barrier, the SSAB experiences clear skies, very low humidity, extremely hot summers, mild winters, and little rainfall. The flat terrain of the valley and the strong temperature differentials created by intense solar heating produce moderate winds and deep thermal convection.

The combination of subsiding air, protective mountains and distance from the ocean all combine to severely limit precipitation. Rainfall is highly variable with heavy precipitation occurring from single storms

[21]Mojave Desert Air Quality Management District, *CEQA and Federal Conformity Guidelines*, February 2009.

[22]Imperial County Air Pollution Control District, *Final 2009 1997 8-Hour Ozone Modified Air Quality Management Plan*, July 13, 2010.

followed by periods of dry air. Humidity is typically low throughout the year, ranging from 28 percent in summer to 52 percent in winter.

The SSAB occasionally experiences periods of high winds. Wind speeds exceeding 31 mph occur most frequently in April and May. On an annual basis, strong winds over 31 miles per hour are observed 0.6 percent of the time, speeds of less than 6.8 mph account for more than one-half of the observed winds. Wind statistics indicate prevailing winds are from the west-northwest through southwest; a secondary flow maximum from the southeast is also evident. Imperial County, in particular, experiences surface inversions almost every day of the year. Due to strong surface heating, these inversions are usually broken allowing pollutants to more easily disperse. Weak, surface inversions are caused by cooling of air in contact with the cold surface of the earth at night. In valleys and low-lying areas, this condition is intensified by the addition of cold air flowing downslope from the hills and pooling on the valley floor.

The presence of the Pacific high-pressure cell can cause the air mass aloft to sink. As the air descends, compressional heating warms it to a temperature higher than the air below. This highly stable atmospheric condition, termed a subsidence inversion can act as a nearly impenetrable lid to the vertical mixing of pollutants. The strength of these inversions makes them difficult to disrupt. Consequently, they can persist for one or more days, causing air stagnation and the buildup of pollutants. Highest or worst-case ozone levels are often associated with the presence of this type of inversion. Subsidence inversions are common from November through June, but appear to be relatively absent July through October.

South Central Coast Air Basin (SCCAB). The SCAG region includes the Ventura County portion of the SCCAB. Ventura County is comprised of coastal mountain ranges, the coastal shore, the coastal plain, and several inland valleys.[23] The northern half of the county (Los Padres National Forest) is extremely mountainous with altitudes up to 8,800 feet. Consequently, the climate in the northern half of the County varies a great deal depending on elevation. Therefore, the climatological and meteorological description presented for Ventura County focuses on the southern half of the county where violations of federal and State ozone standards occur. In the winter, low-pressure systems originating in the northern Pacific Ocean bring clouds, rain, and wind into Ventura County.

The average annual temperature in the coastal and inland valleys of the southern half of Ventura County ranges from the upper 50s at the coast (Point Mugu) to the mid-60s in Simi Valley. The difference between the maximum and minimum temperatures becomes greater as the distance increases from the coast. The average minimum and maximum temperatures at Point Mugu are 50°F and 60°F, respectively, while at the inland location of Simi Valley, the averages are 52°F and 77°F. The smaller range of temperatures at Point Mugu demonstrates the moderating influence of the ocean on air temperature. The ocean's ability to warm and cool the air while its temperature remains relatively unchanged produces the moderating effect. Inland area temperatures are more prone to rapid fluctuations. Almost all rainfall in Ventura County falls during the winter and early spring (November through April). Summer rainfall is normally restricted to scattered thundershowers in lower elevations, and somewhat heavier activity in the mountains. Humidity levels vary throughout the County. The range of humidity is primarily influenced by proximity to the ocean. Although the County's climate is semi-arid, average humidity levels are relatively high due to the marine influence. Coastal areas are more humid than inland areas during typical fair weather. The reverse is true during stormy periods. The lowest humidity levels are recorded during Santa Ana wind conditions.

Ventura County winds are dominated by a diurnal land-sea breeze cycle. The land-sea breeze regime is broken only by occasional winter storms and infrequent strong northeasterly Santa Ana wind flows. Since the sea breeze is stronger than the land breeze, the net wind flow during the day is from west to east. Under light land-sea breeze regimes, recirculation of pollutants can occur as emissions move westward during morning hours, and eastward during the afternoon. This can cause a build-up of pollutants over several days.

[23] VCAPCD, *1994 Air Quality Management Plan*, November 1996.

The vertical dispersion of air pollutants in Ventura County is limited by the presence of persistent temperature inversions. Approximately 60 percent of all inversions measured at Point Mugu are surface-based, with most occurring during the morning hours.

Existing Air Quality

The five air districts in the SCAG region each monitor air quality conditions in their region. **Table 3.2-2** presents the peak readings of criteria pollutants in the SCAG air basins. The data shows that O_3, PM2.5 and PM10 readings consistently exceeded the standards in each of the air basins. In addition, the PM2.5 standard was exceeded multiple times in the SCAG region.

Map 3.2-2 located in Chapter 8 (Maps), shows the average daily O_3 exposure that is in excess of the national 8-hour standard (0.075 parts per million) in the SCAG Region for years 2007 to 2009. Although the region as a whole largely experiences average daily ozone exposure exceeding the federal standard, the highest concentration of O_3 exposure can be seen mostly in southwest San Bernardino and northwest Riverside counties, and also in north Los Angeles County. **Map 3.2-3** located in Chapter 8 (Maps) shows the average annual exposure to PM2.5 for years 2007 to 2009. South Los Angeles County, northeast Orange County, southwest San Bernardino County, and northwest Riverside County experienced the highest average annual exposure to PM2.5, with average rates ranging from 14.6 to 21.4 micrograms of PM2.5 per cubic meter of air. Other high exposure areas include North Los Angeles County, east Ventura County (along the US-101 corridor), central Orange County, central Riverside County (Coachella Valley), and central Imperial County (Imperial Valley basin). Also included in this group are the areas in San Bernardino and Riverside County that are directly outside of the highest intensity areas identified previously that fall between the SR-74, I-15, and I-215 corridors.

The impact of ozone and particulate emissions on health can often be seen in the instances of cancer or poor respiratory health in a designated geographic area. The rate of cancer risk per one million people as a result of emissions in the SCAG region is displayed in **Map 3.2-4** located in Chapter 8 (Maps). The highest instance of cancer risk is exhibited in the area in and around Downtown Los Angeles, along the I-10 and SR-60 highways in San Bernardino County, at the SR-91/I-15, SR-91/I-215 intersections in Riverside County, and at the SR-57/SR-22 intersection in Orange County.

Other areas that have high instances of cancer risk in the SCAG Region are south Ventura County, south and central Los Angeles County, southwest San Bernardino County, northwest Riverside County, and all of Orange County. In addition to cancer risk, respiratory risk is also an indicator of emissions impact on public health. **Map 3.2-5** located in the Chapter 8 (Maps) shows respiratory risk in the SCAG Region. The highest areas of respiratory risk are the segments that closely follow major freeways in the most urbanized portions of the region, with the areas surrounding Downtown Los Angeles showing the highest geographic concentration of respiratory risk in the region. Respiratory risk is also present in the urbanized portions of south Ventura County, south and central Los Angeles County, southeast San Bernardino County, northwest Riverside County, Orange County, and central Imperial County.

Maps 3.2-4 and **3.2-5** are based on 2005 data and show a reasonable representation of the spatial variation of cancer and respiratory risk. The existing risk in the current year is less than presented in these maps because of State regulations implemented since 2005 designed to reduce mobile source toxic emissions. Therefore, **Maps 3.2-4** and **3.2-5** show a conservative quantitative estimate of regional risk.

Rail engines generate emissions of diesel particulate matter and other cancer-causing toxics. **Map 3.2-6** located in Chapter 8.0 (Maps) shows sensitive receptors located along regional rail lines. **Map 3.2-7** located in Chapter 8.0 (Maps) shows regional 2005 cancer risk as it relates to rail lines. Above-average cancer risk is often located near rail lines.

TABLE 3.2-2: PEAK CRITERIA POLLUTANTS READINGS FOR THE SCAG REGION AIR BASINS

Pollutant	Period	Pollutant Standards		2008 Peak Criteria Reading	Days in Excess of Standards 2008		2009 Peak Criteria Reading	Days in Excess of Standards 2009		2010 Peak Criteria Reading	Days in Excess of Standards 2010	
		CA	Federal		CA	Federal		CA	Federal		CA	Federal
SOUTH COAST AIR BASIN												
Ozone (O_3)	1-hour	0.09 ppm (180 µg/m^3)	--	0.176	102	28	0.176	102	15	0.143	85	9
	8-hour	0.07 ppm (137 µg/m^3)	0.075 ppm (147 µg/m^3)	0.131	140	119	California 0.129 Federal 0.128	131	113	0.123	124	102
Respirable Particulate Matter (PM10)	24-hour	50 µg/m^3	150 µg/m^3	California 126 Federal 144.2	46	0	California 105 Federal 147.1	33	0	California 87 Federal 89	23	0
Fine Particulate Matter (PM2.5)	24-hour	--	35 µg/m^3	78.3	--	26	California 82.9 Federal 72	--	28	California 67.8 Federal 54.2	--	13
Carbon Monoxide (CO)	8-hour	9.0 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	4.33	0	0	4.61	0	0	3.58	0	0
Nitrogen Dioxide (NO_2)	1-hour	0.18 ppm (338 µg/m^3)	100 ppb (190 µg/m^3)	0.125	0	--	0.115	0	--	0.118	0	--
MOJAVE DESERT AIR BASIN												
Ozone (O_3)	1-hour	0.09 ppm (180 µg/m^3)	--	0.140	71	5	0.123	51	0	0.137	46	3
	8-hour	0.070 ppm (137 µg/m^3)	0.075 ppm (147 µg/m^3)	0.110	134	107	0.104	120	87	0.114	121	91
Respirable Particulate Matter (PM10)	24-hour	50 µg/m^3	150 µg/m^3	California 144.8 Federal 285.5	3	2	California 81 Federal 307.2	2	1	California 829 Federal 868	2	1
Fine Particulate Matter (PM2.5)	24-hour	--	35 µg/m^3	26.8	--	0	20	--	0	California 20.0 Federal 19.5	--	0
Carbon Monoxide (CO)	8-hour	9.0 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	1.23	0	0	1.14	0	0	5.17	0	0
Nitrogen Dioxide (NO_2)	1-hour	0.18 ppm (338 µg/m^3)	100 ppb (190 µg/m^3)	0.081	0	--	0.065	0	--	0.137	0	--

TABLE 3.2-2: PEAK CRITERIA POLLUTANTS READINGS FOR THE SCAG REGION AIR BASINS

Pollutant	Period	Pollutant Standards		2008 Peak Criteria Reading		Days in Excess of Standards 2008		2009 Peak Criteria Reading		Days in Excess of Standards 2009		2010 Peak Criteria Reading		Days in Excess of Standards 2010	
		CA	Federal			CA	Federal			CA	Federal			CA	Federal
SALTON SEA AIR BASIN															
Ozone (O_3)	1-hour	0.09 ppm (180 μg/m^3)	--	0.135		36	1	0.150		40	2	0.122		24	0
	8-hour	0.070 ppm (137 μg/m^3)	0.075 ppm (147 μg/m^3)	0.101		85	57	0.098		82	59	0.099		94	62
Respirable Particulate Matter (PM_{10})	24-hour	50 μg/m^3	150 μg/m^3	California 138	Federal 336.7	31	3	California 265.8	Federal 275.9	34	3	California 117.3	Federal 144.8	43	0
Fine Particulate Matter ($PM_{2.5}$)	24-hour	--	35 μg/m^3	California 93.6	Federal 37.1	--	1	California 100.9	Federal 45	--	4	California 54	Federal 50.9	--	2
Carbon Monoxide (CO)	8-hour	9.0 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	6.34		0	0	7.46		0	0	9.69		1	1
Nitrogen Dioxide (NO_2)	1-hour	0.18 ppm (338 μg/m^3)	100 ppb (190 μg/m^3)	0.146		0	--	0.122		0	--	0.141		0	--
SOUTH CENTRAL COAST AIR BASIN															
Ozone (O_3)	1-hour	0.09 ppm (180 μg/m^3)	--	0.115		24	0	0.116		15	0	0.104		6	0
	8-hour	0.070 ppm (137 μg/m^3)	0.075 ppm (147 μg/m^3)	0.097		96	63	0.095		54	29	California 0.091	Federal 0.090	44	23
Respirable Particulate Matter (PM_{10})	24-hour	50 μg/m^3	150 μg/m^3	California 109	Federal 88.6	44	0	California 125.9	Federal 119.2	13	0	California 144.3	Federal 167.8	45	1
Fine Particulate Matter ($PM_{2.5}$)	24-hour	--	35 μg/m^3	California 61.1	Federal 44.2	--	2	California 36	Federal 51.6	--	2	California 42.4	Federal 32.6	--	0
Carbon Monoxide (CO)	8-hour	9.0 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	1.70		0	0	1.57		0	0	1.07		0	0
Nitrogen Dioxide (NO_2)	1-hour	0.18 ppm (338 μg/m^3)	100 ppb (190 μg/m^3)	0.077		0	--	0.052		0	--	0.090		0	--

SOURCE: ARB, Historical Air Quality Data, 2011.

THRESHOLDS OF SIGNIFICANCE

The 2012-2035 RTP/SCS would have a significant impact related to air quality in the following circumstances:

- Projected long-term emissions of criteria pollutants are considered significant if they are substantially greater than current emission levels;
- Projected short-term emissions of criteria pollutants (construction of transportation projects and anticipated development) are considered to be significant if they would exceed the thresholds established by the local air districts;
- Projected long-term emissions of toxic air contaminants (diesel particulate matter from heavy-duty diesel trucks and other emissions from industrial activities) are considered significant if they would be greater than current emission levels;
- Localized concentrations of toxic air contaminants at sensitive receptors (short-term and/or long-term) are considered significant if they would exceed existing conditions; and/or
- Projected long-term emissions would be considered to be cumulatively significant if they are not consistent with the local air quality management plans and state implementation plans.
- If the Plan could increase the number of people residing in areas within 500 feet of rail and freeway facilities compared to existing conditions, with the potential to expose them to substantially higher than average cancer and other health risks, the impact is considered significant.

Methodology

This section summarizes the methodology used to evaluate the expected impacts of implementation of the Plan on air quality.[24]

Cumulative Analysis

The 2012-2035 RTP/SCS addresses transportation projects and land use distribution patterns, including land use scenarios. These land use distribution patterns identify growth distribution and anticipated land use development to accommodate growth projections. The Regional Travel Demand Model (RTDM) used for this analysis captures pass-through traffic that does not have an origin or destination in the region, but does impact the region, so that too is included in the project analysis. Although a similar level of development is anticipated even without the 2012-2035 RTP/SCS, this Plan would influence growth, including distribution patterns, throughout the region. To address this, the analysis in the PEIR covers overall impacts of all transportation projects and land development described in the 2012-2035 RTP/SCS. In addition, this PEIR considers cumulative impacts from other regional plans (e.g., the South Coast Air Quality Management Plan [AQMP]), which could result in additional impacts inside and outside the region.

Comparison with the No Project Alternative

The analysis of air quality includes a comparison between the expected future conditions with the Plan and the expected future conditions if no Plan (No Project Alternative) were adopted. This evaluation is not included in the determination of the significance of impacts (which is based on a comparison of future conditions with the Plan to existing conditions); however, it provides a meaningful perspective on the effects of the Plan.

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[24]The Environmental Justice section of the Plan and associated appendix contains substantial analysis of potential air quality impacts to low income, minority and other protected groups. See Environmental Justice Appendix of the 2012-2035 RTP/SCS. However, the PEIR does not rely on this analysis as it addresses air quality impacts to the community as a whole.

Determination of Significance

The methodology for determining the significance of air quality impacts compares the existing conditions to the future 2012-2035 RTP/SCS conditions, as required in CEQA Section 15126.2(a).

Analysis of the potential air quality impacts of the Plan was conducted based on detailed modeling of on-road sources. Regional emissions from stationary and other sources are summarized from the SCAQMD AQMP and associated EIR (the most recently available information as of publication of this Draft PEIR; the AQMP and associated EIR will be updated in 2012). A mobile source health risk assessment has also been completed. Because Plan and cumulative emissions are interrelated, cumulative emissions are discussed together with Plan emissions.

IMPACTS

Impact 3.2-1: Mobile source emissions of ROG, NO_X, CO, PM 10 PM2.5, and SO_X would stay approximately the same or decrease (often substantially) when compared to existing conditions. This is considered to be a beneficial impact. Re-entrained roadway dust would increase proportionate to VMT. This would be a significant impact.

Projected long-term emissions of criteria pollutants are considered significant if they are substantially greater than the current emission levels.[25]

Criteria Pollutant Emissions Analysis

To assess the effectiveness of the improvements proposed in the Plan, estimated air emissions for the buildout year (2035) of the Plan were compared to the 2012 conditions. The calculated emissions were compiled for each county in the SCAG region.

Re-entrained roadway dust as well as roadway construction dust emissions are included in the estimation of criteria pollutant emissions for PM10 and PM2.5 for non-attainment and maintenance areas where AQMD/APCDs include inventories in their State Implementation Plans (SIPs) but are not available for the entire SCAG region (see the Transportation Conformity Appendix to the 2012-2035 RTP/SCS page 16). Thus, re-entrained road dust is accounted for in the attainment demonstrations of applicable PM10 and PM2.5 SIPs. As shown in SCAG's conformity analysis, PM10 and PM2.5 emissions meet applicable emissions budgets for the build/no build interim test (for those areas where there is no emission budget) and thus conform to the SIPs.

Re-entrained dust (PM10 and PM2.5) would be generated by roadway activity (i.e., roadway dust kicked up by moving vehicles on paved and unpaved roadways). In addition roadway construction dust and dust from construction activity, and agricultural activity would add to regional dust levels. Re-entrained roadway dust is proportional to total VMT which is expected to increase under the Plan as compared to existing conditions and, as such, re-entrained roadway dust would increase. Expected growth would also lead to new construction which, in turn, would increase regional dust. These construction emissions, although unavoidable, would be partially controlled by air districts fugitive dust rules. The compact development pattern under the Plan may result in more open/agricultural space remaining and therefore current problems with wind blown dust off agricultural fields would remain if more land stays in agricultural/open space uses under the Plan as compared to the No Project Alternative.

[25] 2012 modeled conditions are used to approximate 2011 conditions as they are readily available and are close to 2011.

Table 3.2-3 summarizes the current and projected mobile source criteria pollutant emissions estimated for the Plan as compared to the current conditions by county. As shown in **Table 3.2-3**, emissions of ozone precursors NO_X and ROG would experience a dramatic improvement over existing conditions under the Plan.

In addition, CO and PM2.5 (other than re-trained roadway and construction dust) emissions would improve over existing conditions. SO_X emissions would increase in every county but Ventura. This is not considered to result in a significant impact as the entire SCAG region is well below State and federal SO_2 standards and designated as an attainment area. Implementation of Mitigation Measures **MM-AQ1** through **MM-AQ18** would further reduce criteria pollutant emissions. Impacts are considered significant because of the increase in PM10 as a result of re-entrained roadway dust (despite the fact that as noted above applicable conformity budgets and build/no build tests would be met).

Maps 3.2-8 and **3.2-9** located in Chapter 8.0 (Maps) show that the Plan would generally have fewer PM and CO emissions along freeways as compared to the No Project Alternative.

Impact 3.2-2: Under the Plan, carcinogenic health risk related to air toxics within any given distance of mobile sources in the region would decrease when compared to existing conditions. Total acute and chronic risk associated with criteria pollutants from mobile sources at given distances would also decrease when compared to existing conditions. Non-carcinogenic health incidences due to VMT-related re-entrained dust would increase under the Plan. However, increases in these health incidences would be at least partially offset by the decrease in health incidences related to air toxics and criteria pollutants generated by vehicle exhaust. (See also Impact 3.2-3 related to shifting populations.)

Regional Cancer Risk

Cancer risk in the region results from a number of sources including industrial sources, contaminated sites, as well as common carcinogens found in the home (many cleaning products, gasoline, paints, etc.). Mobile sources are a major source of cancer risk. As discussed above regional PM10 and PM2.5 from exhaust and tire wear would be expected to be similar to today, although re-entrained roadway dust would be expected to increase proportionate with VMT.

A review of air pollution studies by ARB indicates that residing close to freeways or busy roadways may result in adverse health effects beyond those typically found in urban areas. Several studies found an association between adverse non-cancer health effects (e.g., asthma) and living or attending school near heavily traveled urban roadways; however, these studies also found that the roadway and truck traffic densities were key factors affecting the strength of association with adverse health impacts. For urban roadways, the association of traffic-related emissions with adverse health impacts was generally strongest between 300 and 1,000 feet.

ARB reports that Diesel Particulate Matter (DPM) represents about 70 percent of the potential cancer risk from vehicle travel on a typical urban freeway. As shown in **Table 3.2-4,** exhaust from heavy-duty trucks is anticipated to decrease in all areas of the region as compared to today; thus DPM associated with freeways will also decrease as compared to today.

TABLE 3.2-3: CRITERIA POLLUTANT EMISSIONS BY COUNTY – EXISTING CONDITIONS (2012) VS PLAN (2035)

County		Tons/Day								
		ROG Summer	ROG Annual	NO_x Summer	NO_x Annual	NO_x Winter	CO Winter	PM10 Annual	PM2.5 Annual	SO_x Annual
Los Angeles /a/	Existing	96	94	199	203	218	902	14	9	1
	Plan	42	41	70	71	75	299	12	8	1
	Difference	(54)	(54)	(129)	(132)	(143)	(603)	(1)	(1)	0
Imperial	Existing	5	4	14	13	14	34	1	1	0
	Plan	4	3	9	9	9	24	1	1	0
	Difference	(1)	(1)	(4)	(4)	(5)	(10)	0	0	0
Orange	Existing	31	30	52	53	58	280	4	3	0
	Plan	14	14	19	19	20	96	4	3	0
	Difference	(16)	(16)	(34)	(34)	(38)	(184)	0	0	0
Riverside /b/	Existing	26	23	76	76	80	227	5	4	0
	Plan	15	13	35	35	36	114	5	3	1
	Difference	(11)	(10)	(41)	(41)	(44)	(113)	0	0	0
San Bernardino /c/	Existing	28	25	81	81	85	251	5	4	0
	Plan	15	13	37	37	38	114	5	3	0
	Difference	(13)	(12)	(44)	(44)	(47)	(137)	0	0	0
Ventura	Existing	10	10	16	16	18	83	1	1	0
	Plan	4	4	5	6	6	27	1	1	0
	Difference	(5)	(5)	(10)	(11)	(12)	(56)	0	0	0

/a/ Los Angeles County excludes Antelope Valley
/b/ Riverside County includes portions of the SCAB, MDAB and Coachella Valley
/c/ San Bernardino County includes the SCAB and MDAB portions
SOURCE: SCAG Transportation Modeling, 2011.

TABLE 3.2-4: PM10 EMISSIONS EXHAUST ONLY FOR HEAVY-DUTY TRUCKS PER COUNTY						
	Tons/Day					
Scenario	Los Angeles	Imperial	Orange	Riverside	San Bernardino	Ventura
2012 Existing	3.7	0.4	0.6	2.1	2.2	0.2
2035 No Project	2.0	0.3	0.4	1.0	1.2	0.1
2035 Plan	2.1	0.3	0.4	1.1	1.2	0.1
SOURCE: SCAG Transportation Modeling 2011.						

Respiratory and Other Particulate Matter Health Effects

Ambient PM10 and PM2.5, of which DPM is one component, have been associated with acute (short-term) and chronic (long-term) health effects, such as the worsening of heart and lung diseases. Elevated levels of ambient particulate matter have also been identified as one of many aggravating factors for childhood asthma. PM10 and PM2.5 are a health concern, particularly at levels above the federal and State ambient air quality standards. PM2.5 is thought to have greater effects on health because smaller particles are able to penetrate to the deepest parts of the lungs.

Scientific studies have suggested links between fine particulate matter and numerous health problems, including asthma, bronchitis, and acute and chronic respiratory symptoms such as shortness of breath and painful breathing. Children are more susceptible to the health risks of PM2.5 because their immune and respiratory systems are still developing. Very small particles of certain substances (e.g., sulfates and nitrates) can also directly cause lung damage or can contain absorbed gases (e.g., chlorides or ammonium) that may be injurious to health.

On-road vehicle traffic also produces particulate matter in the form of brake and tire wear and re-entrained roadway dust. This type of dust is comprised mainly of large particles (diameter greater than 10 microns) that settle out rapidly and are more easily filtered by human breathing passages. All dust, however, including some fraction of PM10 and PM2.5 can create localized health impacts (i.e., exceed an ambient air quality standard). Ambient concentrations of PM10 and PM2.5 are regulated directly through health-based ambient air quality standards. As with construction-related impacts, PM10 and PM2.5 impacts will be addressed on a project-by-project basis, rather than in this PEIR.

All of these factors contribute to health incidences and costs associated with air pollution from auto travel. Auto-related air pollution results in a spectrum of health incidences, including cases of chronic bronchitis; acute myocardial infarction; respiratory and cardiovascular hospitalizations; respiratory-related ER visits; acute bronchitis; work loss days; premature mortality; asthma exacerbation; and acute, lower, and upper respiratory symptoms.

Brake and tire wear and fugitive dust from paved road travel emissions are directly related to VMT. As VMT increases so does roadway PM10 and PM2.5. The Plan would increase VMT when compared to existing conditions. However, decreased regional pollution due to Plan implementation and decreased DPM emissions would improve overall regional health when compared to existing conditions. Specifically, **Table 3.2-5** shows avoided health incidences per ton of pollutant and **Table 3.2-6** shows avoided health costs per ton of pollutant.

TABLE 3.2-5 AVOIDED HEALTH INCIDENCES PER TON OF POLLUTANT (2035)				
Health Incidences	**PM2.5**	**SO_X**	**ROG/VOC**	**NO_X**
Premature Mortality	0.07631	0.00619	0.00096	0.00612
Chronic Bronchitis	0.03417	0.00276	0.00035	0.00264
Acute Myocardial Infarction	0.07272	0.00609	0.00076	0.00565
Hospitalization: Respiratory	0.00882	0.00072	0.00096	0.00156
Hospitalization: Cardiovascular	0.01982	0.00165	0.00021	0.00154
Emergency Room Visits (respiratory related)	0.01754	0.00142	0.00045	0.00162
Acute Bronchitis	0.0875	0.00709	0.00089	0.00671
Work Loss Days	6.48295	0.51187	0.20329	0.63809
Asthma Exacerbation	0.95418	0.07681	0.20071	0.26441
Acute Respiratory Symptoms	38.23382	3.02214	0.38744	2.95034
Lower Respiratory Symptoms	1.04022	0.08416	0.0106	0.07988
Upper Respiratory Symptoms	0.78766	0.06357	0.00801	0.06068
SOURCE: TIAX LLC prepared for the American Lung Association of California, 2011.				

TABLE 3.2-6: AVOIDED HEALTH COSTS PER TON OF POLLUTANT (2035)	
Pollutant	**2010 (Dollars per Ton)**
NOx (as component of ozone)	$1,648
VOC (as component of ozone)	$1,648
PM2.5	$756,413
Indirect PM: NOx	$58,841
Indirect PM: SOx	$61,386
Indirect PM: ROG/VOC	$7,778
SOURCE: TIAX LLC prepared for the American Lung Association of California, 2011.	

As noted in the Environmental Setting, rail engines generate emissions of diesel particulate matter and other cancer-causing toxics. **Map 3.2-6** located in Chapter 8.0 (Maps) shows sensitive receptors located along regional rail lines. **Map 3.2-7** located in Chapter 8.0 (Maps) shows regional 2005 cancer risk as it relates to rail lines. As with freeway corridors, above-average cancer risk is often located near rail lines.

Freeway Corridor Analysis

A mobile source HRA was completed for freeways corridors under the Plan. The analysis assessed at least one freeway corridor in each of the six counties contained in the SCAG planning area. To focus on the maximum risks, the segment within each corridor that exhibited the highest daily total traffic volumes were identified and quantitatively modeled for increased cancer risk. The selected segments include:

- I-405 – in Seal Beach, east of the I-605 interchange (Orange County)
- I-710 – in Compton, north of the intersection with SR-91 (Los Angeles County)
- I-8 – in El Centro (Imperial County)
- SR-60 – in Ontario, west of the I-15 interchange (San Bernardino County)
- SR-91 – west of Corona, east of the intersection with SR-71 (Orange County, just west of Riverside County)
- U.S. 101 – in Thousand Oaks, east of SR-23 (Ventura County)
- SR-60 near Diamond Bar (Los Angeles County)
- I-15 in Ontario (San Bernardino County).

Diesel- and gasoline-powered vehicle emissions contain many compounds that have been determined to be carcinogenic. Only a few compounds, however, are emitted in sufficient quantities to contribute to significant cancer risks in areas immediately downwind of roadway segments affected by the Plan. Foremost among these compounds is diesel exhaust particulate matter (DPM), based on its designation as a toxic air contaminant by ARB. The gaseous organic compounds that significantly contribute to cancer risk include 1,3 butadiene, benzene, formaldehyde, and acetaldehyde.

Emission factors for these pollutants from operation of on-road vehicles were developed using the most recent emission factor model developed by the USEPA and CARB. On-road emission factors for DPM and total organic gas (TOG) emissions were generated through use of the ARB EMFAC2007 model. A special toxics module of USEPA's MOBILE6.2 model was used to determine the fractions of individual cancer-causing toxic compounds listed above in TOG emissions, a capability not possessed by the EMFAC2007 model.

SCAG's travel demand modeling system produces estimates of roadway link volumes for light/medium-duty vehicles (e.g., passenger cars and trucks and light/medium commercial vehicles) and heavy-duty vehicles. Since 90 to 95 percent of the TOG toxic emissions come from light/medium-duty vehicles and similar percentages of DPM are emitted by heavy-duty vehicles, emission factors from the EMFAC2007 runs (and MOBILE6 toxic fraction breakdowns) were compiled separately for light/medium duty vehicles and heavy-duty vehicles for each county/area. This approach accounted for variations in the mix of heavy-duty vehicles across roadway links contained in SCAG's travel model outputs and the relative impacts of each compound on overall cancer risk.

The quantification of cancer risk impacts resulting from vehicle operation in the vicinity of each of the selected freeway corridors in the Plan was performed using a USEPA-approved American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee-developed AERMOD modeling system. The meteorological databases recommended for use are those compiled by SCAQMD for calendar year 2005 through 2007 from 26 stations within the SCAB.

Residential cancer risk is expressed in units of increased cancer risk per 70-year exposure. Based on OEHHA guidance for workplace vs. residential exposure, the ARB's Hotspots Analysis and Reporting Program (HARP) model also produces cancer risk results based on workplace exposure. While residential risk assessment assumes 24 hour/day, 7 day/week, 52 week/year, 70-year exposure, HARP uses default workplace exposure assumptions of 8 hours per day and 245 days per year over a 40-year period.

Several simplifying assumptions were made in the health risk assessment. First, the analysis focused only on quantifying increased cancer risks—acute and non-cancer chronic health risks and mortality risks were not considered. Additionally, cancer risk values represent risk based on 70 years of exposure. However, calendar year 2035 emission factors are assumed to persist for years within the 70-year period beyond 2035, since regulations mandating future emissions reductions do not call for any new restrictions beyond 2018. If vehicle emission technology improvements continue, use of 2035 fleet emission factors to represent emissions beyond 2035 will produce conservatively higher average fleet emissions over the 70-year period than actually occur, and cancer risks for future scenarios will be conservatively over-predicted.

The HARP model reports maximum residential and workplace cancer risk at any receptor, referred to as the Maximum Exposed Individual (MEI). The cancer risks reported for each highway segment and planning scenario are for the MEI, even if no residence or workplace actually exists at the location of the MEI. This conservative assumption is designed to overestimate cancer risk. For the analysis of freeway segment operations, the cancer risk values reported by the model represent the chance of contracting cancer from exposure to freeway emissions if a person lived at the same location for a period of 70 years or worked at the same location for 40 years and if freeway emissions did not change over those periods. These risk values reflect only exposure to emissions from freeway traffic and do not include cancer risk due to other sources.

The residential cancer risk values reported for the hypothetical location of the maximum exposed individual for each of the five planning scenarios and each of the eight freeway segments studied are presented in **Table 3.2-7**. **Table 3.2-8** presents a similar summary of maximum cancer risks based on workplace exposure along each modeled corridor.

The maximum residential and workplace risks due to vehicle operation on all freeway segments are much higher under existing (2012) conditions than under the Plan. The declines in cancer risk across all freeway segments are the result of continued decreases in per-vehicle mile fleet emissions projected to occur over the next 23 years. This decrease occurs due to continued emission control technology improvements in new vehicles for which certification standards continue to tighten up through 2018.

Table 3.2-9 presents the distances from roadway boundaries at which maximum residential cancer risks drop by 50 and 90 percent. The 50 percent drop occurs at an average distance of 371 feet and the 90 percent drop occurs at an average distance of 2,009 feet.

TABLE 3.2-7: MAXIMUM CANCER RISK BASED ON RESIDENTIAL EXPOSURE TO VEHICLE OPERATION BY PLANNING SCENARIO AND FREEWAY CORRIDOR

Planning Scenario	Maximum Cancer Risk Over 70-Year Residential Exposure (in one million)							
	I-405 (Orange)	I-710 (Los Angeles)	I-8 (Imperial)	SR-60 (San Bernardino)	SR-91 (Riverside)	US-101 (Ventura)	SR-60 (Los Angeles)	I-15 (San Bernardino)
2012 Existing Conditions	1,080	1,040	503	1,770	1,960	372	1,470	811
2035 No Project	442	734	385	735	943	201	562	368
2035 Plan	462	475	399	714	668	199	536	354

SOURCE: Sierra Research, 2011.

TABLE 3.2-8: MAXIMUM CANCER RISK BASED ON WORKPLACE EXPOSURE TO VEHICLE OPERATION BY PLANNING SCENARIO AND FREEWAY CORRIDOR

Planning Scenario	Maximum Cancer Risk Over 70-Year Residential Exposure (in one million)							
	I-405 (Orange)	I-710 (Los Angeles)	I-8 (Imperial)	SR-60 (San Bernardino)	SR-91 (Riverside)	US 101 (Ventura)	SR-60 (Los Angeles)	I-15 (San Bernardino)
2012 Existing Conditions	163	158	76	269	297	56	223	123
2035 No Project	67	111	58	111	143	30	85	56
2035 Plan	70	72	60	108	101	30	81	54

SOURCE: Sierra Research, 2011.

TABLE 3.2-9: APPROXIMATE DISTANCES AT WHICH CANCER RISKS ARE REDUCED BY 50 AND 90 PERCENT		
Freeway Corridor	**50% Reduction Distance**	**90% Reduction Distance**
I-15 (San Bernardino County)	200	1,750
I-405 (Orange County)	390	1,980
I-710 (Los Angeles County)	470	2,500
I-8 (Imperial County)	410	1,500
SR-60 (San Bernardino County)	390	1,990
SR-91 (Riverside County)	460	2,410
SR-60 (Los Angeles County)	310	2,250
U.S. 101 (Ventura County)	340	1,690
SOURCE: Sierra Research, 2011.		

Table 3.2-10 presents a sample calculation of the contribution of each TAC to total cancer risk for a single freeway link. This calculation shows that cancer risk from DMP accounts for approximately 96 percent of the cancer risk on this link.

TABLE 3.2-10: SAMPLE CALCULATION OF CANCER RISK DUE TO DPM ON I-15				
			Cancer Risk	
TOG	**Cancer Risk (per µg/m^3)**	**Emission Rate (g/s)**	**Per µg/m^3 per g/s**	**Percent of Total**
Acetaldehyde	3.77E-06	3.72E-03	1.40E-08	0.1
Benzene	3.77E-05	2.92E-03	1.10E-07	1.0
1,3-Butadiene	2.26E-04	1.09E-03	2.45E-07	2.3
Formaldehyde	7.91E-06	3.59E-03	2.84E-08	0.3
DPM	4.15E-04	2.48E-02	1.03E-05	96.3
		Total	**1.07E-05**	**100**
SOURCE: Sierra Research, 2011.				

ARB reviewed studies that found measured air pollution concentrations from motor vehicles drop off dramatically between the source and 500 feet. The above analysis is consistent with ARB air quality modeling and risk analyses performed for freeways. The estimated risk from DPM exposure was found to vary substantially due to meteorology: typical downwind areas had much higher risk than upwind areas. Freeways with low truck volumes had lower risks than those with higher truck volumes. ARB based its 500-foot buffer recommendation on a review of several studies and air dispersion modeling. ARB's modeling was based on year 2000 truck and automobile information that included higher DPM emissions rates. New vehicle standards, gasoline and Diesel fuel reformulation, and ARB-adopted Diesel Risk Reduction Measures have resulted in lower potential cancer risks near freeways. As shown by the reductions in cancer risk projected to occur between existing conditions and the Plan in 2035, these risk reduction measures will continue to reduce toxic emissions from motor vehicles and resulting cancer risks.

Impact 3.2-3: Potential to increase population within 500 feet of transportation facilities that could expose residents (schools and other sensitive receptors) to elevated (as compared to average) cancer and other health risks.

As discussed in Chapter 2, Project Description, as a result of SCS policies the anticipated growth pattern would concentrate population adjacent to transit and other transportation facilities in High Quality Transit Areas (HQTAs) that could result in more people being exposed to elevated cancer risk as compared to areas of the region more distant from such facilities. Therefore under the Plan more sensitive receptors would be located adjacent to transportation facilities and would therefore be exposed to transportation-related air toxics.

While as a result of on-going emission controls, cancer and other health risks within any given distance of mobile sources in the region would decrease substantially (see Impact 3.2-2 above), the health risks adjacent to transportation facilities would remain higher than regional averages and above desirable levels. The existing population within 500 feet of freeways is about 1,082,000. In 2035 under the Plan the population would be 1,283,000; without the Plan the population would be about 1,261,000. The 2008 population within 500 feet of railroads is about 962,000. In 2035 under the Plan the population would be about 1,159,000 and without the Plan the population would be about 1,078,000.

As noted in the discussion of Environmental Setting above, the population residing close to freeways or busy roadways may experience adverse health effects beyond those typically found in urban areas. Several studies found an association between adverse non-cancer health effects (e.g., asthma) and living or attending school near heavily traveled urban roadways. Studies also found that the roadway and truck traffic densities were key factors affecting the strength of association with adverse health impacts. For urban roadways, the association of traffic-related emissions with adverse health impacts was generally strongest between 300 and 1,000 feet. As discussed above, proximity to freeways increases cancer risk and exposure to particulate matter. Similarly proximity to heavily travelled rail corridors would expose residents to high levels of DPM. Mitigation Measure **MM-AQ19** would reduce this impact to a less-than-significant level.

Impact 3.2-4: Emissions of short-term criteria pollutants would increase under the Plan as a result of construction of Plan transportation projects and development in the region. Therefore the Plan would result in a significant impact related to construction emissions.

The Plan would involve substantial construction to implement Plan projects. In addition, construction of development that constitutes regional growth would also generate substantial emissions. While each project would result in only short-term emissions, the construction industry itself comprises one component of stationary and area source emissions addressed in the AQMPs.

Construction activities in the region would create air emissions from the following activities: (1) demolition; (2) site preparation operations (grading/excavation); (3) fuel combustion from the operation of construction equipment; (3) delivery and hauling of construction materials and supplies to and from sites; (4) the use of asphalt or other oil based substances during the final construction phases of projects; and (5) travel by construction workers to and from sites.

Construction emissions are site-specific and are based on the type and magnitude of development that would be accommodated under the project, the timeline for construction, the mix of construction equipment required to build the project, and emission factors from the SCAQMD *CEQA Air Quality Handbook* and USEPA's AP-42. Emissions of NOx, VOC, and PM10 depend upon number and type of operating vehicles and the number of hours of operation. Fugitive emissions depends upon the amount of soil disturbed, type of soil, duration, type of activity (grading, excavation, etc.), haul trips and other factors.

Most improvements in transit and system management (signal synchronization, striping, etc.) do not involve construction and are not expected to generate short-term impacts. However, a number of the projects in the Plan would involve construction activities (new goods movement capacity enhancements, arterials, and rail systems). It is very likely that some of these projects would be under concurrent construction throughout the region. Short-term construction impacts generated from the implementation of the Plan are expected to be significant. The SCAQMD has developed thresholds of significance for individual construction projects within their jurisdiction. These thresholds are shown in **Table 3.2-11**.

TABLE 3.2-11: SCAQMD AIR QUALITY SIGNIFICANCE THRESHOLDS FOR CONSTRUCTION	
Pollutant	**Mass Daily Threshold (Pounds/Day)**
NO_x	100
VOC	75
PM10	150
PM2.5	55
SO_x	150
CO	550
Lead (Pb)	3
SOURCE: SCAQMD, *CEQA Air Quality Handbook*, 1993.	

Other air quality management districts within the SCAG region have adopted similar thresholds for individual construction projects for criteria pollutants. Project-level analysis conducted for CEQA purposes would estimate construction emissions for each project based on project specifics. Mitigation measures to reduce air quality impacts would be established in project-specific environmental documents. The construction of highways or arterials would be expected to generate a significant amount of construction activity and therefore exceed the significance thresholds established in the *CEQA Air Quality Handbook*. These impacts would occur in localized areas depending on the construction site locations. Individual projects would be required to implement mitigation measures to reduce construction emissions. Other construction impacts include potential construction-related traffic impacts due to congestion from lane closures. These impacts should be addressed at the project level analysis.

The overall impact of the Plan due to construction of transportation-related projects would create substantial emissions. Implementation of Mitigation Measures **MM-AQ1** through **MM-AQ18** would reduce criteria pollutant impacts; however, impacts would remain significant.

Cumulative Impact 3.2-5: Trains, airplanes, ships and stationary and area sources substantially contribute to emissions in the region; these sources are addressed by the applicable AQMPs and not substantially affected by the Plan. All such emissions are anticipated to be consistent with applicable AQMPs and SIPs and within regional conformity emission budgets. Therefore, the Plan would result in a less-than-significant impact related to cumulatively considerable emissions.

The regional cumulative analysis assesses the impacts potential indirect effects in conjunction with other plans, programs, projects and policies that affect ambient air quality. Projected long-term emissions are considered to be cumulatively significant if they are not consistent with the local air quality management plans and state implementation plans. Consistency is demonstrated through the conformity analysis.

Regional emissions conformity is achieved if the projected emission inventories are within the budget emissions for each air basin for each milestone year (or if no budgets have been established by the interim build/no build or less than base year tests). In addition to the regional emissions analysis, conformity must show: 1) that the implementation of the Transportation Control Measures (TCM) contained in the SIPs are on schedule; 2) that the Financial Constraint Determination has been adequately prepared; and 3) that the required Interagency Consultation and Public Involvement has been adequately implemented.

The emissions budgets reflected in the AQMPs/SIPs function as the applicable emission budgets for the ozone conformity analysis for all non-attainment areas in the SCAG region. The conformity determinations based on the emission budgets for each air basin in the SCAG region, and conducted as part of the Plan development process, provide reasonable analysis of cumulative air quality impacts of the Plan. The 2012-2035 RTP/SCS should conform to the emissions budgets established in each applicable AQMPs/SIPs. Federal conformity regulations require emissions to be based on the Latest Planning Assumptions that include the latest vehicle data (fleet, age, activity) and latest socio-economic data. A conformity determination must be made for each nonattainment area in the region.

A regional analysis estimates the emissions from the implementation of the Plan and compares them to the emission budgets identified in the AQMPs/SIPs. If the estimated emissions from the Plan are greater than the emissions budget then the plan would not conform. In the absence of an emission budget, an interim test, such as the build/no build test is applied. In order to pass the build/no-build test, it must be demonstrated that emissions in the build scenario are less than or equal to the no-build scenario depending upon the non-attainment designation.

The applicable emissions budgets in the SCAG region are established by air basin, by air district, by pollutant and by years of analysis (milestone, attainment, and planning horizon years). The Transportation Conformity analysis is prepared separately from this PEIR and can be found in Appendices of the 2012-2035 RTP/SCS. The analysis concludes that the plan conforms to federal and state requirements for meeting attainment goals throughout the SCAG region.

Therefore, cumulative regional air quality impacts are considered to be less than significant with respect to consistency with applicable plans.

For purposes of comparison of on-road mobile emissions with other emission sources in the region, and to account for cumulative emissions from growth and other sources the following tables present estimated existing (the most recent year available is 2007) and 2035 emissions for the following emission sources in SCAB (which represent about 70 percent of emissions in the region): Trains (**Table 3.2-12**), Aircraft (**Table 3.2-13**), Ships and Commercial Boats (**Table 3.2-14**), Other Mobile Sources such as farm equipment, off-road vehicles, fuel handling, etc. (**Table 3.2-15**), and Stationary and Area Sources which includes all other emission sources including residential, commercial and industrial emissions and construction emissions, including 2012-2035 RTP/SCS projects (**Table 3.2-16**).

TABLE 3.2-12: FINAL 2007 AQMP FORECAST OF ANNUAL AVERAGE TRAIN EMISSIONS IN THE SCAB

	Tons/Day							
Year	**TOG**	**VOC**	**CO**	**NO_x**	**SO_x**	**TSP**	**PM10**	**PM2.5**
2008	2.97	2.48	7.06	28.95	0.14	0.86	0.85	0.78
2023	3.19	2.66	9.92	27.63	0.03	0.90	0.89	0.82
2030	3.41	2.85	11.99	32.86	0.03	0.95	0.95	0.87
2035 /a/	3.58	2.99	13.73	37.19	0.03	0.99	1.00	0.91

/a/ Calculated based on the annualized rate of change observed between 2023 and 2030.
SOURCE: SCAQMD, *2007 Air Quality Management Plan*, 2007.

TABLE 3.2-13: FINAL 2007 AQMP FORECAST OF ANNUAL AVERAGE AIRCRAFT EMISSIONS IN THE SCAB

	Tons/Day							
Year	**TOG**	**VOC**	**CO**	**NO_x**	**SO_x**	**TSP**	**PM10**	**PM2.5**
2008	9.07	8.10	58.31	17.42	1.68	0.97	0.91	0.89
2023	14.64	13.08	85.14	29.34	2.69	1.28	1.19	1.17
2030	17.63	15.75	98.23	35.67	3.21	1.42	1.33	1.30
2035 /a/	20.13	17.98	108.80	41.01	3.64	1.53	1.44	1.40

/a/ Calculated based on the annualized rate of change observed between 2023 and 2030.
SOURCE: SCAQMD, *2007 Air Quality Management Plan*, 2007.

TABLE 3.2-14: FINAL 2007 AQMP FORECAST OF ANNUAL AVERAGE SHIP AND COMMERCIAL BOAT EMISSIONS IN THE SCAB

Year	Tons/Day							
	TOG	VOC	CO	NO_x	SO_x	TSP	PM10	PM2.5
2008	4.31	3.61	10.35	76.95	20.10	4.18	4.05	3.90
2023	4.92	4.13	14.57	116.19	33.05	5.94	5.72	5.55
2030	6.13	5.13	17.69	152.49	48.64	8.31	8.00	7.77
2035 /a/	7.17	5.99	20.32	185.17	64.10	10.56	10.17	9.88

/a/ Calculated based on the annualized rate of change observed between 2023 and 2030.
SOURCE: SCAQMD, *2007 Air Quality Management Plan*, 2007.

TABLE 3.2-15: FINAL 2007 AQMP FORECAST OF ANNUAL AVERAGE OTHER MOBILE SOURCES (NOT INCLUDING AIRCRAFT, RAIL & SHIP) EMISSIONS IN THE SCAB

Year	Tons/Day							
	TOG	VOC	CO	NO_x	SO_x	TSP	PM10	PM2.5
2008	150.97	138.37	904.94	208.24	0.25	15.39	14.90	12.99
2023	108.10	100.46	4,009.67	94.74	0.33	11.18	10.33	8.23
2030	118.11	110.04	1,108.64	82.51	0.39	13.62	12.39	9.61
2035 /a/	125.82	117.44	1,185.22	74.75	0.44	15.68	14.11	10.74

/a/ Calculated based on the annualized rate of change observed between 2023 and 2030.
SOURCE: SCAQMD, *2007 Air Quality Management Plan*, 2007.

TABLE 3.2-16: FINAL 2007 AQMP FORECAST OF ANNUAL AVERAGE STATIONARY & AREA SOURCE EMISSIONS IN THE SCAB

Year	Tons/Day							
	TOG	VOC	CO	NO_x	SO_x	TSP	PM10	PM2.5
2008	476.84	245.08	177.40	86.80	16.60	447.24	231.87	65.19
2023	504.10	276.23	186.06	74.38	16.54	513.00	265.99	73.39
2030	527.34	291.47	192.01	75.99	16.78	544.12	282.21	77.42
2035 /a/	544.59	302.87	196.38	77.16	16.95	567.50	294.40	80.43

/a/ Calculated based on the annualized rate of change observed between 2023 and 2030.
SOURCE: SCAQMD, *2007 Air Quality Management Plan*, 2007.

Since no forecast for 2035 is currently available for these emissions, the annualized growth rate between 2023 and 2030 was used to project inventory estimates in 2035. It should be noted that this forecast is approximate, as it does not separately account for the effects of fleet turnover, growth and projected controls.

The AQMP is in the process of being updated and the emissions estimations have not been revised at the time of this analysis. The ARB prepared the *8-Hour Ozone State Implementation Plan Revisions and Technical Revisions to the PM2.5 State Implementation Plan Transportation Conformity Budgets for the South Coast and San Joaquin Valley Air Basins*[26] that was recently approved by the EPA. This document provides a recent estimation 2023 ROG and NO_X emissions for the SCAB. The ROG and NO_X emissions are within one and eight percent, respectively, of the emissions presented in the 2008 AQMP.

[26]ARB, *Proposed 8-Hour Ozone State Implementation Plan Revisions and Technical Revisions to the PM2.5 State Implementation Plan Transportation Conformity Budgets for the South Coast and San Joaquin Valley Air Basins*, June 20, 2011.

MITIGATION MEASURES[27]

Mitigation Measure **MM-AQ1** facilitates implementation of Transportation Control Measures in the Plan. Mitigation Measures **MM-AQ1** through **MM-AQ20** can and should be implemented by project sponsors (for both development and transportation projects) as applicable. Project specific environmental documents may adjust these mitigation measures as necessary to respond to site-specific conditions. Projects taking advantage of CEQA Streamlining provisions of SB 375 can and should apply mitigation measures as appropriate to site-specific conditions.

MM-AQ1: Transportation Control Measures (TCMs) shall be implemented as appropriate by SCAG and can and should be implemented by local agencies and project sponsors as appropriate. TCMs included in the Plan are identified in the Transportation Conformity Appendix to the 2012-2035 RTP/SCS (starting on page 26). CAA Section 108(f)(1)(A) lists the following sixteen measures as illustrative of TCMs:

I. Programs for improved use of public transit;
II. Restriction of certain roads or lanes to, or construction of such roads or lanes for use by, passenger buses or high occupancy vehicles;
III. Employer-based transportation management plans, including incentives;
IV. Trip-reduction ordinances;
V. Traffic flow improvement programs that achieve emission reductions;
VI. Fringe and transportation corridor parking facilities, serving multiple occupancy vehicle programs or transit service;
VII. Programs to limit or restrict vehicle use in downtown areas or other areas of emission concentration, particularly during periods of peak use;
VIII. Programs for the provision of all forms of high-occupancy, shared-ride services, such as the pooled use of vans;
IX. Programs to limit portions of road surfaces or certain sections of the metropolitan area to the use of non-motorized vehicles or pedestrian use, both as to time and place;
X. Programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists, in both public and private areas;
XI. Programs to control extended idling of vehicles;
XII. Programs to reduce motor vehicle emissions, consistent with Title II of the CAA, which are caused by extreme cold start conditions;
XIII. Employer-sponsored programs to permit flexible work schedules;
XIV. Programs and ordinances to facilitate non-automobile travel, provision and utilization of mass transit, and to generally reduce the need for single-occupant vehicle travel, as part of transportation planning and development efforts of a locality, including programs and ordinances applicable to new shopping centers, special events, and other centers of vehicle activity;
XV. Programs for new construction and major reconstruction of paths, tracks or areas solely for the use by pedestrian or other non-motorized means of transportation, when economically feasible and in the public interest; and
XVI. Programs to encourage the voluntary removal from use and the marketplace of pre-1980 model year light duty vehicles and pre-1980 model light duty trucks.

The Plan has been prepared to facilitate implementation of TCMs that also serve as air quality mitigation measures for the purposes of the PEIR.

[27] Measures included here will also have the effect of reducing adverse impacts to environmental justice communities and have been adopted in the mitigation framework in the Environmental Justice Appendix.

MM-AQ2: Local air districts, local jurisdictions and project sponsors can and should implement measures adopted by ARB designed to attain federal air quality standards for PM2.5 and 8-hour ozone. ARB's strategy, includes the following elements:

- Set technology forcing new engine standards;
- Reduce emissions from the in-use fleet;
- Require clean fuels, and reduce petroleum dependency;
- Work with US EPA to reduce emissions from federal and state sources; and
- Pursue long-term advanced technology measures.
- Proposed new transportation–related SIP measures include:[28]

ON-ROAD SOURCES

- ✓ Improvements and Enhancements to California's Smog Check Program
- ✓ Expanded Passenger Vehicle Retirement
- ✓ Modifications to Reformulated Gasoline Program
- ✓ Cleaner In-Use Heavy-Duty Trucks
- ✓ Ship Auxiliary Engine Cold Ironing and Other Clean Technology
- ✓ Cleaner Ship Main Engines and Fuel
- ✓ Port Truck Modernization
- ✓ Accelerated Introduction of Cleaner Line-Haul Locomotives
- ✓ Clean Up Existing Commercial Harbor Craft

OFF-ROAD SOURCES

- ✓ Cleaner Construction and Other Equipment
- ✓ Cleaner In-Use Off-Road Equipment
- ✓ Agricultural Equipment Fleet Modernization
- ✓ New Emission Standards for Recreational Boats
- ✓ Off-Road Recreational Vehicle Expanded Emission Standards

MM-AQ3: Project sponsors can and should ensure that water or "toxic free" dust suppressants are applied to exposed earth surfaces to control emissions as necessary to control dust and comply with applicable regulations.

MM-AQ4: Project sponsors can and should ensure that all excavating and grading activities should cease during second stage smog alerts and periods of high winds.

MM-AQ5: Project sponsors can and should ensure that all trucks hauling dirt, sand, soil, or other loose materials off-site should be covered or wetted or should maintain at least two feet of freeboard (i.e., minimum vertical distance between the top of the load and the top of the trailer).

MM-AQ6: Project sponsors can and should ensure that all construction roads that have high traffic volumes, should be surfaced with base material or decomposed granite, or should be paved or otherwise be stabilized.

MM-AQ7: Project sponsors can and should ensure that public streets should be cleaned, swept or scraped at frequent intervals or at least three times a week if visible soil material has been carried onto adjacent public roads.

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[28] ARB. April 26, 2007. *Proposed New SIP Measures – Descriptions. http://www.arb.ca.gov/planning/sip/2007sip/apr07draft/sipmeas.pdf*, accessed December 2011.

MM-AQ8: Project sponsors can and should ensure that construction equipment should be visually inspected prior to leaving the site and loose dirt should be washed off with wheel washers as necessary.

MM-AQ9: Project sponsors can and should ensure that water, hydroseed, or non-toxic soil stabilizers are applied to inactive construction areas as needed to reduce off-site transport of fugitive dust.

MM-AQ10: Project sponsors can and should ensure that traffic speeds on all unpaved surfaces should not exceed 25 mph.

MM-AQ11: Project sponsors can and should ensure that low sulfur or other alternative fuels or diesel powered vehicles with Tier 3 or better engines or retrofitted/repowered –to meet equivalent emissions standards as Tier 3 engines -should be used in construction equipment where feasible.

MM-AQ12: Project sponsors can and should ensure that deliveries related to construction activities that affect traffic flow should be scheduled during off-peak hours (e.g., 10:00 a.m. and 3:00 p.m.) and coordinated to achieve consolidated truck trips. When the movement of construction materials and/or equipment impacts traffic flow, temporary traffic control should be provided to improve traffic flow (e.g., flag person).

MM-AQ13: Project sponsors can and should ensure that to the extent possible, construction activity should utilize electricity from power poles rather than temporary diesel power generators and/or gasoline power generators.

MM-AQ14: Local jurisdictions or agencies can and should, as practical and feasible, revegetate exposed earth surfaces following construction. Application of xeriscape principles, including such techniques and materials as native or low water use plants and low precipitation sprinklers heads, bubblers, drip irrigation systems and timing devices, should also be considered.

MM-AQ15: Local jurisdictions can and should set specific limits on idling time for commercial vehicles, including delivery and construction vehicles.

MM-AQ16: Project sponsors can and should ensure that sandbags or other erosion control measures are installed to prevent silt runoff to public roadways as needed.

MM-AQ17: Project sponsors can and should designate a person or persons to monitor the dust control program and to order increased watering, as necessary, to prevent transport of dust offsite. Their duties should include holidays and weekend periods when work may not be in progress. The name and telephone number of such persons should be provided to the local air district prior to the start of construction as well as posted on-site over the duration of construction.

MM-AQ18: Project sponsors can and should ensure that appropriate wind-breaks are installed at the construction site to minimize windblown dust.

MM-AQ19: In order to comply with the California Air Resources Board Air Quality and Land Use Handbook (June 2005) and achieve an acceptable interior air quality level for sensitive receptors, project sponsors can and should identify appropriate measures, to be incorporated into project building design for residential, school and other sensitive uses located within 500 feet of freeways, heavily travelled arterials, railways and other sources of Diesel particulate Matter and other known carcinogens. The appropriate measures should include one or more of the following methods as may be appropriate:

a. The project sponsor should retain a qualified air quality consultant to prepare a health risk assessment (HRA) in accordance with the California Air Resources Board and the Office of Environmental Health and Hazard Assessment requirements to determine the exposure of project residents/occupants/users to stationary air quality polluters prior to issuance of a demolition, grading, or building permit. The HRA should be submitted to the Lead Agency for review and approval. The sponsor should implement the approved HRA recommendations, if any. If the HRA concludes that the air quality risks from nearby sources are at or below acceptable levels, then additional measures are not required.
b. The project sponsor should implement the following features that have been found to reduce the air quality risk to sensitive receptors and should be included in the project construction plans. These should be submitted to the appropriate agency for review and approval prior to the issuance of a demolition, grading, or building permit and ongoing.
   i. Do not locate sensitive receptors near distribution center's entry and exit points.
   ii. Do not locate sensitive receptors in the same building as a perchloroleythene dry cleaning facility.
   iii. Maintain a 50 foot buffer from a typical gas dispensing facility (under 3.6 million gallons of gas per year).
   iv. Install, operate and maintain in good working order a central heating and ventilation (HV) system or other air take system in the building, or in each individual residential unit, that meets the efficiency standard of the MERV 13. The HV system should include the following features: Installation of a high efficiency filter and/or carbon filter-to-filter particulates and other chemical matter from entering the building. Either HEPA filters or ASHRAE 85% supply filters should be used.
   v. Retain a qualified HV consultant or HERS rater during the design phase of the project to locate the HV system based on exposure modeling from the mobile and/or stationary pollutant sources.
   vi. Maintain positive pressure within the building.
   vii. Achieve a performance standard of at least one air exchange per hour of fresh outside filtered air.
   viii. Achieve a performance standard of at least 4 air exchanges per hour of recirculation
   ix. Achieve a performance standard of .25 air exchanges per hour of in unfiltered infiltration if the building is not positively pressurized.
c. Project sponsor should maintain, repair and/or replace HV system or prepare an Operation and Maintenance Manual for the HV system and the filter. The manual should include the operating instructions and maintenance and replacement schedule. This manual should be included in the CC&R's for residential projects and distributed to the building maintenance staff. In addition, the sponsor should prepare a separate Homeowners Manual. The manual should contain the operating instructions and maintenance and replacement schedule for the HV system and the filters. It should also include a disclosure to the buyers of the air quality analysis findings.

MM-AQ20: To the maximum extent practicable the Lead Agency can and should ensure that private (individual and common) exterior open space, including playgrounds, patios, and decks, should either be shielded from stationary sources of air pollution by buildings or otherwise buffered to further reduce air pollution exposure for project occupants.

SIGNIFICANCE OF IMPACTS AFTER MITIGATION

Criteria Pollutant Emissions

Even with implementation Mitigation Measures **MM-AQ1** through **MM-AQ18**, regional emissions of PM10 would increase in Imperial, Orange, and Riverside Counties. Therefore, the Plan would have a significant impact on regional air quality. It must be noted, however, that the SIPs for the region account for the increased fugitive dust (as well as tail pipe emissions) such that the 2012-2035 RTP/SCS conforms to the attainment demonstrations as required by the federal CAA.

Change in Risk Levels Adjacent to Freeways

Impacts related to health incidences were determined to be less than significant because of the decrease in risk at any given distance from freeways (due to emission controls).

Increased Population

Increasing population adjacent to transportation facilities could expose more people to increased cancer and other health risks. Even though cancer and other health risks adjacent to freeways and railroads would decrease considerably as compared to existing conditions, risk levels would remain above average for the region. Mitigation Measure **MM-AQ19** would reduce this impact to a level of less than significance. Mitigation Measure **MM-AQ20** would also reduce impacts associated with stationary sources of pollutants.

Construction Emissions

Even with implementation of Mitigation Measures **MM-AQ1** through **MM-AQ18**, activities related to construction of Plan projects would result in emissions exceeding thresholds for NO_X, CO, PM10, PM2.5, SO_2 and ROG. Therefore, construction of Plan projects and development would have a significant impact on regional air quality.

Cumulative Effects

Impacts related to cumulatively considerable emissions were determined to be less than significant without mitigation. Trains, airplanes, ships and stationary and area sources substantially contribute to emissions in the region; these sources are addressed by the applicable AQMPs and not substantially affected by the Plan. All such emissions are anticipated to be consistent with applicable AQMPs and SIPs and within regional conformity emission budgets. Therefore, the Plan would result in a less-than-significant impact related to cumulatively considerable emissions.

COMPARISION WITH THE NO PROJECT ALTERNATIVE

Direct Impacts

Criteria Pollutant Emissions. **Table 3.2-17** compares the existing conditions to the No Project Alternative criteria pollutant emissions by county. The No Project Alternative would result in more emissions than the Plan. **The Plan impacts would be less than the No Project impacts for Impact 3.10-1.**

Tables 3.2-4 and **3.2-5** show the residential and workplace cancer risk, respectively. The maximum residential and workplace risks due to vehicle operation on all freeway segments are much higher under existing (2012) conditions than under the No Project Alternative. The declines in cancer risk across all freeway segments are the result of continued decreases in per-vehicle mile fleet emissions projected to occur due to continued emission control technology improvements in new vehicles. When compared to the Plan, the No Project Alternative would result in a higher risk in all counties expect for Orange and Imperial Counties. Regardless, the total regional risk would be lower under the Plan than the No Project Alternative. In addition, it is estimated that the Plan would result in 293,633 annual health incidences leading to $4,952,996,222 spent on healthcare. This is a 24 percent reduction when compared to the No Project Alternative. **The Plan impacts would be less than the No Project impacts for Impact 3.10-2.**

Construction Emissions. Under the No Project Alternative, no new transportation investments would be made, beyond those that are currently programmed. As a result, fewer transportation projects would be built resulting in less construction emissions from Plan projects. However, the same growth is anticipated under the No Project Alternative as under the Plan (although under the Plan it would be more concentrated around transit routes). **The Plan impacts would be greater than the No Project impacts for Impact 3.10-3 as a result of increased construction of Plan projects.**

Indirect Impacts

The Plan includes transportation and land use strategies that focus growth along existing corridors and in urbanized areas, rather than allowing development of vacant, open space/recreation and agricultural lands. This compact development pattern included in the Plan would concentrate population in urban areas and encourage alternative modes of travel other than automobiles. Without the planned development patterns, regional emissions would be higher than under the Plan. **The Plan impacts would be less than the No Project impacts for Impact 3.10-4.**

TABLE 3.2-17: CRITERIA POLLUTANT EMISSIONS BY COUNTY – EXISTING CONDITIONS (2012) VS NO PROJECT (2035)

County		Tons/Day								
		ROG Summer	ROG Annual	NO_x Summer	NO_x Annual	NO_x Winter	CO Winter	PM10 Annual	PM2.5 Annual	SO_x Annual
Los Angeles /a/	Existing	96	94	199	203	218	902	14	9	1
	No Project	44	42	72	73	77	328	14	9	2
	Difference	(52)	(50)	(127)	(30)	(141)	(574)	0	0	1
Imperial	Existing	5	4	14	13	14	34	1	1	0
	No Project	4	3	9	9	9	24	1	1	0
	Difference	(1)	(1)	(5)	(4)	(5)	(10)	0	0	0
Orange	Existing	31	30	52	53	58	280	4	3	0
	No Project	15	15	19	19	20	104	4	3	0
	Difference	(16)	(15)	(33)	(34)	(38)	(176)	0	0	0
Riverside /b/	Existing	26	23	76	76	80	227	5	4	0
	No Project	15	14	35	34	36	121	6	4	1
	Difference	(11)	(9)	(41)	(42)	(44)	(106)	1	0	1
San Bernardino /c/	Existing	28	25	81	81	85	251	5	4	0
	No Project	15	14	40	39	40	124	5	4	1
	Difference	(13)	(11)	(41)	(42)	(45)	(127)	0	0	1
Ventura	Existing	10	10	16	16	18	83	1	1	0
	No Project	4	4	5	5	6	29	1	1	0
	Difference	(6)	(6)	(11)	(11)	(12)	(54)	0	0	0

/a/ Los Angeles County excludes Antelope Valley
/b/ Riverside County includes the SCAB, MDAB and Coachella Valley portions
/c/ San Bernardino County includes the SCAB and MDAB portions
SOURCE: SCAG Transportation Modeling, 2011.

Exhibit M

Exhibit M

USC University of Southern California

USC News

Health

New concerns raised about air pollution at LAX

Effects from planes that are landing appear to play a key role in the large area of impact

by **Leslie Ridgeway**
May 30, 2014

Most previous research focused on measuring air quality near where jet takeoffs occur. (Photo/Alan Wilson)

Research conducted by scientists at the Keck School of Medicine of USC shows that airliner activity at Los Angeles International Airport worsens air quality over a far larger area than previously assumed.

The study, published on May 29 in the journal *Environmental Science and Technology* and conducted with University of Washington researchers, found a doubling of ultrafine particle number concentrations extended east more than 10 miles downwind from the airport boundary over a 20-square-mile area, encompassing Lennox, Westmont, parts of South Los Angeles, Hawthorne and Inglewood, and, in certain wind conditions, areas south of LAX.

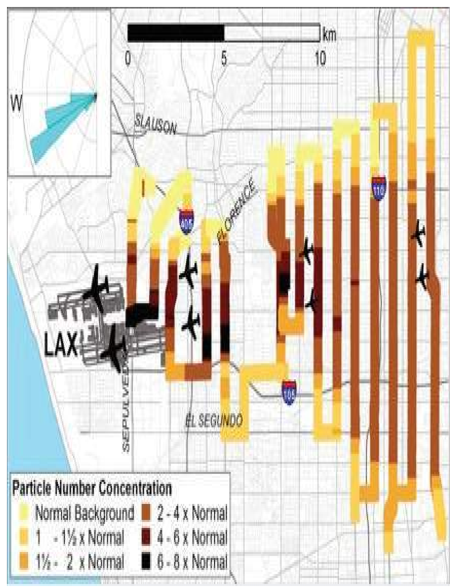
"Our research shows that airport impacts extend more than five times further than previously assumed," said Scott Fruin, lead researcher and assistant professor of preventive medicine at the Keck School of Medicine. "Effects from planes that are landing appear to play a major role in this large area of impact."

To put this large area of impact into perspective, the researchers calculated that one-quarter to one-half of the entire Los Angeles County freeway system produces an equivalent increase in ultrafine particle numbers on a concentration-weighted basis.

"LAX may be as important to LA's air quality as the freeway system," Fruin said. "The impact area is large, and the airport is busy most hours of the day. That makes it uniquely hard for people to avoid the effects of air pollution in affected areas."

A previous assumption was incorrect

Most previous research on the air quality impacts of airports focused on measuring air quality near where jet takeoffs occur. Takeoffs produce immense plumes of exhaust but only intermittently, and pollution concentrations downwind have been observed to fall off rapidly with distance. The assumption has been that total airport impacts also fall off rapidly with distance. The new research finds that this assumption is wrong.



Graphic depicting ultrafine particle increase downwind of LAX relative to urban background air quality (Graphic/Neelakshi Hudda)

The study found that concentrations of ultrafine particles were more than double over 20 square miles compared to background concentrations in nearby areas outside the area of LAX impact. Also, ultrafine particle number concentrations four times higher than background extended a distance of six miles.

"Given the existing concern about the possible health effects of urban ultrafine particle levels, living in an area with two to four times the average LA levels of ultrafine particles is of high public health concern," said first author Neelakshi Hudda, research associate in preventive medicine at the Keck School.

Ultrafine particles are currently unregulated, but are of concern because they appear to be more toxic than larger particles on an equal mass basis in animal and cellular studies, and because they appear able to enter the bloodstream, unlike large particles that lodge in the lungs.

The research team used vehicles equipped with special measurement devices to capture data not available using traditional fixed monitors. The team was able to take moving measurements for more than five hours under consistent wind conditions to fully capture the extent of the impact boundaries.

“Other airports generally have less steady wind directions, which would make these measurements more difficult,” Hudda said. “Similar impacts are probably happening, but their location likely shifts more rapidly than in Los Angeles.”

“The on-shore westerly winds cause this impact regularly in communities east of LAX because the impact’s location corresponds to the wind direction,” Hudda added. “In the winter months, when the winds were different, impacts were measured south of the airport during northerly winds.

The research was funded by the National Institute of Environmental Health Sciences.

University of Washington researchers included Tim Larson and Tim Gould in the Department of Civil Engineering and Kris Hartin in the Department of Environmental and Occupational Health Sciences.

Exhibit N

Exhibit N

COUNTY OF LOS ANGELES
Public Health

AIR QUALITY RECOMMENDATIONS FOR LOCAL JURISDICTIONS

Development of new schools, housing, and other sensitive land-uses in proximity to freeways

Studies indicate that residing near sources of traffic pollution is associated with adverse health effects such as exacerbation of asthma, onset of childhood asthma, non-asthma respiratory symptoms, impaired lung function, reduced lung development during childhood, and cardiovascular morbidity and mortality.[1] These associations are diminished with distance from the pollution source.

Given the association between traffic pollution and health, the California Air Resources Board recommends that freeways be sited at least 500 feet from residences, schools, and other sensitive land uses.[2] Other reputable research entities such as the Health Effects Institute indicate that exposure to unhealthy traffic emissions may in fact occur up to 300 to 500 meters (984 to 1640 feet). The range reported by HEI reflects the variable influence of background pollution concentrations, meteorological conditions, and season.[3]

Based on this large body of scientific evidence, the Los Angeles County Department of Public Health strongly recommends:

- A buffer of at least 500 feet should be maintained between the development of new schools, housing or other sensitive land uses and freeways. Consideration should be given to extending this minimum buffer zone based on site-specific conditions, given the fact that unhealthy traffic emissions are often present at greater distances.[*] Exceptions to this recommended practice should be made only upon a finding by the decision-making body that the benefits of such development outweigh the public health risks.

- New schools, housing or other sensitive land uses built within 1500 feet of a freeway should adhere to current best-practice mitigation measures to reduce exposure to air pollution which may include: the use of air filtration to enhance heating, ventilation and air conditioning (HVAC) systems, and the orientation of site buildings and placement of outdoor facilities designed for moderate physical activity as far from the emission source as possible.[4]

Development of parks and active recreational facilities in proximity to freeways

Parks and recreational facilities provide great benefits to community residents including increased levels of physical activity, improved mental health, and opportunities to strengthen social ties with neighbors.[5,6,7] However, siting parks and active recreational facilities near freeways may increase public exposure to

[*] Conditions along a freeway and on different freeways are subject to considerable variation. Vehicle types on the roadway (diesel, gas, electric, or hybrid vehicles), average speeds, average daily traffic volumes and other factors all impact the levels of pollution generated by a freeway, and thus the necessary buffer zone to reduce health risks.

harmful pollutants, particularly while exercising. Studies show that heavy exercise near sources of traffic pollution may have adverse health effects.[8, 9, 10] However, there are also substantial health benefits associated with exercise.[11] Therefore, DPH recommends the following cautionary approach when siting parks and active recreational facilities near freeways:

- New parks with athletic fields, courts, and other outdoor facilities designed for moderate to vigorous physical activity, should be sited at least 500 feet from a freeway. Consideration should be given to extending this minimum buffer zone based on site-specific conditions given the fact that unhealthy traffic emissions are often present at greater distances. Exceptions to this recommended practice should be made only upon a finding by the decision-making body that the benefits of such development outweigh the public health risks.

- New parks built within 1500 feet of freeways should adhere to best-practice mitigation measures that minimize exposure to air pollution. These include the placement of athletic fields, courts, and other active outdoor facilities as far as possible from the air pollution source.

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[1] Health Effects Institute. 2010. Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects. HEI Special Report. p.1-11

[2] California Environmental Protection Agency. California Air Resources Board. Air Quality and Land Use Handbook: A Community Health Perspective. April 2005.

[3] Health Effects Institute. 2010. Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects. HEI Special Report. p.1-11

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[5] L. Frank et al. 2005. Linking Objectively Measured Physical Activity with Objectively Measured Urban Form: Findings From SMARTRAQ. American Journal of Preventive Medicine, at 117-1255.

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[11] de Hartog JJ, Boogaard H, Nijland H, and G Hoek. Do the Health Benefits of Cycling Outweigh the Risks? Environmental Health Perspectives. 2010; 118(8): 1109-1116.

Exhibit O

Exhibit O

Lesson from Jurupa Valley: Striking a balance between warehouse and your house

FEBRUARY 19, 2013 BY DAN BERNSTEIN

Mira Loma Village resident Jacinto Munoz (red shirt) gets a hug from California Attorney General Kamala Harris following a 2011 discussion about a lawsuit to a stop warehouse project that will surround his housing tract. The pollution levels in his neighborhood are nearly ten times higher than a normal neighborhood. Munoz's 15-year-old daughter died of lung cancer. (Staff Photo.)

As we headed back to Riverside along the 210 stretch paralleling the Metro Gold Line extension, my wife mused, "I bet it took less time to build the transcontinental railroad. They didn't have to get environmental permits, seismic studies, geology reports…"

We didn't Google this theory (we only have dumb phones), but it makes sense. Take any modern project: light-rail extensions, carpool lanes and, yes, warehouse villages. You can't just lay track or slap up buildings like they did in the Old West.

Just last week, warehouse developers and Jurupa Valley, a new city in the New West, settled a 2011 enviro suit filed after RivCo supes OK'd the 65-acre Mira Loma Commerce Center. The 1.1 million square-foot baby can now rumble along, but the city and/or developer must provide air-filtration systems to nearby homes, monitor air quality, install solar panels and charging stations for e-vehicles, ban heavy trucks on a major road near Mira Loma Village, a neighborhood of mostly low-income Hispanic families. And enforce all the above.

This settlement was such a big deal that California AG Kamala Harris announced it herself, calling it "a model for local governments, developers and communities."

Perhaps even a stronger voice weighed in: "This settlement has created the gold standard for settlements," said Penny Newman, leader of the suing enviro group. If you know your toxic waste history, you'll remember Newman as a key figure in the drive to clean up the Stringfellow Acid Pits.

So here we have a gold standard on a silver platter. A model for local governments, developers and communities. And a lump-of-coal reminder from the AG's spokeswoman that the J'Val settlement is not binding on other cities with Warehouse Wonderland aspirations.

But other cities, developers, enviro groups and pollution-busting agencies should look at it anyway. When Penny Newman says, "We are extremely impressed with the cooperative process that took place to arrive at this agreement," it's well worth asking, "What did they do and how did they do it?"

What finally unfolded in J'Val contrasts starkly with the MoVal Drama (Now Playing!), where the proposed 41.6 million-square-foot World Logistics Center is rolling toward a City Council vote. At the same time, the council and citizens groups are sniping at the Sierra Club. SoCal's top pollution-fighting agency is pressing MoVal to look at cancer and other health risks linked to its array of warehouse proposals. MoVal says it can't control no stinkin' diesel gunk. And a just-released draft EIR of the World Logistics project says diesel and other emissions would spread the cancer risk to Riverside, S'Berdoo and other points well beyond MoVal.

This suggests any World Logistics Center lawsuit(s) could make the just-settled J'Val case look like small claims court.

"It is a false choice," said AG Harris, "that in order for California business to thrive, public health must suffer."

J'Val shows a balance can be struck. The test: Do other cities have the will to strike it — and how much money and wasted time will it cost taxpayers and desperate job-seekers before they do?

Reach Dan Bernstein at 951-368-9439 or dbernstein@PE.com

Facebook: PE Columnist Dan Bernstein

Twitter: @DbernsteinCol

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Exhibit P

LEED 2009 FOR NEIGHBORHOOD DEVELOPMENT

For Public Use and Display

LEED 2009 for Neighborhood Development Rating System

Created by the Congress for the New Urbanism, Natural Resources Defense Council, and the U.S. Green Building Council

(Updated October 2013)

LEED-ND™

PREFACE FROM USGBC

The built environment has a profound impact on our natural environment, economy, health, and productivity. Through its Leadership in Environmental and Energy Design (LEED®) certification programs, the U.S. Green Building Council (USGBC) is transforming the built environment. The green building movement offers an unprecedented opportunity to respond to the most important challenges of our time, including global climate change, dependence on nonsustainable and expensive sources of energy, and threats to human health. The work of innovative building planning professionals is a fundamental driving force in the green development movement. Such leadership is a critical component to achieving USGBC's mission of a sustainable built environment for all within a generation.

USGBC MEMBERSHIP

USGBC's greatest strength is the diversity of our membership. USGBC is a balanced, consensus-based nonprofit with more than 20,000 member companies and organizations representing the entire building industry. Since its inception in 1993, USGBC has played a vital role in providing a leadership forum and a unique, integrating force for the building industry. USGBC's programs have three distinguishing characteristics:

Committee-based

The heart of this effective coalition is our committee structure, in which volunteer members design strategies that are implemented by staff and expert consultants. Our committees provide a forum for members to resolve differences, build alliances, and forge cooperative solutions for influencing change in all sectors of the building industry.

Member-driven

Membership is open and balanced and provides a comprehensive platform for carrying out important programs and activities. We target the issues identified by our members as the highest priority. We conduct an annual review of achievements that allows us to set policy, revise strategies, and devise work plans based on members' needs.

Consensus-focused

We work together to promote green buildings and neighborhoods, and in doing so, we help foster greater economic vitality and environmental health at lower costs. We work to bridge ideological gaps between industry segments and develop balanced policies that benefit the entire industry.

Contact the U.S. Green Building Council:
2101 L Street, NW
Suite 500
Washington, DC 20037
(800) 795-1747 Office
(202) 828-5110 Fax
www.usgbc.org

PARTNERSHIP

The Congress for the New Urbanism and the Natural Resources Defense Council collaborated with the U.S. Green Building Council in creating the LEED for Neighborhood Development Rating System. USGBC's consensus-focused approach to rating system development was furthered by these organizations' expertise in New Urbanism and smart growth strategies.

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U.S. Green Building Council
2101 L Street, NW
Suite 500
Washington, DC 20037

TRADEMARKS

ACKNOWLEDGMENTS

The LEED 2009 for Neighborhood Development Rating System has been made possible only through the efforts of many dedicated volunteers, staff members from USGBC and the two partner organizations, consultants, and others in the USGBC community. The rating system development work was managed and implemented by USGBC staff and the LEED for Neighborhood Development Core Committee and included review and input by many Technical Advisory Group (TAG) members with oversight by the LEED Steering Committee. We extend our deepest gratitude to all of our LEED committee members who participated in the development of this rating system, and especially the LEED for Neighborhood Development Core Committee, for their tireless volunteer efforts and support of USGBC's mission:

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LEED for Neighborhood Development Core Committee

The LEED 2009 for Neighborhood Development Rating System is the work of members of the LEED for Neighborhood Development Core Committee, both those who have worked on this version and those who helped create previous versions. In addition, staff would like to thank Criterion Planners, Urban Advantage, and AECOM for the graphics.

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LEED 2009 FOR NEIGHBORHOOD DEVELOPMENT PROJECT CHECKLIST

Smart Location and Linkage — 27 possible points

☑	Prerequisite 1	Smart Location	Required
☑	Prerequisite 2	Imperiled Species and Ecological Communities	Required
☑	Prerequisite 3	Wetland and Water Body Conservation	Required
☑	Prerequisite 4	Agricultural Land Conservation	Required
☑	Prerequisite 5	Floodplain Avoidance	Required
☐	Credit 1	Preferred Locations	10
☐	Credit 2	Brownfield Redevelopment	2
☐	Credit 3	Locations with Reduced Automobile Dependence	7
☐	Credit 4	Bicycle Network and Storage	1
☐	Credit 5	Housing and Jobs Proximity	3
☐	Credit 6	Steep Slope Protection	1
☐	Credit 7	Site Design for Habitat or Wetland and Water Body Conservation	1
☐	Credit 8	Restoration of Habitat or Wetlands and Water Bodies	1
☐	Credit 9	Long-Term Conservation Management of Habitat or Wetlands and Water Bodies	1

Neighborhood Pattern and Design — 44 possible points

☑	Prerequisite 1	Walkable Streets	Required
☑	Prerequisite 2	Compact Development	Required
☑	Prerequisite 3	Connected and Open Community	Required
☐	Credit 1	Walkable Streets	12
☐	Credit 2	Compact Development	6
☐	Credit 3	Mixed-Use Neighborhood Centers	4
☐	Credit 4	Mixed-Income Diverse Communities	7
☐	Credit 5	Reduced Parking Footprint	1
☐	Credit 6	Street Network	2
☐	Credit 7	Transit Facilities	1
☐	Credit 8	Transportation Demand Management	2
☐	Credit 9	Access to Civic and Public Spaces	1
☐	Credit 10	Access to Recreation Facilities	1
☐	Credit 11	Visitability and Universal Design	1
☐	Credit 12	Community Outreach and Involvement	2
☐	Credit 13	Local Food Production	1
☐	Credit 14	Tree-Lined and Shaded Streets	2
☐	Credit 15	Neighborhood Schools	1

Green Infrastructure and Buildings — 29 possible points

☑	Prerequisite 1	Certified Green Building	Required
☑	Prerequisite 2	Minimum Building Energy Efficiency	Required
☑	Prerequisite 3	Minimum Building Water Efficiency	Required
☑	Prerequisite 4	Construction Activity Pollution Prevention	Required

☐	Credit 1	Certified Green Buildings	5
☐	Credit 2	Building Energy Efficiency	2
☐	Credit 3	Building Water Efficiency	1
☐	Credit 4	Water-Efficient Landscaping	1
☐	Credit 5	Existing Building Reuse	1
☐	Credit 6	Historic Resource Preservation and Adaptive Use	1
☐	Credit 7	Minimized Site Disturbance in Design and Construction	1
☐	Credit 8	Stormwater Management	4
☐	Credit 9	Heat Island Reduction	1
☐	Credit 10	Solar Orientation	1
☐	Credit 11	On-Site Renewable Energy Sources	3
☐	Credit 12	District Heating and Cooling	2
☐	Credit 13	Infrastructure Energy Efficiency	1
☐	Credit 14	Wastewater Management	2
☐	Credit 15	Recycled Content in Infrastructure	1
☐	Credit 16	Solid Waste Management Infrastructure	1
☐	Credit 17	Light Pollution Reduction	1

Innovation and Design Process **6 possible points**

☐	Credit 1	Innovation and Exemplary Performance	1–5
☐	Credit 2	LEED® Accredited Professional	1

Regional Priority Credit **4 possible points**

☐	Credit 1	Regional Priority	1–4

LEED 2009 for Neighborhood Development Certification Levels

100 base points plus 6 possible Innovation and Design Process and 4 possible Regional Priority Credit points

Certified	40–49 points
Silver	50–59 points
Gold	60–79 points
Platinum	80 points and above

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INTRODUCTION

I. THE CASE FOR GREEN NEIGHBORHOOD DEVELOPMENTS

As the U.S. population continues to expand rapidly, consumption of land grows exponentially—currently, three times the rate of population growth. At this breathtaking pace, two-thirds of the development on the ground in 2050 will be built between now and then.[1] The way we grow—especially how and where we grow—will have a profound effect on our planet and on us.

Land use and neighborhood design patterns create a particular physical reality and compel behaviors that have a significant effect on the environmental performance of a given place. Segregated land uses accessed by high-speed roadways that necessitate the use of cars have been the predominant development pattern over the past 50 years. In the United States, transportation accounts for roughly one-third of greenhouse gas emissions, a large portion of which can be attributed to personal automobile use.[2] Burning fossil fuels for transportation increases air pollution and related respiratory diseases. Automobile-oriented neighborhoods tend to be hostile to pedestrians and unsupportive of traditional mixed-use neighborhood centers. Sprawling development patterns fragment habitat, endanger sensitive land and water bodies, destroy precious farmland, and increase the burden on municipal infrastructure.

In contrast, by placing residences and jobs proximate to each other, thoughtful neighborhood planning and development can limit automobile trips and the associated greenhouse gas emissions. Mixed-use development and walkable streets encourage walking, bicycling, and public transportation for daily errands and commuting. Environmentally responsible buildings and infrastructure are an important component of any green neighborhood, further reducing greenhouse gas emissions by decreasing energy consumption. Green buildings and infrastructure also lessen negative consequences for water resources, air quality, and natural resource consumption.

Green neighborhood developments are beneficial to the community and the individual as well as the environment. The character of a neighborhood, including its streets, homes, workplaces, shops, and public spaces, significantly affects the quality of life. Green neighborhood developments enable a wide variety of residents to be part of the community by including housing of varying types and price ranges. Green developments respect historical resources and the existing community fabric; they preserve open space and encourage access to parks. Green buildings, community gardens, and streets and public spaces that encourage physical activity are beneficial for public health. Combine the substantial environmental and social benefits and the case for green neighborhoods makes itself.

II. LEED® RATING SYSTEMS

Background on LEED®

Following the formation of the U.S. Green Building Council (USGBC) in 1993, the organization's members quickly realized that the sustainable building industry needed a system to define and measure "green buildings." USGBC began to research existing green building metrics and rating systems. Less than a year after formation, the members acted on the initial findings by establishing a committee to focus solely on this topic. The composition of the committee was diverse; it included architects, real estate agents, a building owner, a lawyer, an environmentalist, and

1 Reid Ewing, Keith Bartholomew, Steve Winkelman, Jerry Walters, and Don Chen, *Growing Cooler: The Evidence on Urban Development and Climate Change* (Washington, D.C.: Urban Land Institute, 2008).
2 "Greenhouse Gases, Climate Change, and Energy" (Energy Information Administration, May 2008).

industry representatives. This cross section of people and professions added a richness and depth both to the process and to the ultimate product, the Leadership in Energy and Environmental Design (LEED) certification system.

The first LEED Pilot Project Program, also referred to as LEED Version 1.0, was launched at the USGBC Membership Summit in August 1998. After extensive modifications, LEED Green Building Rating System Version 2.0 was released in March 2000, with LEED Version 2.1 following in 2002 and LEED Version 2.2 following in 2005.

As LEED has evolved and matured, the program has undertaken new initiatives. In addition to a rating system specifically devoted to building operational and maintenance issues (LEED for Existing Buildings: Operations & Maintenance), LEED addresses the different project development and delivery processes that exist in the U.S. building design and construction market, through rating systems for specific building typologies, sectors, and project scopes: LEED for Core & Shell, LEED for New Construction, LEED for Schools, LEED for Retail, LEED for Healthcare, LEED for Homes, and LEED for Commercial Interiors. LEED for Neighborhood Development is the latest LEED certification system to be released.

The green building and neighborhood development field is growing and changing daily. New technologies and products are being introduced into the marketplace, and innovative designs and practices are proving their effectiveness. The LEED rating systems and reference guides will evolve as well. Project teams must comply with the version of the rating system that is current at the time of their registration. USGBC will highlight new developments on its website on a continual basis, at www.usgbc.org.

Background on LEED for Neighborhood Development

The U.S. Green Building Council (USGBC), the Congress for the New Urbanism (CNU), and the Natural Resources Defense Council (NRDC)—organizations that represent leading design professionals, progressive builders and developers, and the environmental community—have come together to develop a rating system for neighborhood planning and development based on the combined principles of smart growth, New Urbanism, and green infrastructure and building. The goal of this partnership is to establish a national leadership standard for assessing and rewarding environmentally superior green neighborhood development practices within the framework of the LEED® Green Building Rating System™.

Unlike other LEED rating systems, which focus primarily on green building practices and offer only a few credits for site selection and design, LEED for Neighborhood Development places emphasis on the site selection, design, and construction elements that bring buildings and infrastructure together into a neighborhood and relate the neighborhood to its landscape as well as its local and regional context. The work of the LEED-ND core committee, made up of representatives from all three partner organizations, has been guided by sources such as the Smart Growth Network's ten principles of smart growth, the charter of the Congress for the New Urbanism, and other LEED rating systems. LEED for Neighborhood Development creates a label, as well as guidelines for both decision making and development, to provide an incentive for better location, design, and construction of new residential, commercial, and mixed-use developments.

Whereas the other LEED rating systems have five environmental categories, LEED for Neighborhood Development has three: Smart Location and Linkage, Neighborhood Pattern and Design, and Green Infrastructure and Buildings. An additional category, Innovation and Design Process, addresses sustainable design and construction issues and measures not covered under the three categories. Regional bonus credits are another feature of LEED-ND. These credits acknowledge the importance of local conditions in determining best environmental design and construction practices as well as social and health practices.

The LEED 2009 minimum program requirements define the minimum characteristics that a project must possess to be eligible for certification under LEED 2009. These requirements do not apply to LEED for Neighborhood Development projects.

LEED Credit Weightings

In LEED 2009, the allocation of points among credits is based on the potential environmental impacts and human benefits of each credit with respect to a set of impact categories. The impacts are defined as the environmental or human effect of the design, construction, operation, and maintenance of the building, such as greenhouse gas emissions, fossil fuel use, toxins and carcinogens, air and water pollutants, and indoor environmental conditions. In the LEED for Neighborhood Development Rating System, social and public health benefits were added to the impact categories, and the impact categories were then applied at the neighborhood scale. A combination of approaches, including energy modeling, life-cycle assessment, and transportation analysis, is used to quantify each type of impact. The resulting allocation of points among credits is called credit weighting.

LEED 2009 uses the U.S. Environmental Protection Agency's TRACI[3] environmental impact categories as the basis for weighting each credit. TRACI was developed to assist with impact evaluation for life-cycle assessment, industrial ecology, process design, and pollution prevention. LEED 2009 also takes into consideration the weightings developed by the National Institute of Standards and Technology (NIST); these compare impact categories with one another and assign a relative weight to each. Together, the two approaches provide a solid foundation for determining the point value of each credit in LEED 2009.

The LEED 2009 credit weightings process is based on the following parameters, which maintain consistency and usability across rating systems:

- All LEED credits are worth a minimum of 1 point.
- All LEED credits are positive, whole numbers; there are no fractions or negative values.
- All LEED credits receive a single, static weight in each rating system; there are no individualized scorecards based on project location.
- All LEED rating systems have 100 base points; Innovation and Design Process and Regional Priority credits provide opportunities for up to 10 bonus points.

Given the above criteria, the LEED 2009 credit weightings process involves three steps for LEED for Neighborhood Development:

1. A reference neighborhood is used to estimate the environmental impacts in 15 categories associated with a typical neighborhood development pursuing LEED certification.
2. The relative importance of neighborhood impacts in each category is set to reflect values based on the NIST weightings.[4]
3. Data that quantify neighborhood impacts on environmental and human health are used to assign points to individual credits.

Each credit is allocated points based on the relative importance of the neighborhood-related impacts that it addresses. The result is a weighted average that combines neighborhood impacts and the relative value of the impact categories. Credits that most directly address the most important impacts are given the greatest weight, subject to the system design parameters described above. Credit weights also reflect a decision by LEED to recognize the market implications of point allocation.

The details of the weightings process vary slightly among individual rating systems. For example, LEED for Neighborhood Development includes credits related to infill development but LEED for New Construction does not. This results in a difference in the portion of the environmental footprint addressed by each rating system and the relative allocation of points.

3 Tools for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) (U.S. Environmental Protection Agency, Office of Research and Development, http://www.epa.gov/nrmrl/std/sab/traci/).

4 Relative impact category weights based on an exercise undertaken by NIST (National Institute of Standards and Technology) for the BEES program, http://www.bfrl.nist.gov/oae/software/bees/.

The weightings process for each rating system is fully documented in a weightings workbook. The credit weightings process will be reevaluated over time to incorporate changes in values ascribed to different neighborhood impacts and neighborhood types, based on both market reality and evolving knowledge related to buildings and neighborhood design. A complete explanation of the LEED credit weightings system is available on the USGBC website, at www.usgbc.org.

III. OVERVIEW AND PROCESS

The LEED 2009 for Neighborhood Development Rating System is a set of performance standards for certifying the planning and development of neighborhoods. The intent is to promote healthful, durable, affordable, and environmentally sound practices in building design and construction.

Prerequisites and credits in the rating system address five topics:

- Smart Location and Linkage (SLL)
- Neighborhood Pattern and Design (NPD)
- Green Infrastructure and Buildings (GIB)
- Innovation and Design Process (IDP)
- Regional Priority Credit (RPC)

When to Use LEED for Neighborhood Development

The LEED for Neighborhood Development Rating System responds to land use and environmental considerations in the United States. It is designed to certify exemplary development projects that perform well in terms of smart growth, urbanism, and green building. Projects may constitute whole neighborhoods, portions of neighborhoods, or multiple neighborhoods. There is no minimum or maximum size for a LEED-ND project, but the core committee's research has determined that a reasonable minimum size is at least two habitable buildings and that the maximum area that can appropriately be considered a neighborhood is 320 acres, or half a square mile. A project larger than 320 acres is eligible but may find documenting certain credits difficult and may want to consider dividing the area into separate LEED-ND projects, each smaller than 320 acres. Although projects may contain only a single use, typically a mix of uses will provide the most amenities to residents and workers and enable people to drive less and safely walk or bike more. Small infill projects that are single use but complement existing neighboring uses, such as a new affordable-housing infill development in a neighborhood that is already well served by retail and commercial uses, are also good candidates for certification.

This rating system is designed primarily for the planning and development of new green neighborhoods, whether infill sites or new developments proximate to diverse uses or adjacent to connected and previously developed land. Many infill projects or projects near transit will be in urban areas, which helps direct growth into places with existing infrastructure and amenities. LEED-ND also promotes the redevelopment of aging brownfield sites into revitalized neighborhoods by rewarding connections beyond the site, walkable streets within the site, and the integration of any historic buildings and structures that will give the new neighborhood development a unique sense of place.

Existing neighborhoods can also use the rating system, and its application in this context could be especially beneficial in urban areas and historic districts. It is, however, important to point out that the owner or owners applying for certification should already own, have title to, or have significant control over a majority of the land within the project boundary and the plan for new construction or major renovation for the majority of the project's square footage. The new construction could take place on vacant land within the boundary, and the major renovations could involve existing buildings, recent or historic, within the project. In addition to guiding infill development opportunities, LEED-ND has additional relevance for existing neighborhoods, as a tool to set performance levels for a group of owners wanting to retrofit their homes, offices, or shops, and finally for shaping new green infrastructure, such as sidewalks, alleys, and public spaces. Many prerequisites or credits have a specific compliance path for existing buildings; this is highlighted in the rating system, and more detail is provided in the reference guide.

LEED-ND also can be used in suburban locations. There are tremendous opportunities to retrofit the suburbs, whether this involves reviving old shopping centers and their surrounding parking lots or adding new units and vibrant walkable town centers to existing subdivisions. Increasingly, many suburbs are well served by transit and thus should be considered good candidates for creating mixed-use, walkable developments with the potential to decrease residents' and workers' dependence on personal automobiles.

LEED for Neighborhood Development was not designed as a rating system for existing campuses, such as colleges, universities, and military bases. Many campuses have circulation patterns and building forms and placement that differ from the strategies outlined in LEED-ND. As a result, the rating system may not be appropriate for such facilities, but it could be applied in certain situations. For example, LEED-ND could be used for a civilian-style development on or adjacent to a military base, especially now that there is increased interest in developing mixed-use main streets as a focal point for new residential development in military bases. In addition, with many installations facing closure under the Base Realignment and Closure Act, LEED-ND could be used to guide the redevelopment of a base as it finds a new use. For colleges and universities, the program best lends itself to campuses that are expanding or undergoing major redevelopment. Increasingly, many universities are creating mixed-use development projects, often with local partners, to serve as catalytic projects in their communities, and LEED-ND could be a good framework and certification tool. Some universities are looking to their own campus lands for new development opportunities, particularly for housing that is affordable to faculty and staff but also walkable to campus and other amenities, and LEED-ND may be appropriate.

LEED for Neighborhood Development is not meant to be a national standard that replaces zoning codes or comprehensive plans, nor has it been designed to certify sector plans or other policy tools. Local development patterns and performance levels vary greatly across the country because land regulation is largely controlled by local governments. One city may be a leader in stormwater management, and another an innovator in traffic calming, but neither may be advanced in all areas covered by LEED-ND. The rating system should therefore not be considered a one-size-fits-all policy tool. Instead, LEED-ND is a voluntary leadership standard, and local governments should consider promoting its use by the development community or public-private partnerships. In addition, LEED-ND can be used to analyze whether existing development regulations, such as zoning codes, development standards, landscape requirements, building codes, or comprehensive plans are "friendly" to sustainable developments. By comparing a locality's development practices with the rating system, public officials and the planning department can better identify code barriers that make it onerous, costly, or even impossible to undertake some aspects of sustainable development. Finally, public sector projects (e.g., those sponsored by housing authorities, redevelopment agencies, or specialized development authorities) are eligible to use the rating system. Please visit the LEED for Neighborhood web page at www.usgbc.org for LEED-ND policy guidance for state and local governments.

“Neighborhood Development,” Defined

Based on research on the origins of neighborhood design and current best practices for locating and designing new development, the LEED for Neighborhood Development core committee has developed a rating system for smart, healthy, and green neighborhood development. Although LEED-ND does not strictly define what constitutes a neighborhood, the prerequisites and credits are written to encourage a type of development that recalls the siting and design of traditional neighborhoods and promotes best practices in new neighborhood development today.

Since ancient times, cities around the world have been spatially divided into districts or neighborhoods. Excavations of some of the earliest cities reveal evidence of social neighborhoods. Urban scholar Lewis Mumford noted that “neighborhoods, in some primitive, inchoate fashion exist wherever human beings congregate, in permanent family dwellings; and many of the functions of the city tend to be distributed naturally—that is, without any theoretical preoccupation or political direction—into neighborhoods.”[5] In basic terms, a neighborhood is an area of dwellings, employment, retail, and civic places and their immediate environment that residents and/or employees identify with in terms of social and economic attitudes, lifestyles, and institutions.

A neighborhood can be considered the planning unit of a town. The charter of the Congress for the New Urbanism characterizes this unit as “compact, pedestrian-friendly, and mixed-use.”[6] By itself the neighborhood is a village, but combined with other neighborhoods it becomes a town or a city. Similarly, several neighborhoods with their centers at transit stops can constitute a transit corridor. The neighborhood, as laid out in LEED-ND, is in contrast to sprawl development patterns, which create podlike clusters that are disconnected from surrounding areas. Existing and new traditional neighborhoods provide an alternative to development patterns that characterize sprawl, such as the single-zoned, automobile-dominated land uses that have been predominant in suburban areas since the 1950s. Instead, traditional neighborhoods meet all those same needs—for housing, employment, shopping, civic functions, and more—but in formats that are compact, complete, and connected, and ultimately more sustainable and diverse.[7] The metrics of a neighborhood vary in density, population, mix of uses, and dwelling types and by regional customs, economies, climates, and site conditions. In general, they include size, identifiable centers and edges, connectedness with the surroundings, walkable streets, and sites for civic uses and social interaction.

Size is a defining feature of a neighborhood and is typically based on a comfortable distance for walking from the center of the neighborhood to its edge; that suggests an area of 40 to 160 acres. In the 1929 Regional Plan of New York and Environs, urban planner Clarence Perry outlined a neighborhood center surrounded by civic uses, parks, residential uses, a school, and retail at the edge, all within one-quarter mile—about a 5-minute walk. This amounts to an area or pedestrian “shed” of 125 acres, or if the land area is a square, 160 acres. Although Perry’s diagram does not address many of the sustainable features of LEED-ND, such as access to multimodal transportation options, location of infrastructure, and building form, it serves as a reference point for the mix of uses and walkable scale of neighborhood development encouraged in the rating system. Most people will walk approximately one-quarter mile (1,320 feet) to run daily errands; beyond that, many will take a bicycle or car. Additional research shows that people will walk as far as a half-mile (2,640 feet) to reach heavy rail transit systems or more specialized shops or civic uses.[8] Since half a square mile contains 320 acres, the core committee has decided that this size should serve as guidance for the upper limit of a LEED-ND project.

5 Lewis Mumford, “The Neighbourhood and the Neighbourhood Unit,” *Town Planning Review* 24 (1954): 256-270, p. 258.
6 Charter of the Congress for the New Urbanism, www.cnu.org/charter, 1996.
7 Ibid
8 H. Dittmar and G. Ohland, eds., *The New Transit Town: Best Practices in Transit-Oriented Development* (Washington, D.C.: Island Press, 2004), p. 120.

Figure 1. Clarence Perry's Neighborhood Unit, 1929. Source: Regional Plan Association

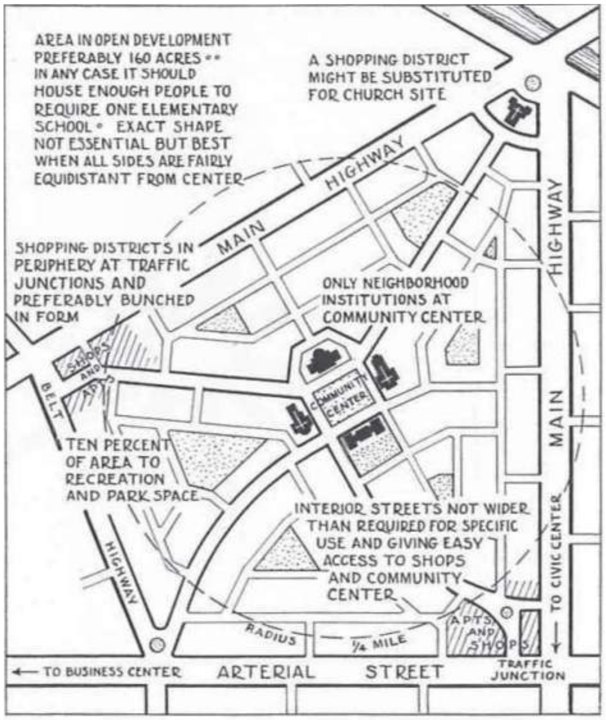
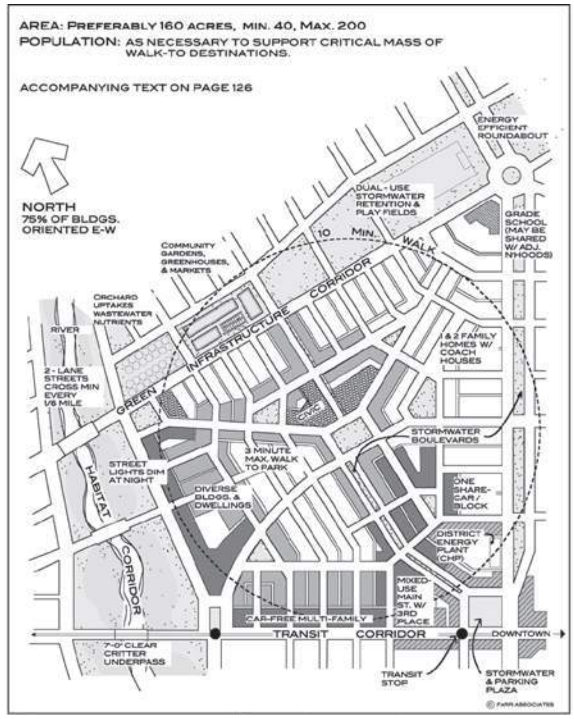


Figure 2. A "sustainable" update of Perry's neighborhood unit. Source: Douglas Farr, *Sustainable Urbanism*

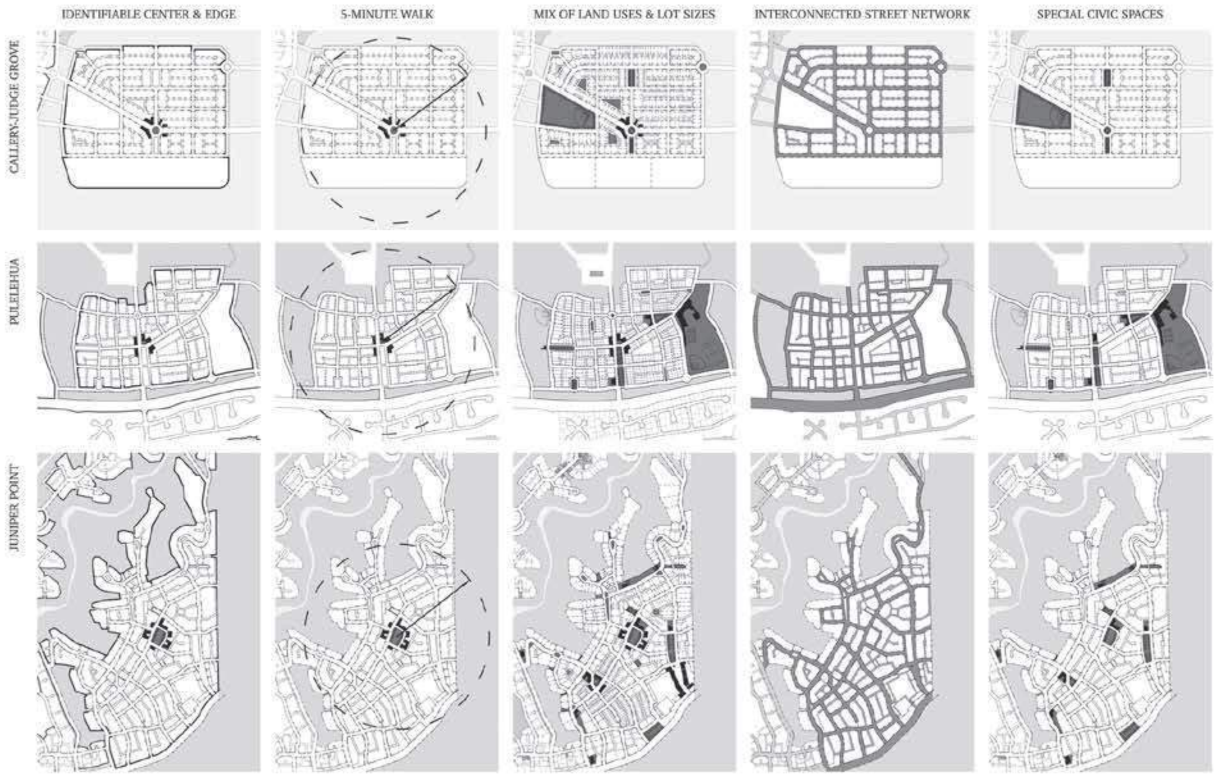


A neighborhood should have places where the public feels welcome and encouraged to congregate, recognizable as the heart of the community. A proper center has at least one outdoor public space for this purpose, designed with pedestrians in mind; this is the most well-defined outdoor "room" in the neighborhood. The best centers are within walking distance of the primarily residential areas, and typically some gradient in density is discernible from center to edge. The "center" need not be in the geographic center of the neighborhood; it can be along the edge, on an arterial or transit line. It is important for a neighborhood to have boundaries as well as a defined center, and this characteristic is often achieved through identifiable edges, either man-made or natural, such as adjacent farmland, parks, greenways, schools, major rights-of-way, or other uses.

When a neighborhood has a robust network of internal streets and good connections to surrounding communities, pedestrians, bicyclists, and drivers can move more efficiently and more safely. Multiple intersections and short blocks also give pedestrians a more interesting environment. The maximum average block perimeter to achieve an integrated network is 1,500 feet, with a maximum uninterrupted block face of ideally no more than 450 feet; intersecting streets are placed at intervals of 500 to 600 feet, and no greater than 800 feet apart along any single stretch.

The morphology of a sustainable neighborhood—the design of its blocks, streets, and buildings—can serve as the foundation of a walkable environment. Walkable streets have many features, and those elements deemed most important by the core committee are encouraged by the LEED-ND Rating System. These features, such as human-scaled buildings and street widths, wide sidewalks, buildings that are pulled up to the sidewalk to create a continuous street wall, retail storefronts and other uses, and interesting street furniture and trees, are meant to create a safe, inviting, and well-used public realm with visual interest. To keep loading docks, garage openings, and utilities away from sidewalks, neighborhoods with walkable streets often feature alleys.

Figure 3. Examples of neighborhood morphology. Source: Douglas Farr, *Sustainable Urbanism*



A mix of uses is often integral to the vitality of a neighborhood; the mix can include not only residential and commercial but also a variety of retail establishments, services, community facilities, and other kinds of "diverse uses," whether available within the neighborhood or adjacent. Urban theorist Ray Oldenburg would classify diverse uses as "Third Places"—small neighborhood grocers, coffee shops, pubs, or post offices that allow residents and workers to mingle and have social interactions. A mix of active and diverse retail uses on a walkable street can create a place that is alive day and night, and not closed down at 6 p.m.

Existing neighborhoods have the added benefit of historic buildings and events with cultural significance. Jane Jacobs argued that every neighborhood needed a mixture of newer and older buildings to allow for a variety of uses, income levels, and even ideas within the neighborhood.[9] New neighborhoods can bring some of the architectural diversity found in existing neighborhoods by including a mix of uses and housing types, each of which might need a different building type and design, thus generating visual interest. Finally, placing important civic buildings, such as churches, libraries, schools, or local government buildings at the termination of a street can create civic pride and also an interesting vista for pedestrians. With a focus on civic buildings and gathering places and the pedestrian experience in general, it is no surprise that walkable neighborhoods are often defined by the social interaction among people living and working near one another.

In conclusion, LEED for Neighborhood Development emphasizes the creation of compact, walkable, vibrant, mixed-use neighborhoods with good connections to nearby communities. In addition to neighborhood morphology, pedestrian scale, and mix of uses, the rating system also emphasizes the location of the neighborhood and the performance of the infrastructure and buildings within it. The sustainable benefits of a neighborhood increase when it offers proximity to transit and when residents and workers can safely travel by foot or bicycle to jobs, amenities,

9 Jane Jacobs, *The Death and Life of Great American Cities* (New York: Random House, 1961), p. 187.

and services. This can create a neighborhood with a high quality of life and healthy inhabitants. Likewise, green buildings can reduce energy and water use, and green infrastructure, such as landscaping and best practices to reduce stormwater runoff, can protect natural resources. Together, well-located and well-designed green neighborhood developments will play an integral role in reducing greenhouse gas emissions and improving quality of life.

Certification

To earn LEED certification, the applicant project must satisfy all the prerequisites and qualify for a minimum number of points to attain the project ratings listed below. Having satisfied the basic prerequisites of the program, applicant projects are then rated according to their degree of compliance within the rating system.

LEED for Neighborhood Development certifications are awarded according to the following scale:

Certified	40–49 points
Silver	50–59 points
Gold	60–79 points
Platinum	80 points and above

Stages of Certification

LEED for Neighborhood Development involves projects that may have significantly longer construction periods than single buildings, and as a result the standard LEED certification process has been modified. To provide developers of certifiable projects with conditional approval at an early stage, LEED 2009 for Neighborhood Development certification is divided into a three-stage process. A land-use entitlement, referred to below, is the existing or granted right to use property for specific types and quantities of residential and nonresidential land uses.

Stage 1. Conditional Approval of a LEED-ND Plan. This stage is optional for projects at any point before the entitlement process begins, or when no more than 50% of a project's total new and/or renovated building square footage has land-use entitlements to use property for the specific types and quantities of residential and nonresidential land uses proposed, either by right or through a local government regulatory change process. Projects with more than 50% of new and/or renovated square footage already entitled must complete the local entitlement process for 100% of new and/or renovated square footage and apply under Stage 2. If conditional approval of the plan is achieved, a letter will be issued stating that if the project is built as proposed, it will be eligible to achieve LEED for Neighborhood Development certification. The purpose of this letter is to help the developer build a case for entitlement among land-use planning authorities, as well as attract financing and occupant commitments.

Stage 2. Pre-Certified LEED-ND Plan. This stage is available after 100% of the project's total new and/or renovated building square footage has been fully entitled by public authorities with jurisdiction over the project. The project can also be under construction or partially completed, but no more than 75% of the total square footage can be constructed; projects that are more than 75% constructed must finish and use Stage 3. Any changes to the conditionally approved plan that could affect prerequisite or credit achievement must be communicated as part of this submission. If precertification of the plan is achieved, a certificate will be issued stating that the plan is a Pre-Certified LEED for Neighborhood Development Plan and it will be listed as such on the USGBC website.

Stage 3. LEED-ND Certified Neighborhood Development. This final step takes place when the project can submit documentation for all prerequisites and attempted credits, and when certificates of occupancy for buildings and acceptance of infrastructure have been issued by public authorities with jurisdiction over the project. Any changes to the Pre-Certified LEED-ND Plan that could affect prerequisite or credit achievement must be communicated as part of this submission. If certification of the completed neighborhood development is achieved, a plaque or similar award for public display at the project site will be issued and it will be listed as certified on the USGBC website.

Since the location of a project cannot be changed, whereas its design and technologies can, a review is offered to determine a project's compliance with the Smart Location and Linkage (SLL) prerequisites and inform the team whether the location qualifies. If it does, a project team can proceed; if it doesn't, the team can end its participation in the program before investing more time. This optional review of the SLL prerequisites is available to projects in advance of a Stage 1, Stage 2, or Stage 3 application.

IV. EXEMPLARY PERFORMANCE

Exemplary performance strategies result in performance that greatly exceeds the performance level or expands the scope required by an existing credit. To earn an exemplary performance point, teams must meet the performance level defined by the next step in the threshold progression. For a credit with more than one compliance path, an Innovation and Design Process point can be earned by satisfying more than one compliance path if their benefits are additive.

The credits for which exemplary performance points are available are listed in the LEED Reference Guide for Green Neighborhood Development, 2009 Edition.

V. REGIONAL PRIORITY

To provide incentive to address geographically specific environmental issues, USGBC regional councils and chapters, the Congress for the New Urbanism chapters, and representatives of Smart Growth America's State and Local Caucus have identified 6 credits per rating system that are of particular importance to specific areas. Each Regional Priority credit is worth an additional 1 point, and a total of 4 additional points may be earned by achieving Regional Priority credits, with 1 point earned per credit. If the project achieves more than 4 Regional Priority credits, the team can choose the credits for which these points will apply. The USGBC website contains a searchable database of Regional Priority credits.

SMART LOCATION AND LINKAGE

SLL Prerequisite 1: Smart Location

Required

Intent

To encourage development within and near *existing* communities and public transit infrastructure. To encourage improvement and redevelopment of existing cities, suburbs, and towns while limiting the expansion of the *development footprint* in the region to appropriate circumstances. To reduce vehicle trips and *vehicle miles traveled* (VMT). To reduce the incidence of obesity, heart disease, and hypertension by encouraging daily physical activity associated with walking and bicycling.

Requirements

FOR ALL PROJECTS

Either (a) locate the *project* on a site served by existing *water and wastewater infrastructure* or (b) locate the project within a legally adopted, publicly owned, planned water and wastewater service area, and provide new water and wastewater infrastructure for the project.

AND

OPTION 1. Infill Sites

Locate the project on an *infill site*.

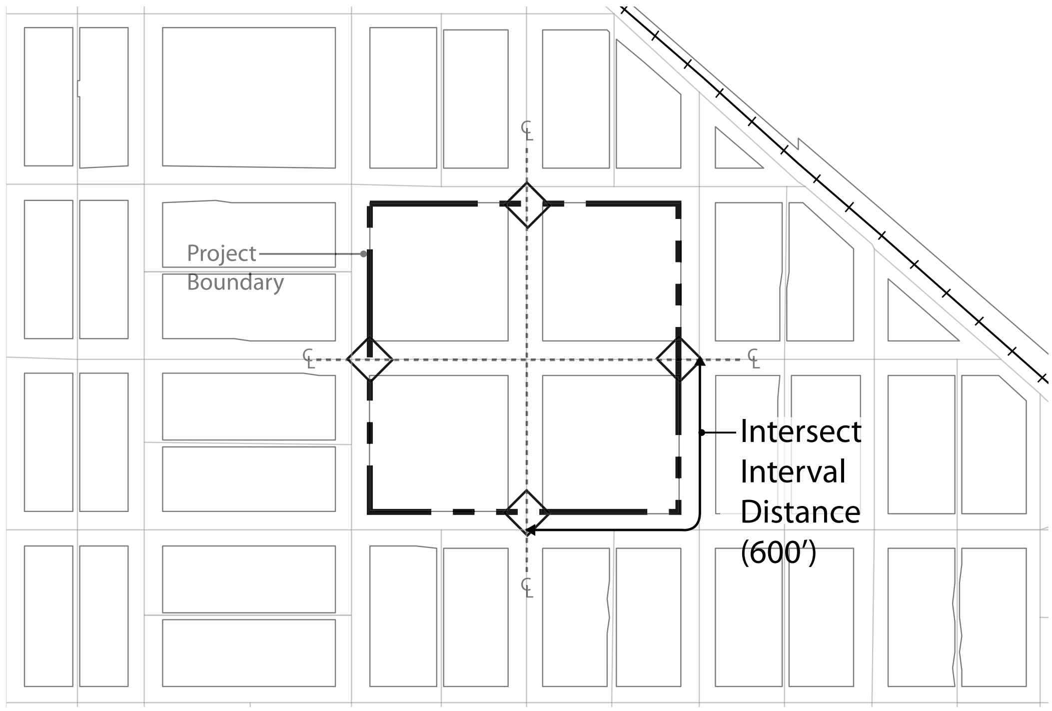
OR

OPTION 2. Adjacent Sites with Connectivity

Locate the project on an *adjacent site* (i.e., a site that is adjacent to *previously developed* land; see Definitions) where the *connectivity* of the site and adjacent land is at least 90 intersections/square mile as measured within a 1/2-mile distance of a continuous segment of the *project boundary*, equal to or greater than 25% of the project boundary, that is adjacent to previous development. Existing external and internal intersections may be counted if they were not constructed or funded by the project *developer* within the past ten years. Locate and/or design the project such that a through-*street* and/or nonmotorized right-of-way intersects the project boundary at least every 600 feet on average, and at least every 800 feet, connecting it with an existing street and/or right of way outside the project; nonmotorized rights-of-way may count for no more than 20% of the total. The exemptions listed in NPD Prerequisite 3, Connected and Open Community, do not apply to this option.

Figure 1. Adjacent and connected project site based on minimum 25% of perimeter adjacent to previously developed parcels and at least 90 eligible intersections per square mile within 1/2 mile of boundary segment adjacent to previous development

Figure 2. Project site with through-street right-of-way intersecting project boundary at least every 600 feet on average



OR

OPTION 3. Transit Corridor or Route with Adequate Transit Service

Locate the project on a site with existing and/or planned transit service such that at least 50% of *dwelling units* and nonresidential building entrances (inclusive of existing buildings) are within a 1/4 mile *walk distance* of bus and/or streetcar stops, or within a 1/2 mile walk distance of *bus rapid transit* stops, light or heavy rail stations, and/or ferry terminals, and the transit service at those stops in aggregate meets the minimums listed in Table 1 (both weekday and weekend trip minimums must be met).

Weekend trips must include service on both Saturday and Sunday. Commuter rail must serve more than one *metropolitan statistical area* (MSA) and/or the area surrounding the core of an MSA.

Table 1. Minimum daily transit service

	Weekday trips	Weekend trips
Projects with multiple transit types (bus, streetcar, rail, or ferry)	60	40
Projects with commuter rail or ferry service only	24	6

If transit service is planned but not yet operational, the project must demonstrate one of the following:

a. The relevant transit agency has a signed full funding grant agreement with the Federal Transit Administration that includes a revenue operations date for the start of transit service. The revenue operations date must be no later than the occupancy date of 50% of the project's total building square footage.

b. For bus, streetcar, bus rapid transit, or ferry service, the transit agency must certify that it has an approved budget that includes specifically allocated funds sufficient to provide the planned service at the levels listed above and that service at these levels will commence no later than occupancy of 50% of the project's total building square footage.

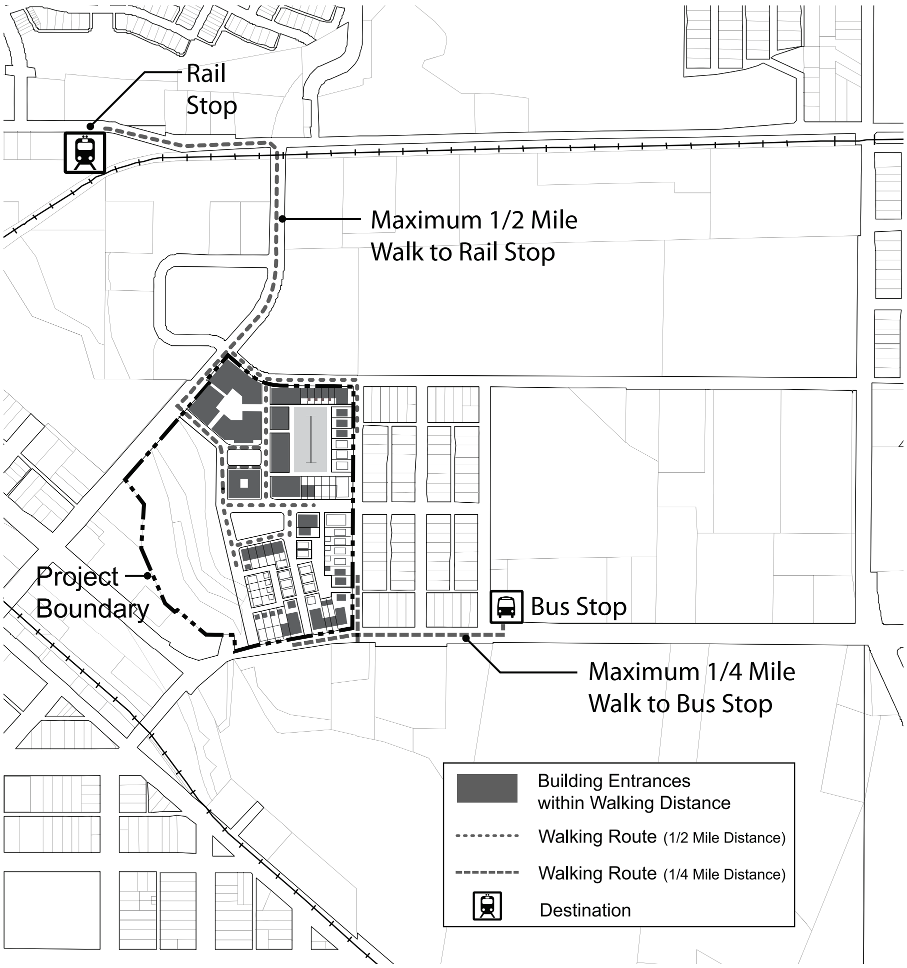
c. For rail service other than streetcars, the transit agency must certify that preliminary engineering for a rail line has commenced. In addition, the service must meet either of these two requirements:

   - A state legislature or local subdivision of the state has authorized the transit agency to expend funds to establish rail transit service that will commence no later than occupancy of 50% of the project's total building square footage.

   OR

   - A municipality has dedicated funding or reimbursement commitments from future tax revenue for the development of stations, platforms, or other rail transit infrastructure that will service the project no later than occupancy of 50% of the project's total building square footage.

Figure 3. Walking routes on pedestrian network showing distances from dwellings and nonresidential uses to transit stops



OR

OPTION 4. Sites with Nearby Neighborhood Assets

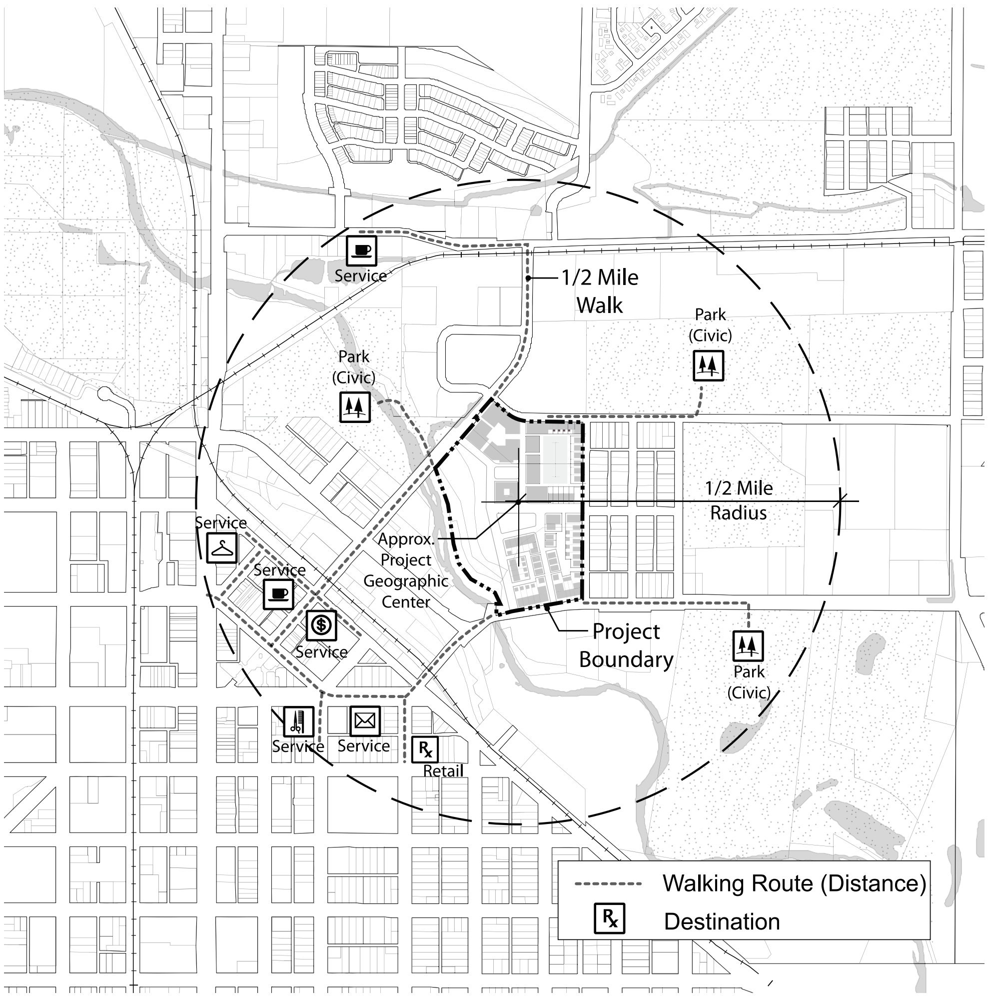
Include a residential component equaling at least 30% of the project's total building square footage (exclusive of portions of parking structures devoted exclusively to parking), and locate the project near existing neighborhood shops, uses, and facilities ("diverse uses"; see Appendix) such that the project boundary is within 1/4-mile walk distance of at least five diverse uses, or such that the project's geographic center is within 1/2-mile walk distance of at least seven diverse uses. In either case the qualifying uses must include at least one food retail establishment and at least one use from each of two other categories, with the following limitations:

a. A single establishment may not be counted in two categories (e.g., a place of worship may be counted only once even if it also contains a daycare facility, and a retail store may be counted only once even if it sells products in several categories).

b. Establishments in a mixed-use building may each count if they are distinctly operated enterprises with separate exterior entrances, but no more than half of the minimum number of diverse uses can be situated in a single building or under a common roof.

c. Only two establishments in a single category may be counted (e.g., if five restaurants are within the required distance, only two may be counted).

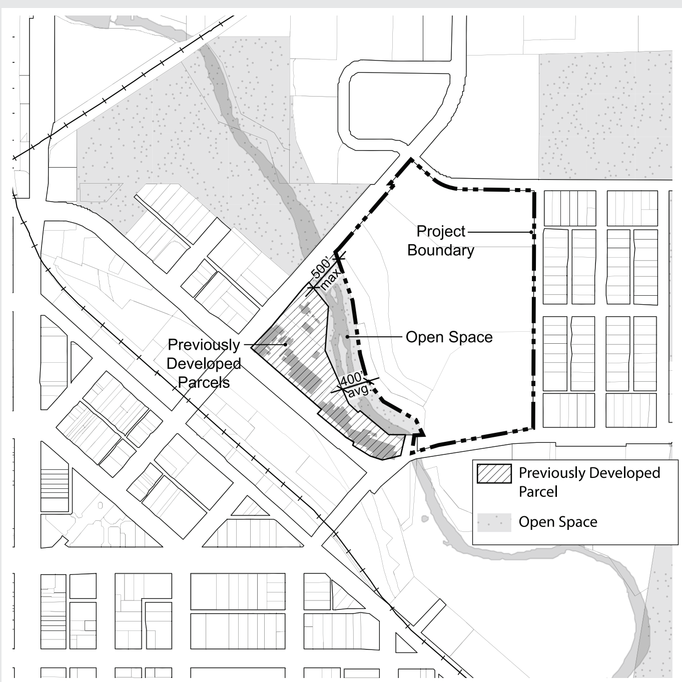
Figure 4. Walking routes on pedestrian network showing distances from dwellings and nonresidential uses to diverse use destinations



Key Definitions

adjacent site a site having at least 25% of its boundary bordering parcels that are each at least 75% *previously developed*. A *street* or other right-of-way does not constitute previously developed land; instead, it is the status of the property on the other side of the street or right-of-way that matters. Any fraction of the boundary that borders waterfront other than a stream is excluded from the calculation. A site is still considered adjacent if the 25% adjacent portion of its boundary is separated from previously developed parcels by undeveloped, permanently protected land averaging no more than 400 feet in width and no more than 500 feet in any one place. The undeveloped land must be permanently preserved as natural area, riparian corridor, *park*, greenway, agricultural land, or designated *cultural landscape*. Permanent pedestrian paths connecting the project through the protected parcels to the bordering site may be counted to meet the requirement of SLL Prerequisite 1, Option 2 (that the *project* be connected to the adjacent parcel by a through-street or nonmotorized right-of-way every 600 feet on average, provided the path or paths traverse the undeveloped land at no more than a 10% grade for walking by persons of all ages and physical abilities).

Adjacent project site based on minimum 25% of perimeter adjacent to previously developed parcels, including allowance for permanently protected land between project boundary and previously developed parcels



connectivity the number of publicly accessible intersections per square mile, including any combination of streets, dedicated alleys, transit rights-of-way, and nonmotorized rights-of-way. If one must both enter and exit an area through the same intersection, such an intersection and any intersections beyond that point are not counted; intersections leading only to culs-de-sac are also not counted. The calculation of square mileage excludes water bodies, parks larger than 1/2 acre, public facility campuses, airports, rail yards, slopes over 15%, and areas nonbuildable under codified law or the rating system. Street rights-of-way may not be excluded.

infill site a site that meets any of the following four conditions:

a. At least 75% of its boundary borders parcels that individually are at least 50% *previously developed,* and that in aggregate are at least 75% previously developed.

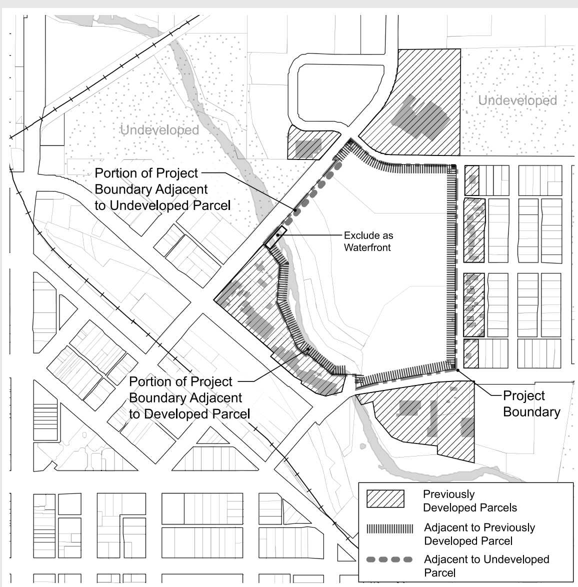
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

c. At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the *project boundary* is previously developed.

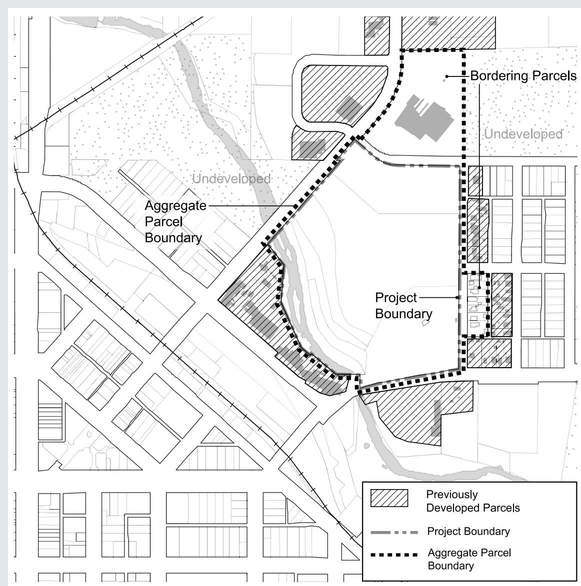
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

A *street* or other right-of-way does not constitute previously developed land; it is the status of property on the other side or right-of-way of the street that matters. For conditions (a) and (b) above, any fraction of the perimeter that borders waterfront other than a stream is excluded from the calculation.

(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels

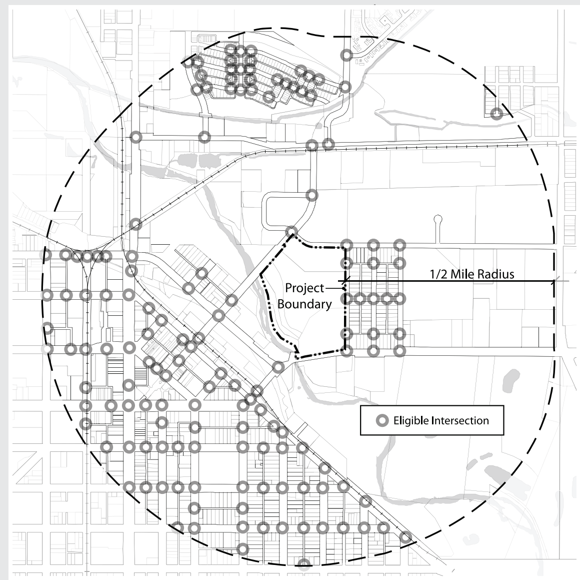


(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(c). Infill project site based on minimum 75% of land area within 1/2 mile of project boundary being previously developed

(d). Infill project site based on minimum 140 intersections/sq.mi. within 1/2 mile of project boundary



previously developed altered by paving, construction, and/or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Previously developed land includes a platted lot on which a building was constructed if the lot is no more than 1 acre; previous development on lots larger than 1 acre is defined as the *development footprint* and land alterations associated with the footprint. Land that is not previously developed and altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land. The date of previous development permit issuance constitutes the date of previous development, but permit issuance in itself does not constitute previous development.

SLL Prerequisite 2: Imperiled Species and Ecological Communities Conservation

Required

Intent

To conserve imperiled species and ecological communities.

Requirements

FOR ALL PROJECTS

Consult with the state Natural Heritage Program and state fish and wildlife agencies to determine whether species listed as threatened or endangered under the federal Endangered Species Act, the state's endangered species act, or species or ecological communities classified by NatureServe as GH (possibly extinct), G1 (critically imperiled), or G2 (imperiled) have been or are likely to be found on the *project* site because of the presence of suitable habitat and nearby occurrences. If the consultations are inconclusive and site conditions indicate that imperiled species or ecological communities could be present, using a qualified biologist, perform biological surveys using accepted methodologies during appropriate seasons to determine whether such species or communities occur or are likely to occur on the site.

OPTION 1. Sites without Affected Species or Ecological Community

The prerequisite is satisfied if the consultation and any necessary biological surveys determine that no such imperiled species or ecological communities have been found or have a high likelihood of occurring.

OR

OPTION 2. Sites with Affected Species or Ecological Community: Habitat Conservation Plan

Comply with an approved habitat conservation plan under the Endangered Species Act for each identified species or ecological community.

OR

OPTION 3. Sites with Affected Species or Ecological Community: Habitat Conservation Plan Equivalent

Work with a qualified biologist, a nongovernmental conservation organization, or the appropriate state, regional, or local agency to create and implement a conservation plan that includes the following actions:

a. Identify and map the extent of the habitat and the appropriate buffer, not less than 100 feet, according to best available scientific information.

b. To the maximum extent practicable, protect the identified habitat and buffer in perpetuity by donating or selling the land or a conservation easement on the land to an accredited land trust or relevant public agency.

c. If on-site protection can be accomplished, analyze threats from development and develop a monitoring and management plan that eliminates or significantly reduces the threats.

d. If any portion of the identified habitat and buffer cannot be protected in perpetuity, quantify the effects by acres or number of plants and/or animals affected, and protect from development in perpetuity habitat of similar or better quality, on-site or off-site, by donating or selling a conservation easement on it to an accredited land trust or relevant public agency. The donation or easement must cover an amount of land equal to or larger than the area that cannot be protected.

SLL Prerequisite 3: Wetland and Water Body Conservation

Required

Intent

To preserve water quality, natural hydrology, habitat, and biodiversity through conservation of *wetlands* and *water bodies*.

Requirements

Limit development effects on wetlands, water bodies, and surrounding buffer land according to the requirements below.

OPTION 1. Sites with No Wetlands, Water Bodies, Land within 50 Feet of Wetlands, or Land within 100 Feet of Water Bodies

Locate the *project* on a site that includes no wetlands, no water bodies, no land within 50 feet of wetlands, and no land within 100 feet of water bodies.

OR

OPTION 2. Sites with Wetlands, Water Bodies, Land within 50 Feet of Wetlands, or Land within 100 Feet of Water Bodies

a. Locate the project such that *preproject* wetlands, water bodies, land within 50 feet of wetlands, and land within 100 feet of water bodies is not affected by new development, unless the development is minor improvements or is on *previously developed* land.

OR

b. Earn at least 1 point under GIB Credit 8, Stormwater Management, and limit any impacts beyond minor improvements to less than the percentage of buffer land listed in Table 1.

Table 1. Maximum allowable area of impacts within buffer zone, by density

Residential density (DU/acre)*	Nonresidential density (FAR)*	Percentage of buffer land** where impacts beyond minor improvements are allowed
> 25	> 1.75	≤ 20%
> 18 and ≤ 25	> 1.25 to ≤ 1.75	≤ 15%
> 10 and ≤ 18	> .75 to ≤ 1.25	≤ 10%
≤ 10	≤ .75	≤ 5%
DU = dwelling unit; FAR = floor-area ratio.		
* For this option, a mixed-use project may use either its residential or its nonresidential *density* to determine the percentage of allowable impacts, regardless of which is higher.		
** For this option, buffer width may vary as long as the total buffer area is equal to the area within 50 feet of wetlands and/or within 100 feet of water bodies, minus excluded features (see below). The minimum buffer width, however, is 25 feet for wetlands and 50 feet for water bodies, measured from the edge. In the minimum buffer, only minor improvements and/or improvements that result in no ecological impairment of the wetland or water body, as determined by a qualified biologist, are allowed.		

AND

FOR ALL PROJECTS

Comply with all local, state, and federal regulations pertaining to wetland and water body conservation.

The following features are not considered wetlands, water bodies, or buffer land that must be protected for the purposes of this prerequisite:

a. Previously developed land.

b. Man-made water bodies (such as industrial mining pits, concrete-lined canals, or stormwater retention ponds) that lack natural edges and floors or native ecological communities in the water and along the edge.

c. Man-made linear wetlands that result from the interruption of natural drainages by *existing* rights-of-way.

d. Wetlands that were man-made incidentally and have been rated "poor" for all measured wetland functions. Wetland quality assessment must be performed by a qualified biologist using a method that is accepted by state or regional permitting agencies.

Minor improvements within the buffer may be undertaken to enhance appreciation for the wetland or water body, provided such facilities are open to public access. Only the following improvements are permitted:

a. Bicycle and pedestrian pathways no more than 12 feet wide, of which no more than 8 feet may be impervious.

b. Activities to maintain or restore native natural communities and/or natural hydrology.

c. One single-story structure not exceeding 500 square feet per 300 linear feet of buffer, on average.

d. Grade changes necessary to ensure public access.

e. Clearings, limited to one per 300 linear feet of buffer on average, not exceeding 500 square feet each, for tables, benches, and access for nonmotorized recreational watercraft. Off-street parking is not considered a minor improvement.

f. Removal of hazardous trees; up to 75% of dead trees; trees less than 6 inches diameter at breast height; trees under 40% condition rating; and up to 20% of trees more than 6 inches diameter at breast height with a condition rating of 40% or higher. The condition rating must be based on an assessment by an arborist certified by the International Society of Arboriculture (ISA) using ISA standard measures.

g. *Brownfield* remediation activities.

Direct impacts to wetlands and water bodies are prohibited, except for minimal-impact structures, such as an elevated boardwalk, that allow access to the water for educational and recreational purposes. Structures that protrude into wetlands or water bodies may be replaced, provided the replacement structure has the same or smaller footprint and a similar height.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

previously developed altered by paving, construction, and/or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Previously developed land includes a platted lot on which a building was constructed if the lot is no more than 1 acre; previous development on lots larger than 1 acre is defined as the d*evelopment footprint* and land alterations associated with the footprint. Land that is not previously developed and altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land. The date of previous development permit issuance constitutes the date of previous development, but permit issuance in itself does not constitute previous development.

SLL Prerequisite 4: Agricultural Land Conservation

Required

Intent

To preserve irreplaceable agricultural resources by protecting prime and unique soils on farmland and forestland from development.

Requirements

FOR ALL PROJECTS

Locate the *project* on a site that is not within a state or locally designated agricultural preservation district, unless any changes made to the site conform to the requirements for development within the district (as used in this requirement, district does not equate to land-use zoning).

AND

OPTION 1. Protected Soils Not Impacted

Locate the project *development footprint* such that it does not disturb *prime soils*, *unique soils*, or soils of state significance as identified in a state Natural Resources Conservation Service soil survey.

OR

OPTION 2. Infill Sites

Locate the project on an *infill site*.

OR

OPTION 3. Sites Served by Transit

Comply with SLL Prerequisite 1, Option 3, Transit Corridor or Route with Adequate Transit Service.

OR

OPTION 4. Development Rights Receiving Area

Locate the project within a designated receiving area for development rights under a publicly administered farmland protection program that provides for the transfer of development rights from lands designated for conservation to lands designated for development.

OR

OPTION 5. Sites with Impacted Soils

If development footprint affects land with prime soils, unique soils, or soils of state significance, as identified in a state Natural Resources Conservation Service soil survey, mitigate the loss through the purchase of easements providing permanent protection from development on land with comparable soils in accordance with the ratios based on densities per acre of *buildable land* as listed in Tables 1 and 2.

Table 1. Mitigation ratios for projects in metropolitan or micropolitan statistical areas, pop. 250,000 or more

Residential density (DU per acre of buildable land available for residential use)	Nonresidential density (FAR of buildable land available for nonresidential use)	Mitigation ratio (acres of easement : acres of project on prime, unique, or significant soil)
> 7 and ≤ 8.5	> 0.50 and ≤ 0.67	2 to 1
> 8.5 and ≤ 10	> 0.67 and ≤ 0.75	1.5 to 1
> 10 and ≤ 11.5	> 0.75 and ≤ 0.87	1 to 1
> 11.5 and ≤ 13	> 0.87 and ≤ 1.0	.5 to 1
> 13	> 1.0	No mitigation

Table 2. Mitigation ratios for projects in metropolitan or micropolitan statistical areas, pop. less than 250,000

Residential density (DU/acre of buildable land available for residential use)	Nonresidential density (FAR of buildable land available for nonresidential use)	Mitigation ratio (acres of easement : acres of project on prime, unique, or significant soil)
> 7 and ≤ 8	> 0.50 and ≤ 0.58	2 to 1
> 8 and ≤ 9	> 0.58 and ≤ 0.67	1 to 1
> 9 and ≤ 10	> 0.67 and ≤ 0.75	0.5 to 1
> 10	> 0.75	No mitigation
DU = dwelling unit; FAR = floor-area ratio.		

All off-site mitigation must be located within 100 miles of the project.

Up to 15% of the impacted soils area may be exempted from the *density* requirements if it is permanently dedicated for community gardens, and may also count toward the mitigation requirement for the remainder of the site. Portions of parking structures devoted exclusively to parking must be excluded from the numerator when calculating the *floor-area ratio* (FAR).

The mitigation ratio for a mixed-use project is calculated as follows:

1. Determine the total square footage of all residential and nonresidential uses.
2. Calculate the percentage residential and percentage nonresidential of the total square footage.
3. Determine the density of the residential and nonresidential components as measured in *dwelling units* per acre and FAR, respectively.
4. Referring to Tables 1 and 2, find the appropriate mitigation ratios for the residential and nonresidential components.
5. If the mitigation ratios are different, multiply the mitigation ratio of the residential component by its percentage of the total square footage, and multiply the mitigation ratio of the nonresidential component by its percentage.
6. Add the two numbers produced by Step 5. The result is the mitigation ratio.

Key Definitions

buildable land the portion of the site where construction can occur, including land voluntarily set aside and not constructed upon. When used in *density* calculations, buildable land excludes public rights-of-way and land excluded from development by codified law or LEED for Neighborhood Development prerequisites. An *applicant* may exclude additional land not exceeding 15% of the buildable land base defined above, provided the following conditions are present:

a. The land is protected from residential and nonresidential construction by easement, deed restriction, or other enforceable legal instrument.

AND

b. Either 25% or more of the boundary of each contiguous parcel proposed for exclusion borders a *water body* or areas outside the *project boundary* that are protected by codified law; or ownership of, or management authority over, the exclusion area is transferred to a public entity.

infill site a site that meets any of the following four conditions:

a. At least 75% of its boundary borders parcels that individually are at least 50% *previously developed*, and that in aggregate are at least 75% previously developed.

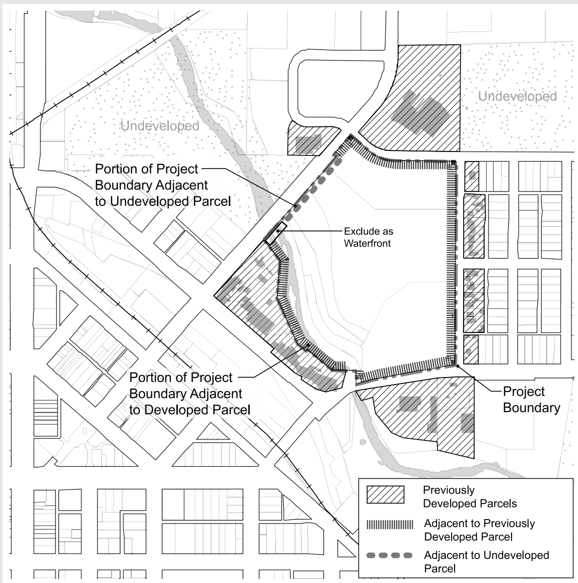
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

c. At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the *project boundary* is previously developed.

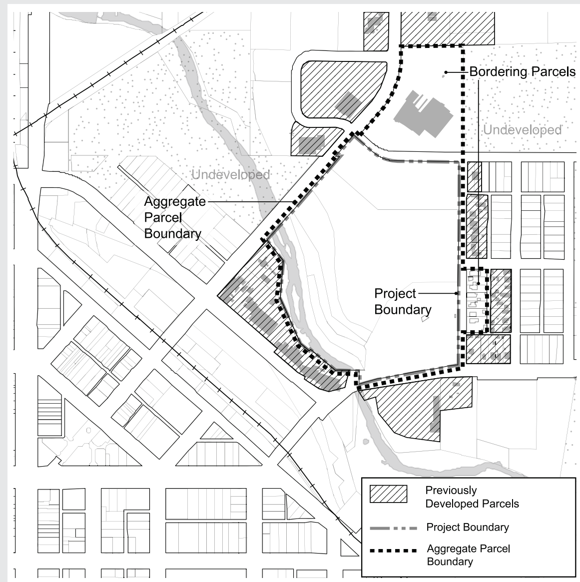
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

A *street* or other right-of-way does not constitute previously developed land; it is the status of property on the other side or right-of-way of the street that matters. For conditions (a) and (b) above, any fraction of the perimeter that borders waterfront other than a stream is excluded from the calculation.

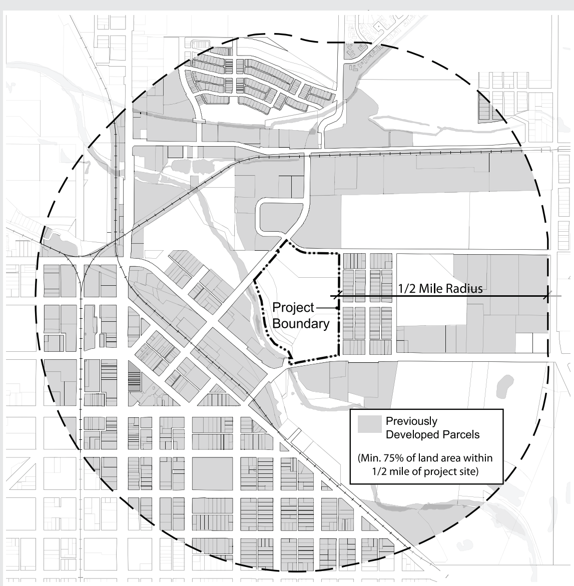
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



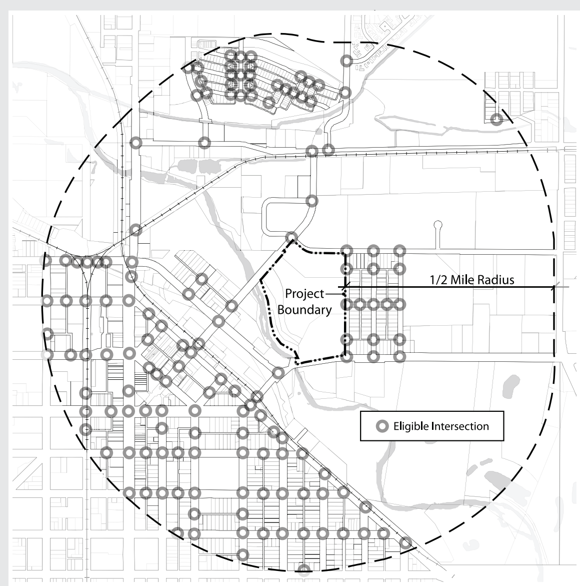
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(c). Infill project site based on minimum 75% of land area within 1/2 mile of project boundary being previously developed



(d). Infill project site based on minimum 140 intersections/sq.mi. within 1/2 mile of project boundary



SLL Prerequisite 5: Floodplain Avoidance

Required

Intent

To protect life and property, promote open space and habitat conservation, and enhance water quality and natural hydrological systems.

Requirement

OPTION 1. Sites without Floodplains

Locate on a site that does not contain any land within a 100-year high- or moderate-risk floodplain as defined and mapped by the Federal Emergency Management Agency (FEMA) or a state or local floodplain management agency, whichever is more recent.

OR

OPTION 2. Infill or Previously Developed Sites with Floodplains

Locate the *project* on an *infill site* or a *previously developed site* or in a nonconveyance area of river or coastal floodplain without storm surge potential where compensatory storage is used in accordance with a FEMA-approved mitigation plan. Comply with the National Flood Insurance Program (NFIP) requirements for developing any portions of the site that lie within a 100-year high-or moderate-risk floodplain, as defined in Option 1. If the project includes construction of any critical facility, such as a hospital, water and sewage treatment facility, emergency center, or fire or police station, the critical facility must be designed and built so as to be protected and operable during a 500-year event, as defined by FEMA.

OR

OPTION 3. All Other Sites with Floodplains

If any part of the site is located within a 100-year high- or moderate-risk floodplain, as defined above, develop only on portions of the site that are not in the floodplain, or that have been previously developed, or that are in a nonconveyance area of river or coastal floodplain without storm surge potential where compensatory storage is used in accordance with a FEMA-approved mitigation plan. Previously developed portions in the floodplain must be developed according to NFIP requirements. If development includes construction of any critical facility, as described above, the critical facility must be designed and built so as to be protected and operable during a 500-year event, as defined by FEMA.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

infill site a site that meets any of the following four conditions:

a. At least 75% of its boundary borders parcels that individually are at least 50% *previously developed,* and that in aggregate are at least 75% previously developed.

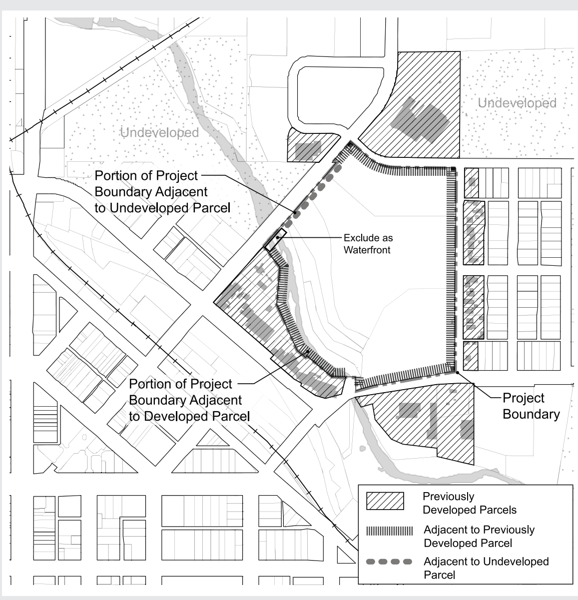
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

c. At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the *project boundary* is previously developed.

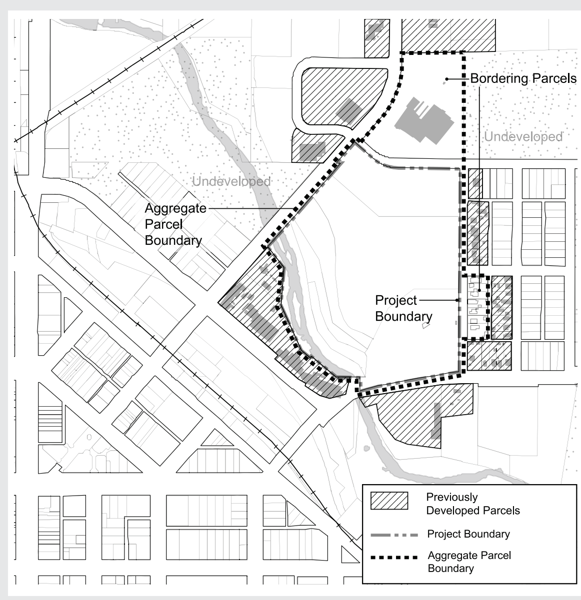
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

A *street* or other right-of-way does not constitute previously developed land; it is the status of property on the other side or right-of-way of the street that matters. For conditions (a) and (b) above, any fraction of the perimeter that borders waterfront other than a stream is excluded from the calculation.

(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels

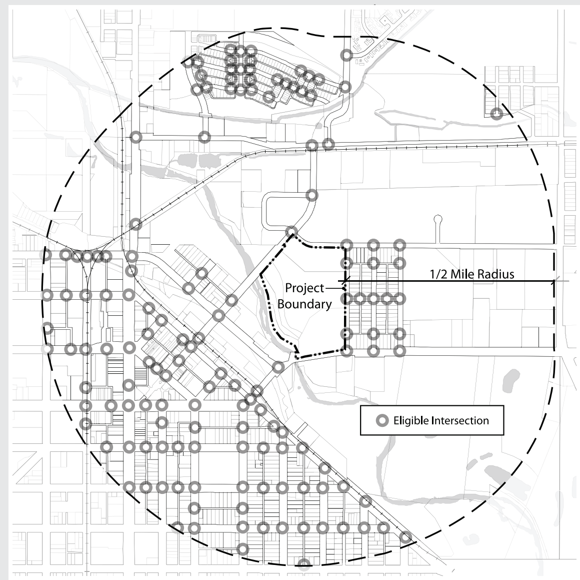


(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(c). Infill project site based on minimum 75% of land area within 1/2 mile of project boundary being previously developed

(d). Infill project site based on minimum 140 intersections/sq.mi. within 1/2 mile of project boundary



SLL Credit 1: Preferred Locations

1–10 points

Intent

To encourage development within *existing* cities, suburbs, and towns to reduce adverse environmental and public health effects associated with sprawl. To reduce development pressure beyond the limits of existing development. To conserve natural and financial resources required for construction and maintenance of infrastructure.

Requirements

Achieve any combination of requirements in the following three options:

OPTION 1. Location Type

Locate the *project* in one of the following locations:

a. A *previously developed site* that is not an *adjacent site* or *infill site* (1 point).

b. An adjacent site that is also a previously developed site (2 points).

c. An infill site that is not a previously developed site (3 points).

d. An infill site that is also a previously developed site (5 points).

AND/OR

OPTION 2. Connectivity

Locate the project in an area that has existing *connectivity* within 1/2 mile of the *project boundary*, as listed to Table 1.

Table 1. Points for connectivity within 1/2 mile of project

Intersections per square mile	Points
≥ 200 and < 250	1
≥ 250 and < 300	2
≥ 300 and < 350	3
≥ 350 and < 400	4
≥ 400	5

Intersections within the site may be counted if the intersections were not constructed or funded by the *developer* within the past ten years.

AND/OR

OPTION 3. Designated High-Priority Locations

Achieve the following (3 points):

- Earn at least 2 points under NPD Credit 4, Mixed-Income Diverse Communities, Option 2, Affordable Housing.

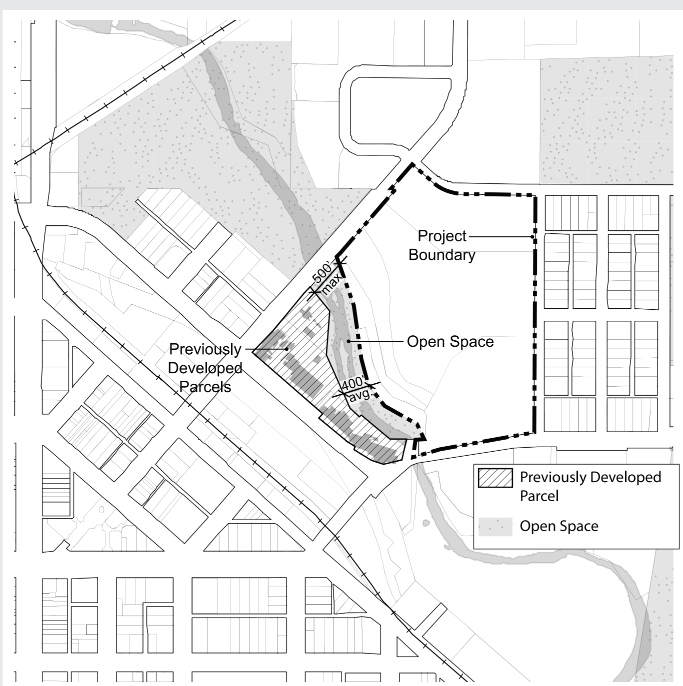
- In addition, locate the project in one of the following high-priority redevelopment areas: EPA National Priorities List, Federal Empowerment Zone, Federal Enterprise Community, Federal Renewal Community, Department of Justice Weed and Seed Strategy Community, Department of the Treasury Community Development Financial Institutions Fund Qualified Low-Income Community (a subset of the New Markets Tax Credit Program), or the U.S. Department of Housing and Urban Development's Qualified Census Tract (QCT) or Difficult Development Area (DDA).

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

adjacent site a site having at least 25% of its boundary bordering parcels that are each at least 75% *previously developed*. A *street* or other right-of-way does not constitute previously developed land; instead, it is the status of the property on the other side of the street or right-of-way that matters. Any fraction of the boundary that borders waterfront other than a stream is excluded from the calculation. A site is still considered adjacent if the 25% adjacent portion of its boundary is separated from previously developed parcels by undeveloped, permanently protected land averaging no more than 400 feet in width and no more than 500 feet in any one place. The undeveloped land must be permanently preserved as natural area, riparian corridor, *park*, greenway, agricultural land, or designated *cultural landscape*. Permanent pedestrian paths connecting the project through the protected parcels to the bordering site may be counted to meet the requirement of SLL Prerequisite 1, Option 2 (that the *project* be connected to the adjacent parcel by a through-street or nonmotorized right-of-way every 600 feet on average, provided the path or paths traverse the undeveloped land at no more than a 10% grade for walking by persons of all ages and physical abilities).

Adjacent project site based on minimum 25% of perimeter adjacent to previously developed parcels, including allowance for permanently protected land between project boundary and previously developed parcels



connectivity the number of publicly accessible intersections per square mile, including any combination of streets, dedicated alleys, transit rights-of-way, and nonmotorized rights-of-way. If one must both enter and exit an area through the same intersection, such an intersection and any intersections beyond that point are not counted; intersections leading only to culs-de-sac are also not counted. The calculation of square mileage excludes water bodies, parks larger than 1/2 acre, public facility campuses, airports, rail yards, slopes over 15%, and areas nonbuildable under codified law or the rating system. Street rights-of-way may not be excluded.

infill site a site that meets any of the following four conditions:

a. At least 75% of its boundary borders parcels that individually are at least 50% *previously developed,* and that in aggregate are at least 75% previously developed.

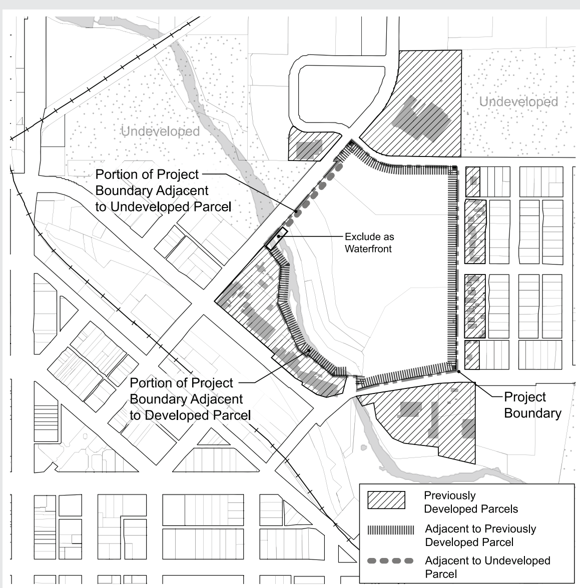
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

c. At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the *project boundary* is previously developed.

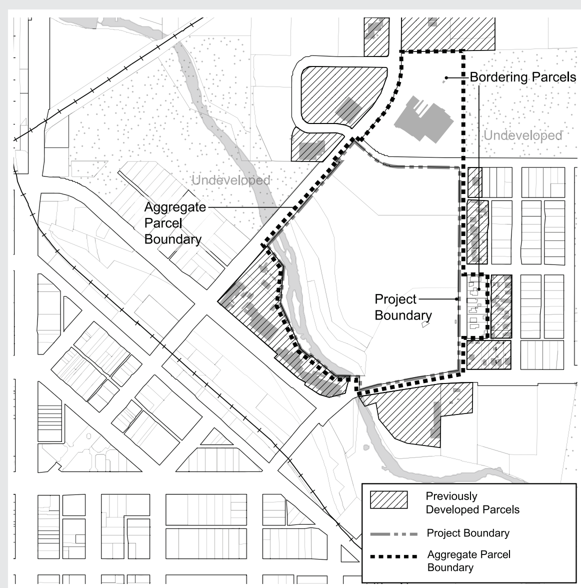
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

A *street* or other right-of-way does not constitute previously developed land; it is the status of property on the other side or right-of-way of the street that matters. For conditions (a) and (b) above, any fraction of the perimeter that borders waterfront other than a stream is excluded from the calculation.

(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels

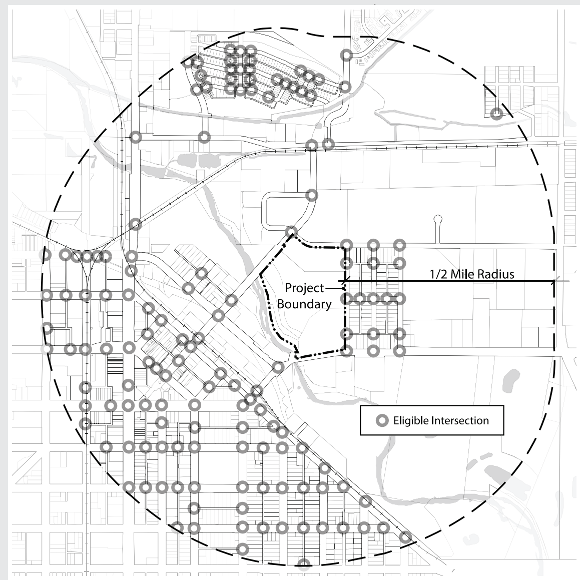


(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(c). Infill project site based on minimum 75% of land area within 1/2 mile of project boundary being previously developed

(d). Infill project site based on minimum 140 intersections/sq.mi. within 1/2 mile of project boundary



SLL Credit 2: Brownfields Redevelopment

1–2 points

Intent

To encourage the reuse of land by developing sites that are complicated by environmental contamination, thereby reducing pressure on undeveloped land.

Requirements

OPTION 1. Brownfield Sites (1 point)

Locate the *project* on a site, part or all of which is documented as contaminated (by means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local Voluntary Cleanup Program), or on a site defined as a *brownfield* by a local, state, or federal government agency; and remediate site contamination such that the controlling public authority approves the protective measures and/or cleanup as effective, safe, and appropriate for the future use of the site.

OR

OPTION 2. High-Priority Redevelopment Areas (2 points)

Achieve the requirements in Option 1;

AND

Locate the project in one of the following high-priority redevelopment areas: EPA National Priorities List, Federal Empowerment Zone, Federal Enterprise Community, Federal Renewal Community, Department of Justice Weed and Seed Strategy Community, Department of the Treasury Community Development Financial Institutions Fund Qualified Low-Income Community (a subset of the New Markets Tax Credit Program), or the U.S. Department of Housing and Urban Development's Qualified Census Tract (QCT) or Difficult Development Area (DDA).

SLL Credit 3: Locations with Reduced Automobile Dependence

1–7 points

Intent

To encourage development in locations shown to have multimodal transportation choices or otherwise reduced motor vehicle use, thereby reducing greenhouse gas emissions, air pollution, and other adverse environmental and public health effects associated with motor vehicle use.

Requirements

OPTION 1. Transit-Served Location

Locate the *project* on a site with *existing* transit service such that at least 50% of *dwelling units* and nonresidential building entrances (inclusive of existing buildings) are within a 1/4-mile *walk distance* of bus or streetcar stops, or within a 1/2-mile walk distance of *bus rapid transit* stops, light or heavy rail stations, or ferry terminals, and the transit service at those stops in aggregate meets the minimums listed in Tables 1 and 2. Both weekday and weekend trip minimums must be met to earn points at a particular threshold.

Projects larger than 125 acres can meet the requirements by locating on a site with existing transit service such that at least 40% of dwelling units and nonresidential building entrances (inclusive of existing buildings) are within a 1/4-mile walk distance of bus or streetcar stops, or within a 1/2-mile walk distance of bus rapid transit stops, lightor heavy rail stations, or ferry terminals, and the transit service at those stops in aggregate meets the minimums listed in Tables 1 and 2 (both weekday and weekend trip minimums must be met to earn points at a particular threshold), as long as the 40% complies with NPD Prerequisite 2 and any portion of the project beyond the 1/4-mile and/or 1/2-mile walk distances meets SLL Prerequisite 1, Option 3-compliant planned transit service.

Projects greater than 500 acres can meet the requirements by locating on a site with existing transit service such that at least 30% of dwelling units and nonresidential building entrances (inclusive of existing buildings) are within a 1/4-mile walk distance of bus or streetcar stops, or within a 1/2-mile walk distance of bus rapid transit stops, light or heavy rail stations, or ferry terminals, and the transit service at those stops in aggregate meets the minimums listed in Tables 1 and 2 (both weekday and weekend trip minimums must be met to earn points at a particular threshold), as long as the 30% complies with NPD Prerequisite 2 and any portion of the project beyond the 1/4-mile and/or 1/2-mile walk distances meets SLL Prerequisite 1, Option 3-compliant planned transit service.

For all projects, weekend daily trips must include service on both Saturday and Sunday. Commuter rail must serve more than one *metropolitan statistical area* (MSA) and/or the area surrounding the core of an MSA.

Table 1. Minimum daily transit service for projects with multiple transit types (bus, streetcar, rail, or ferry)

Weekday trips	Weekend trips	Points
60	40	1
76	50	2
100	65	3
132	85	4
180	130	5
246	150	6
320	200	7

Table 2. Minimum daily transit service for projects with commuter rail or ferry service only

Weekday trips	Weekend trips	Points
24	6	1
40	8	2
60	12	3

Projects served by two or more transit routes such that no one route provides more than 60% of the prescribed levels may earn 1 bonus point, up to the maximum 7 points.

Projects where existing transit service is temporarily rerouted outside the required distances for less than 2 years may meet the requirements if the local transit agency has committed to restoring the compliant routes with service at or above the prior level.

OR

OPTION 2. Metropolitan Planning Organization Location with Low VMT

Locate the project within a region served by a metropolitan planning organization (MPO) and within a transportation analysis zone (TAZ) where either a) the current annual home-based vehicle miles traveled (VMT) per capita (if TAZ is 100% residential) or b) the annual non-home-based VMT per employee (if TAZ is 100% non-residential) does not exceed 90% of the average of the equivalent metropolitan region value. The research must be derived from household or employment transportation surveys conducted by the MPO within ten years of the date of submission for LEED for Neighborhood Development certification. Additional credit may be awarded for increasing levels of performance, as indicated in Table 3. Mixed-use TAZs must use whichever TAZ VMT is greater, either residential per capita or non-residential per employee.

Table 3. Points for low-VMT location

Percentage of average regional VMT per capita	Points
81–90%	1
71–80%	2
61–70%	3
51–60%	4
41–50%	5
31–40%	6
30 or less	7
VMT = vehicle miles traveled.	

Points earned under Options 1 and 2 may not be combined.

SLL Credit 4: Bicycle Network and Storage

1 point

Intent

To promote bicycling and transportation efficiency, including reduced *vehicle miles traveled* (VMT). To support public health by encouraging utilitarian and recreational physical activity.

Requirements

BICYCLE NETWORK

Design and/or locate the *project* to meet at least one of the three requirements below:

a. An *existing bicycle network* of at least 5 continuous miles in length is within 1/4-mile bicycling distance of the *project boundary*.

b. If the project is 100% residential, an existing bicycle network begins within 1/4-mile bicycling distance of the project boundary and connects to a *school* or *employment center* within 3 miles' bicycling distance.

c. An existing bicycle network within 1/4-mile bicycling distance of the project boundary connects to at least ten diverse uses (see Appendix) within 3 miles' bicycling distance from the project boundary.

AND

BICYCLE STORAGE

Provide bicycle parking and storage capacity to new buildings as follows:

a. **Multiunit residential.** Provide at least one secure, enclosed bicycle storage space per occupant for 30% of the *planned occupancy* but no fewer than one per unit. Provide secure visitor bicycle racks on-site, with at least one bicycle space per ten *dwelling units* but no fewer than four spaces per project site.

b. **Retail.** Provide at least one secure, enclosed bicycle storage space per new retail worker for 10% of retail worker planned occupancy. Provide visitor or customer bicycle racks on-site, with at least one bicycle space per 5,000 square feet of retail space, but no fewer than one bicycle space per business or four bicycle spaces per project site, whichever is greater. Provide at least one on-site shower with changing facility for any development with 100 or more new workers and at least one additional on-site shower with changing facility for every 150 new workers thereafter.

c. **Nonresidential other than retail.** Provide at least one secure, enclosed bicycle storage space per new occupant for 10% of planned occupancy. Provide visitor bicycle racks on-site with at least one bicycle space per 10,000 square feet of new commercial nonretail space but not fewer than four bicycle spaces per building. Provide at least one on-site shower with changing facility for any development with 100 or more new workers and at least one additional on-site shower with changing facility for every 150 new workers thereafter.

Secure, enclosed bicycle storage areas must be locked and easily accessible to residents and/or workers. Provide informational signage on using the storage facilities.

Visitors' and customers' bicycle racks must be clearly visible from a main entry, located within 100 feet of the door, served with night lighting, and protected from damage from nearby vehicles. If the building has multiple main entries, bicycle racks must be proportionally dispersed within 100 feet of each.

Shower and changing facility requirements may be met by providing the equivalent of free access to on-site health club shower facilities, if the health club can be accessed without going outside. Provide informational signage on using the shower facilities.

SLL Credit 5: Housing and Jobs Proximity

1–3 points

Intent

To encourage balanced communities with a diversity of uses and employment opportunities.

Requirements

OPTION 1. Project with Affordable Residential Component (3 points)

Include a residential component equaling at least 30% of the *project*'s total building square footage (exclusive of parking structures), and locate and/or design the project such that the geographic center (or boundary if the project exceeds 500 acres) is within 1/2-mile *walk distance* of *existing* full-time-equivalent jobs whose number is equal to or greater than the number of *dwelling units* in the project; and satisfy the requirements necessary to earn at least one point under NPD Credit 4, Mixed-Income Diverse Communities, Option 2, Affordable Housing.

OR

OPTION 2. Project With Residential Component (2 points)

Include a residential component equaling at least 30% of the project's total building square footage (exclusive of parking structures), and locate and/or design the project such that the geographic center (or boundary if the project exceeds 500 acres) is within 1/2-mile walk distance of existing full-time-equivalent jobs whose number is equal to or greater than the number of dwelling units in the project.

OR

OPTION 3. Infill Project with Nonresidential Component (1 point)

Include a nonresidential component equaling at least 30% of the project's total building square footage (exclusive of parking structures), and locate on an *infill site* whose geographic center (or boundary if the project exceeds 500 acres) is within 1/2-mile walk distance of an existing rail transit, ferry, or tram stop and within 1/2-mile walk distance of existing dwelling units whose number is equal to or greater than 50% of the number of new full-time-equivalent jobs created as part of the project.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

infill site a site that meets any of the following four conditions:

a. At least 75% of its boundary borders parcels that individually are at least 50% *previously developed,* and that in aggregate are at least 75% previously developed.

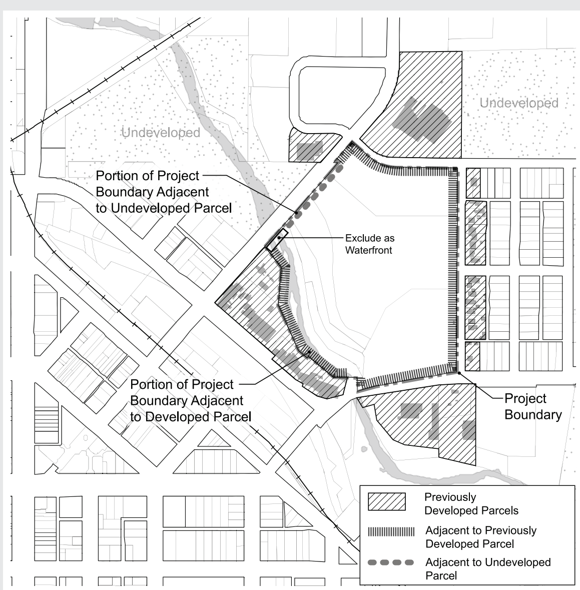
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

c. At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the *project boundary* is previously developed.

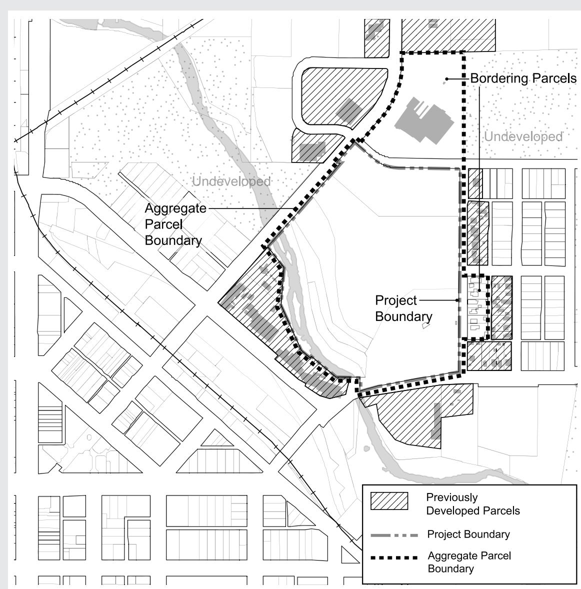
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

A *street* or other right-of-way does not constitute previously developed land; it is the status of property on the other side or right-of-way of the street that matters. For conditions (a) and (b) above, any fraction of the perimeter that borders waterfront other than a stream is excluded from the calculation.

(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels

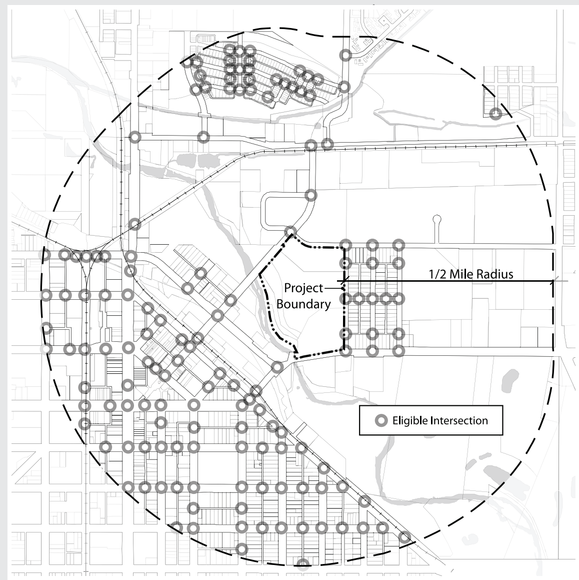


(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(c). Infill project site based on minimum 75% of land area within 1/2 mile of project boundary being previously developed

(d). Infill project site based on minimum 140 intersections/sq.mi. within 1/2 mile of project boundary



SLL Credit 6: Steep Slope Protection

1 point

Intent

To minimize erosion to protect habitat and reduce stress on natural water systems by preserving steep slopes in a natural, vegetated state.

Requirements

FOR ALL PROJECTS

All options apply to *existing* natural or constructed slopes. Portions of *project* sites with slopes up to 20 feet in elevation, measured from toe (a distinct break between a 40% slope and lesser slopes) to top, that are more than 30 feet in any direction from another slope greater than 15% are exempt from the requirements, although more restrictive local regulations may apply.

OPTION 1. No Disturbance of Slopes Over 15%

Locate on a site that has no existing slopes greater than 15%, or avoid disturbing portions of the site that have existing slopes greater than 15%.

OR

OPTION 2. Previously Developed Sites with Slopes Over 15%

On portions of *previously developed sites* with existing slopes greater than 15%, restore the slope area with *native plants* or noninvasive *adapted plants* according to Table 1.

Table 1. Required restoration area of slope

Slope	Restoration
> 40%	100%
26% to 40%	60%
< 15% to 25%	40%

In addition, develop *covenants, conditions, and restrictions* (CC&R); development agreements; or other binding documents that will protect the specified steep slope areas in perpetuity. Comply with the requirements of Option 3 on any slope over 15% that has not been previously developed.

OR

OPTION 3. Sites Other than Previously Developed Sites with Slopes Over 15%

On sites that are not previously developed sites, protect existing slopes over 15% as follows:

a. Do not disturb slopes greater than 40% and do not disturb portions of the project site within 50 feet horizontally of the top of the slope and 75 feet horizontally from the toe of the slope.

b. Limit development to no more than 40% of slopes between 25% and 40% and to no more than 60% of slopes between 15% and 25%.

c. Locate development such that the percentage of the *development footprint* that is on existing slopes less than 15% is greater than the percentage of *buildable land* that has existing slopes less than 15%.

d. Develop CC&R, development agreements, or other binding documents that will protect steep slopes in perpetuity.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

buildable land the portion of the site where construction can occur, including land voluntarily set aside and not constructed upon. When used in *density* calculations, buildable land excludes public rights-of-way and land excluded from development by codified law or LEED for Neighborhood Development prerequisites. An *applicant* may exclude additional land not exceeding 15% of the buildable land base defined above, provided the following conditions are present:

a. The land is protected from residential and nonresidential construction by easement, deed restriction, or other enforceable legal instrument.

AND

b. Either 25% or more of the boundary of each contiguous parcel proposed for exclusion borders a *water body* or areas outside the *project boundary* that are protected by codified law; or ownership of, or management authority over, the exclusion area is transferred to a public entity.

SLL Credit 7: Site Design for Habitat or Wetland and Water Body Conservation

1 point

Intent

To conserve *native plants*, wildlife habitat, *wetlands*, and *water bodies*.

Requirements

OPTION 1. Sites without Significant Habitat or Wetlands and Water Bodies

Locate the *project* on a site that does not have significant habitat, as defined in Option 2 of this credit, or land within 100 feet of such habitat, and fulfill the requirements of Options 1 or 2(a) under SLL Prerequisite 3, Wetland and Water Body Conservation.

OR

OPTION 2. Sites with Significant Habitat

Work with both the state's Natural Heritage Program and the state fish and wildlife agency to delineate identified significant habitat on the site. Do not disturb significant habitat or portions of the site within an appropriate buffer around the habitat. The geographic extent of the habitat and buffer must be identified by a qualified biologist, a nongovernmental conservation organization, or the appropriate state or regional agency. Protect significant habitat and its identified buffers from development in perpetuity by donating or selling the land, or a conservation easement on the land, to an accredited land trust or relevant public agency (a deed covenant is not sufficient to meet this requirement). Identify and commit to ongoing management activities, along with parties responsible for management and funding available, so that habitat is maintained in *preproject* condition or better for a minimum of three years after the project is built out. The requirement for identifying ongoing management activities may also be met by earning SLL Credit 9, Long-Term Conservation Management of Wetlands and Water Bodies.

Significant habitat for this credit includes the following:

a. Habitat for species that are listed or are candidates for listing under state or federal endangered species acts, habitat for species of special concern in the state, and/or habitat for those species and/or ecological communities classified as GH, G1, G2, G3, and/or S1 and S2 species by NatureServe.

b. Locally or regionally significant habitat of any size, or patches of predominantly native vegetation at least 150 acres (even if some of the 150 acres lies outside the *project boundary*).

c. Habitat flagged for conservation under a regional or state conservation or green infrastructure plan.

OR

OPTION 3. Sites with Wetlands and Water Bodies

Design the project to conserve 100% of all water bodies, wetlands, land within 100 feet of water bodies, and land within 50 feet of wetlands on the site. Using a qualified biologist, conduct an assessment, or compile *existing* assessments, showing the extent to which those water bodies and/or wetlands perform the following functions: (1) water quality maintenance, (2) wildlife habitat protection, and (3) hydrologic function maintenance, including flood protection. Assign appropriate buffers (not less than 100 feet for water bodies and 50 feet for wetlands) based on the functions provided, contiguous soils and slopes, and contiguous land uses. Do not disturb wetlands, water bodies, and their buffers, and protect them from development in perpetuity by donating or selling the land, or a conservation easement on the land, to an accredited land trust or relevant public agency (a deed covenant is not sufficient to meet this requirement). Identify and commit to ongoing management activities, along with parties responsible for management and funding available, so that habitat is maintained in preproject condition or better for a minimum of three years after the project is built out. The requirement for identifying ongoing management activities may also be met by earning SLL Credit 9, Long-Term Conservation Management of Wetlands and Water Bodies. The project does not meet the requirements if it has negative effects on habitat for species identified in Option 2(a).

FOR ALL PROJECTS

The following features are not considered wetlands, water bodies, or buffer land that must be protected:

a. *Previously developed* land.

b. Man-made water bodies (such as industrial mining pits, concrete-lined canals, or stormwater retention ponds) that lack natural edges and floors or native ecological communities in the water and along the edge

c. Man-made linear wetlands that result from the interruption of natural drainages by existing rights-of-way.

d. Wetlands that were created incidentally by human activity and have been rated "poor" for all measured wetland functions. Wetland quality assessment must be performed by a qualified biologist using a method that is accepted by state or regional permitting agencies.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

previously developed altered by paving, construction, and/or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Previously developed land includes a platted lot on which a building was constructed if the lot is no more than 1 acre; previous development on lots larger than 1 acre is defined as the *development footprint* and land alterations associated with the footprint. Land that is not previously developed and altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land. The date of previous development permit issuance constitutes the date of previous development, but permit issuance in itself does not constitute previous development.

SLL Credit 8: Restoration of Habitat or Wetlands and Water Bodies

1 point

Intent

To restore *native plants*, wildlife habitat, *wetlands*, and *water bodies* that have been harmed by previous human activities.

Requirements

Using only native plants, restore *predevelopment* native ecological communities, water bodies, or wetlands on the *project* site in an area equal to or greater than 10% of the *development footprint*. Work with a qualified biologist to ensure that restored areas will have the native species assemblages, hydrology, and other habitat characteristics that likely occurred in predevelopment conditions. Protect such areas from development in perpetuity by donating or selling the land, or a conservation easement on the land, to an accredited land trust or relevant public agency (a deed covenant is not sufficient to meet this requirement). Identify and commit to ongoing management activities, along with parties responsible for management and funding available, so that restored areas are maintained for a minimum of three years after the project is built out or the restoration is completed, whichever is later. The requirement for identifying ongoing management activities may also be met by earning SLL Credit 9, Long-Term Conservation Management of Wetlands and Water Bodies. The project does not meet the requirements if it has negative effects on habitat for species identified in Option 2(a) of SLL Credit 7, Site Design for Habitat or Wetland and Water Body Conservation.

SLL Credit 9: Long-Term Conservation Management of Habitat or Wetlands and Water Bodies

1 point

Intent

To conserve *native plants*, wildlife habitat, *wetlands*, and *water bodies*.

Requirements

Create and commit to implementing a long-term (at least ten-year) management plan for new or *existing* on-site native habitats, water bodies, and/or wetlands and their buffers, and create a guaranteed funding source for management. Involve a qualified biologist or a professional from a natural resources agency or natural resources consulting firm in writing the management plan and conducting or evaluating the ongoing management. The plan must include biological objectives consistent with habitat and/or water resource conservation, and it must identify (1) procedures, including personnel to carry them out, for maintaining the conservation areas; (2) estimated implementation costs and funding sources; and (3) threats that the *project* poses for habitat and/or water resources within conservation areas (e.g., introduction of exotic species, intrusion of residents in habitat areas) and measures to substantially reduce those threats. The project does not meet the requirements if it has negative effects on habitat for species identified in Option 2(a) of SLL Credit 7, Site Design for Habitat or Wetland and Water Body Conservation.

NPD Prerequisite 1: Walkable Streets

Required

Intent
To promote transportation efficiency, including reduced *vehicle miles traveled* (VMT). To promote walking by providing safe, appealing, and comfortable *street* environments that support public health by reducing pedestrian injuries and encouraging daily physical activity.

Requirements
Design and build the *project* to achieve all of the following:

a. For 90% of new building frontage, a principal *functional entry* on the front façade faces a public space, such as a street, square, *park*, *paseo*, or *plaza*, but not a parking lot, and is connected to sidewalks or equivalent provisions for walking. The square, park, or plaza must be at least 50 feet wide at a point perpendicular to each entry.

b. At least 15% of *existing* and new street frontage within and bordering the project has a minimum building-height-to-street-width ratio of 1:3 (i.e., a minimum of 1 foot of building height for every 3 feet of street width).

   - Nonmotorized rights-of-way may be counted toward the 15% requirement, but 100% of such spaces must have a minimum building-height-to-street-width ratio of 1:1.
   - Projects with bordering street frontage must meet only their proportional share of the height-to-width ratio (i.e., only on the project side of the street).
   - Street frontage is measured in linear feet.
   - Building height is measured to eaves or the top of the roof for a flat-roof structure, and street width is measured façade to façade. For building frontages with multiple heights, use the weighted average height of all frontage segments based on each segment's height weighted by the segment's share of total building width.
   - *Alleys* and driveways are excluded.

c. Continuous sidewalks or equivalent all-weather provisions for walking are provided along both sides of 90% of streets or frontage within the project, including the project side of streets bordering the project. New sidewalks, whether adjacent to streets or not, must be at least 8 feet wide on retail or mixed-use blocks and at least 4 feet wide on all other blocks. Equivalent provisions for walking include *woonerfs* and all-weather-surface footpaths. Alleys, driveways, and reconstructed existing sidewalks are excluded from these calculations.

d. No more than 20% of the street frontages within the project are faced directly by garage and service bay openings.

Projects in a designated *historic district* subject to review by a local historic preservation entity are exempt from (b), (c), and (d) if approval for compliance is not granted by the review body. Projects in historic districts listed in or eligible for listing in a state register or the National Register of Historic Places that are subject to review by a state historic preservation office or the National Park Service are exempt from (b), (c), and (d) if approval for compliance is not granted. If the public space is a square, park, or plaza, it must be at least 50 feet deep, measured at a point perpendicular to each entry.

NPD Prerequisite 2: Compact Development

Required

Intent

To conserve land. To promote livability, walkability, and transportation efficiency, including reduced *vehicle miles traveled* (VMT). To leverage and support transit investments. To reduce public health risks by encouraging daily physical activity associated with walking and bicycling.

Requirements

OPTION 1. Projects in Transit Corridors

For *projects* with e*xisting* and/or planned transit service (i.e., service with the funding commitments specified in SLL Prerequisite 1, Smart Location) that meets or exceeds the 2-point threshold in SLL Credit 3, Locations with Reduced Automobile Dependence, Option 1, build at the following densities, based on the *walk distances* to the transit service specified in SLL Credit 3:

a. For residential components located within the walk distances: 12 or more *dwelling units* per acre of buildable land available for residential uses.

b. For residential components falling outside the walk distances: 7 or more dwelling units per acre of buildable land available for residential uses.

c. For nonresidential components located within the walk distances: 0.80 *floor-area ratio* (FAR) or greater of buildable land available for nonresidential uses.

d. or nonresidential components falling outside the walk distances: 0.50 FAR or greater of buildable land available for nonresidential uses.

If the project location is served by a transit agency that has specified guidelines for minimum service densities that are greater than the densities required by this prerequisite, the project must achieve those service densities instead.

OR

OPTION 2. All Other Projects

Build any residential components of the project at a *density* of 7 dwelling units per acre of *buildable land* available for residential uses.

AND

Build any nonresidential components of the project at a density of 0.50 FAR or greater of buildable land available for nonresidential uses.

FOR ALL PROJECTS

Density calculations include all planned and existing buildings within the *project boundary*, excluding those portions of parking structures devoted exclusively to parking.

The specified density must be achieved within five years of the date that the first building of any type is occupied.

If one component of the project, residential or nonresidential, meets the minimum density requirement but the other component does not, include only the qualifying density. Use that component's dwelling units or nonresidential floor area in the numerator and the total buildable land area in the denominator. If the resulting density meets the minimum requirement, the prerequisite is achieved.

NPD Prerequisite 3: Connected and Open Community

Required

Intent

To promote *projects* that have high levels of internal *connectivity* and are well connected to the community at large. To encourage development within *existing* communities that promote transportation efficiency through multimodal transportation. To improve public health by encouraging daily physical activity.

Requirements

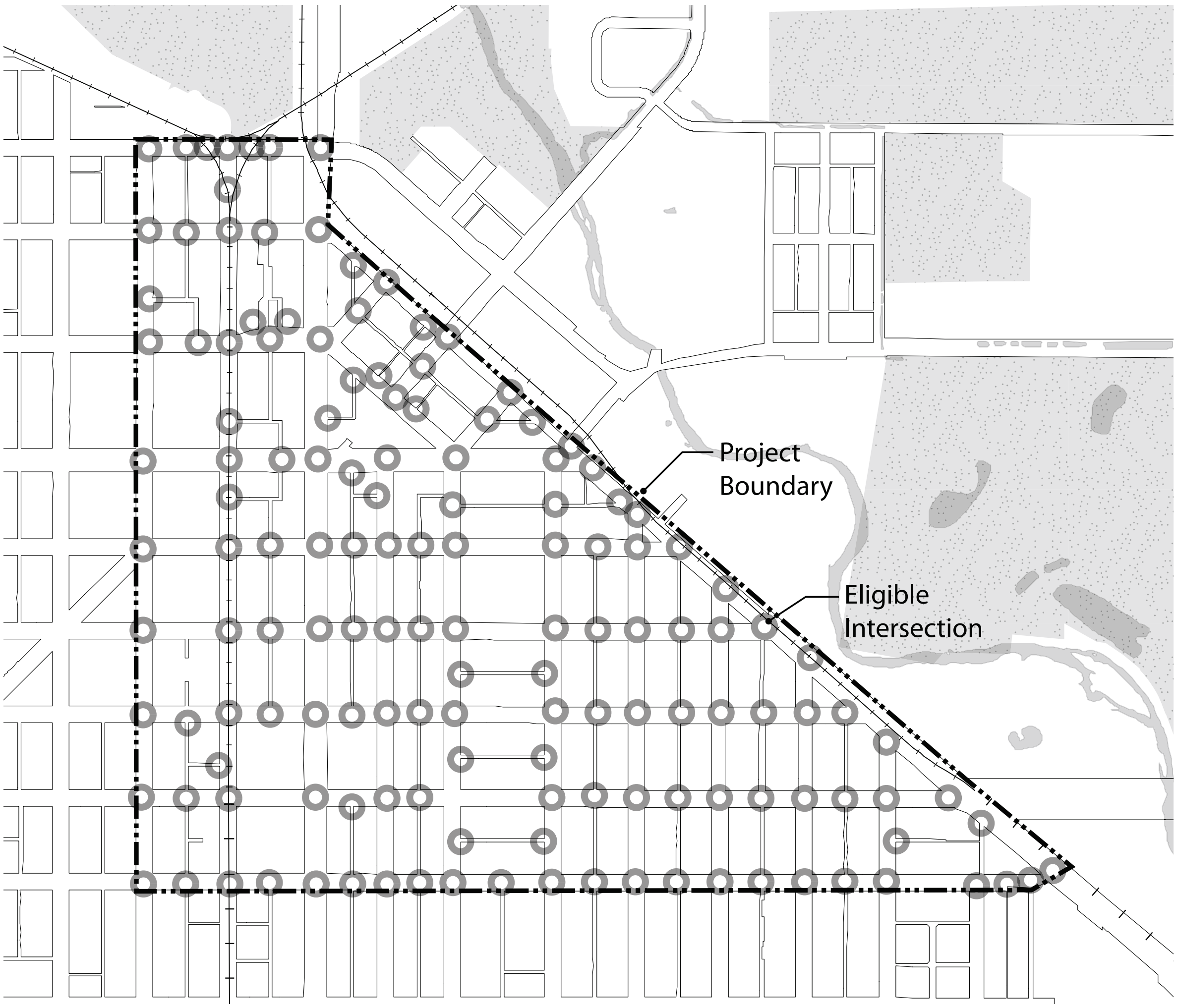
OPTION 1. Projects with Internal Streets

Design and build the project such that its internal connectivity is at least 140 intersections per square mile. All *streets* and sidewalks that are counted toward the connectivity requirement must be available for general public use and not gated. Gated areas are not considered available for public use, with the exception of education and health care campuses and military bases where gates are used for security purposes.

AND

Design and build the project with at least one through-street and/or nonmotorized right-of-way intersecting or terminating at the *project boundary* at least every 800 feet, or at existing abutting street intervals and intersections, whichever is the shorter distance. Nonmotorized rights-of-way may count for no more than 20% of the total. This does not apply to portions of the boundary where connections cannot be made because of physical obstacles, such as prior platting of property, construction of existing buildings or other barriers, slopes over 15%, *wetlands* and *water bodies*, railroad and utility rights-of-way, existing limited-access motor vehicle rights-of-way, and parks and dedicated open space.

Figure 1. Project site design with 140 eligible intersections per square mile on streets that are not gated

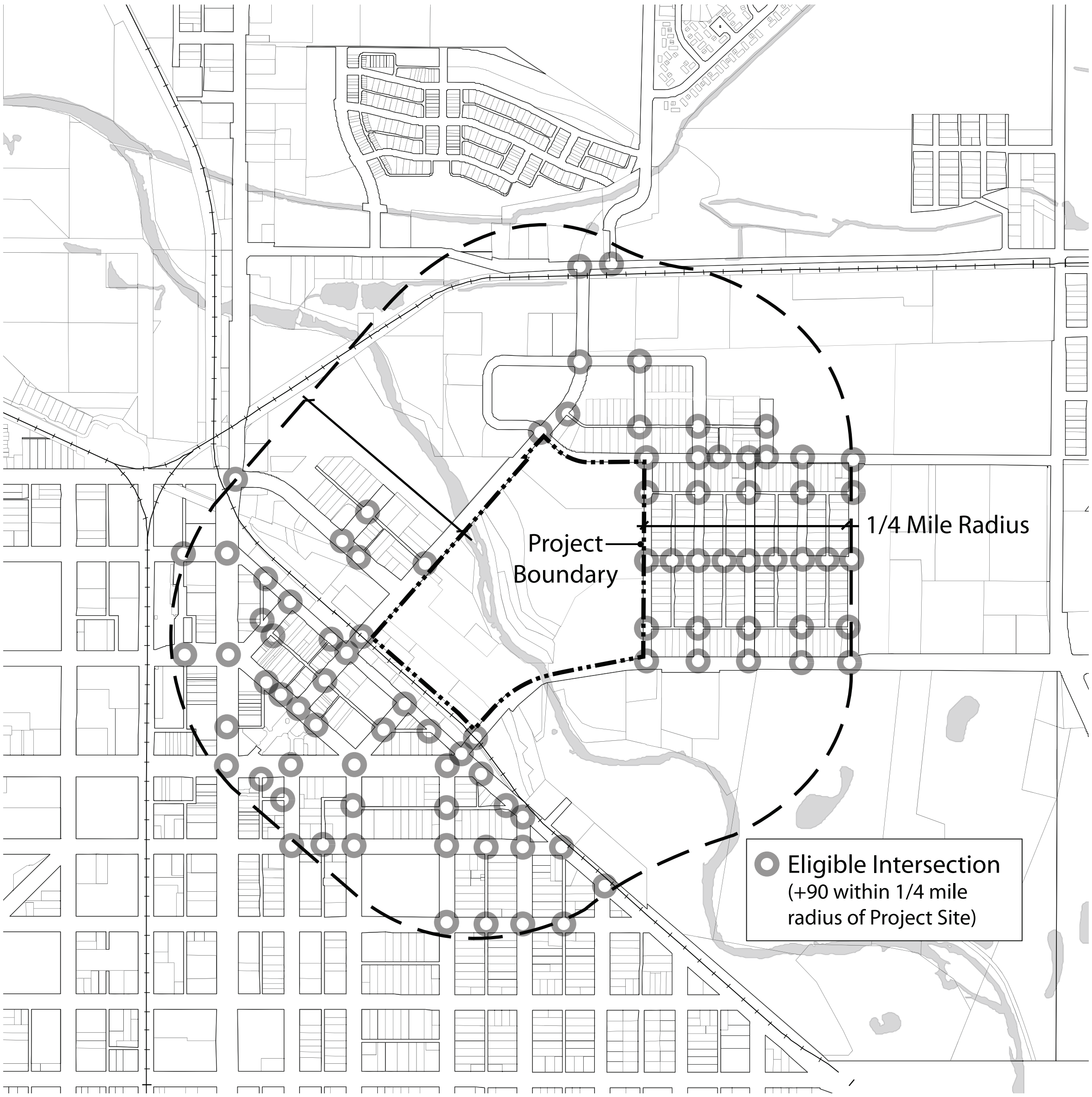


OR

OPTION 2. Projects without Internal Streets

Locate the project such that the connectivity of the existing streets within 1/4 mile of the project boundary is at least 90 intersections per square mile. All streets and sidewalks that are counted toward the connectivity requirement must be available for general public use and not gated. Gated areas are not considered available for public use, with the exception of education and health care campuses and military bases where gates are used for security purposes.

Figure 2. Project site with at least 90 eligible intersections per square mile within 1/4 mile of project boundary



Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

connectivity the number of publicly accessible intersections per square mile, including any combination of streets, dedicated alleys, transit rights-of-way, and nonmotorized rights-of-way. If one must both enter and exit an area through the same intersection, such an intersection and any intersections beyond that point are not counted; intersections leading only to culs-de-sac are also not counted. The calculation of square mileage excludes water bodies, parks larger than 1/2 acre, public facility campuses, airports, rail yards, slopes over 15%, and areas nonbuildable under codified law or the rating system. Street rights-of-way may not be excluded.

NPD Credit 1: Walkable Streets

1–12 points

Intent

To promote transportation efficiency, including reduced *vehicle miles traveled* (VMT). To promote walking by providing safe, appealing, and comfortable *street* environments that support public health by reducing pedestrian injuries and encouraging daily physical activity.

Requirements

A *project* may earn a maximum of 12 points according to the schedule in Table 1:

Table 1. Points for walkable street features

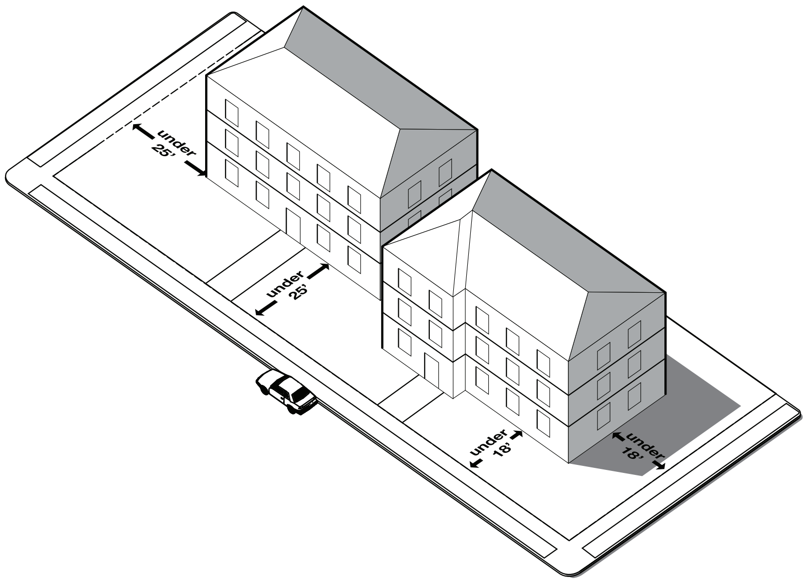
Items achieved	Points
2–3	1
4–5	2
6–7	3
8–9	4
10	7
11	8
12	9
13	10
14	11
15–16	12

Façades and Entries

a. At least 80% of the total linear feet of street-facing building façades in the project is no more than 25 feet from the property line.

b. At least 50% of the total linear feet of street-facing building façades in the project is no more than 18 feet from the property line.

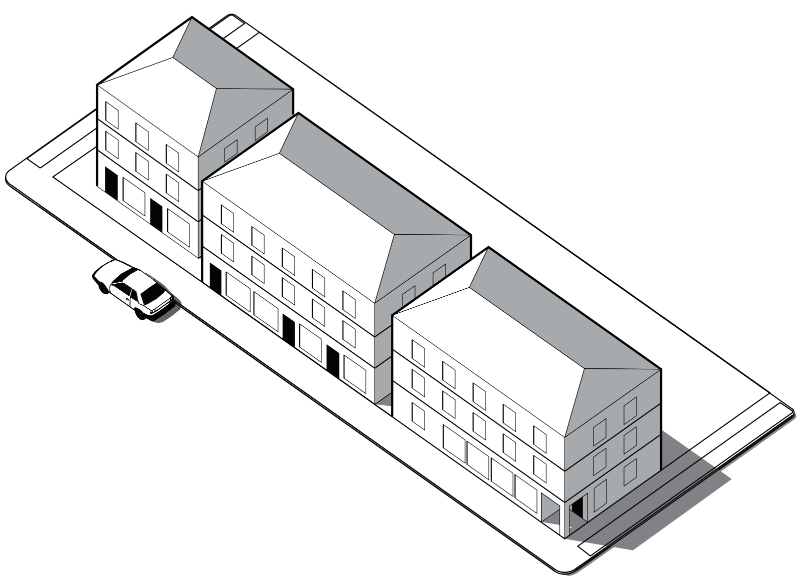
Figure 1. Minimal street-facing building façade setbacks



c. At least 50% of the total linear feet of mixed-use and nonresidential street-facing building façades in the project is within 1 foot of a sidewalk or equivalent provision for walking.

d. *Functional entries* to the building occur at an average of 75 feet or less along nonresidential or mixed-use buildings or *blocks*.

Figure 2. Functional building entries at minimum average distances along blocks



e. Functional entries to the building occur at an average of 30 feet or less along nonresidential or mixed-use buildings or blocks (items d and e are cumulative).

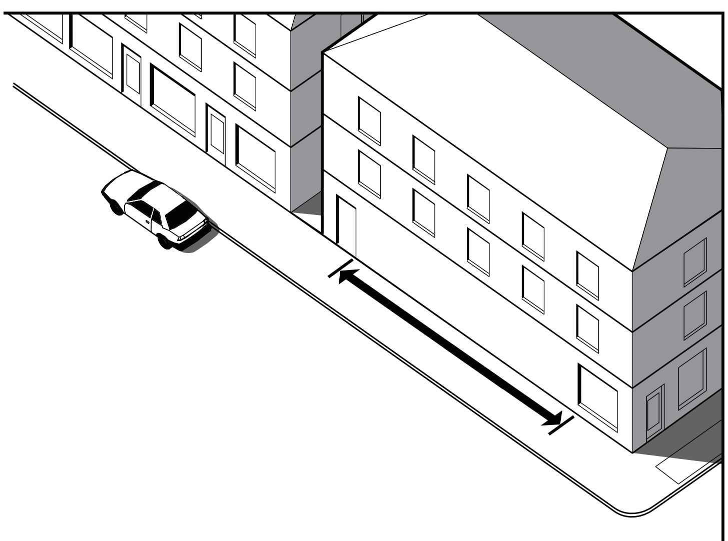
Ground-Level Use and Parking

f. All ground-level retail, service, and trade uses that face a public space have clear glass on at least 60% of their façades between 3 and 8 feet above grade.

Figure 3. Ground-level retail and service uses with minimum amounts of clear glass façades

g. If a façade extends along a sidewalk, no more than 40% of its length or 50 feet, whichever is less, is blank (without doors or windows).

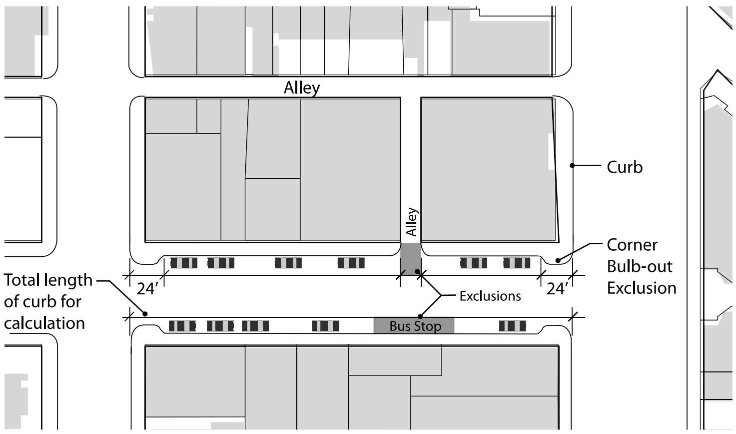
Figure 4. Limits on length of blank walls along sidewalks



h. Any ground-level retail, service, or trade windows must be kept visible (unshuttered) at night; this must be stipulated in *covenants, conditions, and restrictions* (CC&R) or other binding documents.

i. On-street parking is provided on a minimum of 70% of both sides of all new and *existing* streets, including the project side of bordering streets. The percentage of on-street parking is calculated by dividing the length of street designated for parking by the total length of the curb along each street, including curb cuts, driveways, and intersection radii. Space within the parking lane that is occupied by corner bulb-outs (within 24 feet of an intersection), transit stops, and motorcycle or bicycle parking may be counted as designated for parking in this calculation. *Woonerfs* are not considered streets for this subsection.

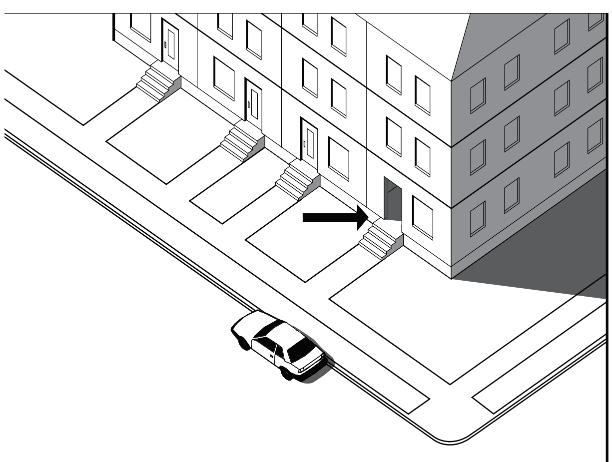
Figure 5. On-street parking requirements



j. Continuous sidewalks or equivalent provisions for walking are available along both sides of all streets within the project, including the project side of streets bordering the project. New sidewalks, whether adjacent to streets or not, must be at least 10 feet wide on retail or mixed-use blocks and at least 5 feet wide on all other blocks. Equivalent provisions for walking include woonerfs and all-weather-surface footpaths at least 5 feet wide. Note that these requirements specify wider sidewalks than required by NPD Prerequisite 1, Walkable Streets.

k. If the project has ground-floor *dwelling units*, the principal floor of at least 50% of those units must have an elevated finished floor no less than 24 inches above the sidewalk grade. Below-grade basement spaces and/or *accessory dwelling units* are exempt from this requirement.

Figure 6. Minimal above-grade entrance requirements



l. In nonresidential or mixed-use projects, 50% or more of the total number of office buildings include ground-floor retail along 60% of the length of the street-level façade; 100% of mixed-use buildings include ground-floor retail, live-work spaces, and/or ground-floor dwelling units along at least 60% of the street-level façade; and all businesses and/or other community services on the ground floor are accessible directly from sidewalks along a public space, such as a street, square, paseo, or plaza, but not a parking lot.

m. At least 40% of all street frontage within the project has a minimum building-height-to-street-width ratio of 1:3 (i.e., a minimum of 1 foot of building height for every 3 feet of street width).

- Nonmotorized rights-of-way may be counted toward the 40% requirement, but 100% of such spaces must have a minimum 1:1 ratio of building height to street width.
- Projects with bordering street frontage must meet only their proportional share of the height-to-width ratio (i.e., only on the project side of the street).
- Street frontage is measured in linear feet.
- Building height is measured to eaves or the top of the roof for a flat-roof structure, and street width is measured façade to façade. For building frontages with multiple heights, use the weighted average height of all frontage segments based on each segment's height weighted by the segment's share of total building width.
- *Alleys* and driveways are excluded.

Design Speeds for Safe Pedestrian and Bicycle Travel

n. 75% of residential-only streets within the project are designed for a target speed of no more than 20 mph (existing streets may be exempted from calculations).

o. 70% of nonresidential and/or mixed-use streets within the project are designed for a target speed of no more than 25 mph. A multiway boulevard, with travel lanes separated from access lanes by medians, may apply this requirement to its outer access lanes only (through-lanes are exempt), provided pedestrian crosswalks are installed across the boulevard at intervals no greater than 800 feet (existing streets may be exempted from calculations).

Sidewalk Intrusions

p. At-grade crossings with driveways account for no more than 10% of the length of sidewalks within the project.

NPD Credit 2: Compact Development

1–6 points

Intent

To encourage development in *existing* areas to conserve land and protect farmland and wildlife habitat. To promote livability, walkability, and transportation efficiency, including reduced *vehicle miles traveled* (VMT). To improve public health encouraging daily physical activity associated with alternative modes of transportation and compact development.

Requirements

Design and build the *project* such that residential and nonresidential components achieve the *densities* per acre of *buildable land* listed in Table 1 (excluding those portions of parking structures devoted to parking).

Table 1. Points for density per acre of buildable land

Residential density (DU/acre)	Nonresidential density (FAR)	Points
> 10 and ≤ 13	> 0.75 and ≤ 1.0	1
> 13 and ≤ 18	> 1.0 and ≤ 1.25	2
> 18 and ≤ 25	> 1.25 and ≤ 1.75	3
> 25 and ≤ 38	> 1.75 and ≤ 2.25	4
> 38 and ≤ 63	> 2.25 and ≤ 3.0	5
> 63	> 3.0	6
DU = dwelling unit; FAR = floor-area ratio.		

The specified densities must be achieved within five years of the date that the first building of any type is occupied.

The scoring of a mixed-use project is calculated with a weighted average, according to the following steps.

1. Determine the total square footage of all residential and nonresidential uses.
2. Calculate the percentage residential and percentage nonresidential of the total square footage.
3. Determine the density of each component as measured in *dwelling units* per acre and *floor-area ratio*, respectively.
4. Referring to Table 1, find the appropriate points for the densities of the residential and nonresidential components.
5. If the points are different, multiply the point value of the residential component by its percentage of the total square footage and multiply the point value of the nonresidential component by its percentage.
6. Add the two scores.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

buildable land the portion of the site where construction can occur, including land voluntarily set aside and not constructed upon. When used in *density* calculations, buildable land excludes public rights-of-way and land excluded from development by codified law or LEED for Neighborhood Development prerequisites. An *applicant* may exclude additional land not exceeding 15% of the buildable land base defined above, provided the following conditions are present:

a. The land is protected from residential and nonresidential construction by easement, deed restriction, or other enforceable legal instrument.

AND

b. Either 25% or more of the boundary of each contiguous parcel proposed for exclusion borders a *water body* or areas outside the *project boundary* that are protected by codified law; or ownership of, or management authority over, the exclusion area is transferred to a public entity.

NPD Credit 3: Mixed-Use Neighborhood Centers

1–4 points

Intent

To cluster diverse land uses in accessible neighborhood and regional centers to encourage daily walking, biking, and transit use, reduce *vehicle miles traveled* (VMT) and automobile dependence, and support car-free living.

Requirements

FOR ALL PROJECTS

Locate and/or design the *project* such that 50% of its *dwelling units* are within a 1/4-mile *walk distance* of the number of diverse uses (see Appendix) in Table 1, including at least one use from each of the four categories. For projects with no dwellings, 50% of dwelling units within 1/4 mile of the *project boundary* must be within a 1/4-mile walk distance of the number of diverse uses specified in Table 1, including at least one food retail store and at least one establishment from each of two other categories. Establishments may be inside or outside the project and may be *existing* or *planned diverse uses*.

The specified number of diverse uses must be in place by the time of occupancy according to the percentages indicated in Table 1 (exclusive of portions of parking structures devoted to parking):

Table 1. Points for diverse uses within 1/4-mile walk distance, by time of occupancy

Diverse uses	Percentage occupancy of total square footage	Points
4–6	20%	1
7–10	30%	2
11–18	40%	3
≥ 19	50%	4

Per neighborhood center, the following restrictions apply:

a. A single establishment may not be counted in two categories or as two types of diverse use (e.g., a place of worship may be counted only once even if it also contains a daycare facility, and a retail store may be counted only once even if it sells products in several categories).

b. Establishments in a mixed-use building may each count if they are distinctly operated enterprises with separate exterior entrances, but no more than half of the minimum number of diverse uses can be situated in a single building or under a common roof.

c. Only two establishments of a single type may be counted (e.g., if five restaurants are within the required distance, only two may be counted).

FOR PROJECTS 40 ACRES OR GREATER

Cluster diverse uses into neighborhood centers as follows:

Table 2. Points for clustering of diverse uses

Diverse uses	Minimum uses per neighborhood center	Points
4–6	3	1
7–10	5	2
11–18	7	3
≥ 19	9	4

Within each neighborhood center, the principal entries of the establishments must be within a 300-foot walk distance from a single common point that represents the center of the cluster (1 or 2 points) or within a 400-foot walk distance (3 or 4 points).

Also, projects with multiple centers must determine points earned based on the number of uses in the centers weighted by the percentage of total dwelling units within a 1/4-mile walk distance from each center's common point.

AND

FOR PROJECTS WITH REGIONAL-SERVING RETAIL OF 150,000 OR MORE SQUARE FEET

Projects with retail uses totaling 150,000 or more square feet, if they have at least one retail establishment totaling 75,000 or more square feet, must also earn a minimum of 1 point under SLL Credit 3, Reduced Automobile Dependence, Option 1, Transit-Served Location (planned transit service can be counted), and for every additional 50,000 square feet of retail above 150,000 square feet, must earn 1 additional point under SLL Credit 3.

If transit service is planned but not yet operational, the project must demonstrate one of the following:

a. The relevant transit agency has a signed full funding grant agreement with the Federal Transit Administration that includes a revenue operations date for the start of transit service. The revenue operations date must be no later than the occupancy date of 50% of the project's total building square footage.

b. For bus, streetcar, *bus rapid transit*, or ferry service, the transit agency must certify that it has an approved budget that includes specifically allocated funds sufficient to provide the planned service at the levels listed above and that service at these levels will commence no later than occupancy of 50% of the project's total building square footage.

c. For rail service other than streetcars, the transit agency must certify that preliminary engineering for a rail line has commenced. In addition, the service must meet either of these two requirements:

   - A state legislature or local subdivision of the state has authorized the transit agency to expend funds to establish rail transit service that will commence no later than occupancy of 50% of the project's total building square footage.

   OR

   - A municipality has dedicated funding or reimbursement commitments from future tax revenue for the development of stations, platforms, or other rail transit infrastructure that will service the project no later than occupancy of 50% of the project's total building square footage.

NPD Credit 4: Mixed-Income Diverse Communities

1–7 points

Intent

To promote socially equitable and engaging communities by enabling residents from a wide range of economic levels, household sizes, and age groups to live in a community.

Requirements

Meet the requirements of one or more options below.

OPTION 1. Diversity of Housing Types

Include a sufficient variety of housing sizes and types in the *project* such that the total variety of planned and *existing* housing within the project achieves a Simpson Diversity Index score greater than 0.5, using the housing categories below. Projects of less than 125 acres may calculate the Simpson Diversity Index for the area within 1/4 mile of the project's geographic center. The Simpson Diversity Index calculates the probability that any two randomly selected *dwelling units* in a project will be of a different type.

Score = $1- \sum (n/N)^2$

where n = the total number of dwelling units in a single category, and N = the total number of dwelling units in all categories.

Table 1. Points for housing diversity

Simpson Diversity Index score	Points
> 0.5 to < 0.6	1
≥ 0.6 to < 0.7	2
≥ 0.7	3

Housing categories are defined according to the dwelling unit's net square footage, exclusive of any garage, as listed in Table 2.

Table 2. Housing categories

Type	Square feet
Detached residential, large	> 1,250
Detached residential, small	≤ 1,250
Duplex or townhouse, large	> 1,250
Duplex or townhouse, small	≤ 1,250
Dwelling unit in multiunit building with no elevator, large	> 1,250
Dwelling unit in multiunit building with no elevator, medium	> 750 to ≤ 1,250
Dwelling unit in multiunit building with no elevator, small	≤ 750
Dwelling unit in multiunit building with elevator, 4 stories or fewer, large	> 1,250
Dwelling unit in multiunit building with elevator, 4 stories or fewer, medium	> 750 to ≤ 1,250
Dwelling unit in multiunit building with elevator, 4 stories or fewer, small	≤ 750
Dwelling unit in multiunit building with elevator, 5 to 8 stories, large	> 1,250
Dwelling unit in multiunit building with elevator, 5 to 8 stories, medium	> 750 to ≤ 1,250
Dwelling unit in multiunit building with elevator, 5 to 8 stories, small	≤ 750
Dwelling unit in multiunit building with elevator, 9 stories or more, large	> 1,250
Dwelling unit in multiunit building with elevator, 9 stories or more, medium	> 750 to ≤ 1,250
Dwelling unit in multiunit building with elevator, 9 stories or more, small	≤ 750
Live-work space, large	> 1,250
Live-work space, small	≤ 1,250
Accessory dwelling unit, large	> 1,250
Accessory dwelling unit, small	≤ 1,250

For the purposes of this credit, townhouse and live-work units may have individual ground-level entrances and/or be within a multiunit or mixed-use building. Double counting is prohibited; each dwelling may be classified in only one category. The number of stories in a building is inclusive of the ground floor regardless of its use.

AND/OR

OPTION 2. Affordable Housing

Include a proportion of new rental and/or for-sale dwelling units priced for households earning below the *area median income* (AMI). Rental units must be maintained at affordable levels for a minimum of 15 years. Existing dwelling units are exempt from requirement calculations. A maximum of 3 points may be earned by meeting any combination of thresholds in Table 3.

Table 3. Points for affordable housing

Rental dwelling units				For-sale dwelling units			
Priced up to 60% AMI		Priced up to 80% AMI		Priced up to 100% AMI		Priced up to 120% AMI	
Percentage of total rental units	**Points**	Percentage of total rental units	**Points**	Percentage of total for-sale units	**Points**	Percentage of total for-sale units	**Points**
5	**1**	10	**1**	5	**1**	8	**1**
10	**2**	15	**2**	10	**2**	12	**2**
15	**3**	25	**3**	15	**3**	--	**--**
AMI = area median income.							

AND/OR

OPTION 3. Mixed-Income Diverse Communities

A project may earn 1 additional point by earning at least 2 points in Option 1 and at least 2 points in Option 2 (at least one of which must be for providing housing at or below 100% AMI).

NPD Credit 5: Reduced Parking Footprint

1 point

Intent

To design parking to increase the pedestrian orientation of *projects* and minimize the adverse environmental effects of parking facilities. To reduce public health risks by encouraging daily physical activity associated with walking and bicycling.

Requirements

For new nonresidential buildings and *multiunit residential* buildings, either do not build new off-street parking lots, or locate all new off-street surface parking lots at the side or rear of buildings, leaving building frontages facing streets free of surface parking lots.

AND

Use no more than 20% of the total *development footprint* area for all new off-street surface parking facilities, with no individual surface parking lot larger than 2 acres. For the purposes of this credit, surface parking facilities include ground-level garages unless they are under *habitable building* space. Underground or multistory parking facilities can be used to provide additional capacity, and on-street parking spaces are exempt from this limitation.

AND

Provide bicycle parking and storage capacity to new buildings as follows:

a. **Multiunit residential.** Provide at least one secure, enclosed bicycle storage space per occupant for 30% of the *planned occupancy* but no fewer than one per unit. Provide secure visitor bicycle racks on-site, with at least one bicycle space per ten *dwelling units* but no fewer than four spaces per project site.

b. **Retail.** Provide at least one secure, enclosed bicycle storage space per new retail worker for 10% of retail worker planned occupancy. Provide visitor or customer bicycle racks on-site, with at least one bicycle space per 5,000 square feet of retail space, but no fewer than one bicycle space per business or four bicycle spaces per project site, whichever is greater. Provide at least one on-site shower with changing facility for any development with 100 or more new workers and at least one additional on-site shower with changing facility for every 150 new workers thereafter.

c. **Nonresidential other than retail.** Provide at least one secure, enclosed bicycle storage space per new occupant for 10% of planned occupancy. Provide visitor bicycle racks on-site with at least one bicycle space per 10,000 square feet of new commercial nonretail space but not fewer than four bicycle spaces per building. Provide at least one on-site shower with changing facility for any development with 100 or more new workers and at least one additional on-site shower with changing facility for every 150 new workers thereafter.

Secure, enclosed bicycle storage areas must be locked and easily accessible to residents and/or workers. Provide informational signage on using the storage facilities.

Visitors' and customers' bicycle racks must be clearly visible from a main entry, located within 100 feet of the door, served with night lighting, and protected from damage from nearby vehicles. If the building has multiple main entries, bicycle racks must be proportionally dispersed within 100 feet of each.

Shower and changing facility requirements may be met by providing the equivalent of free access to on-site health club shower facilities, if the health club can be accessed without going outside. Provide informational signage on using the shower facilities.

AND

Provide carpool and/or shared-use vehicle parking spaces equivalent to 10% of the total automobile parking for each nonresidential and mixed-use building on the site. Signage indicating such parking spots must be provided, and the parking spots must be within 200 feet of entrances to the buildings served.

NPD Credit 6: Street Network

1–2 points

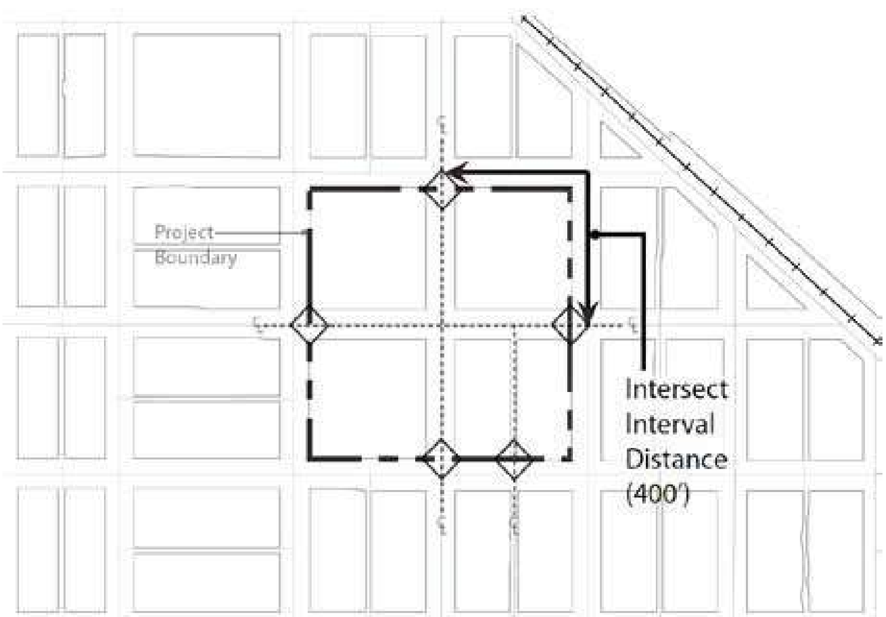
Intent

To promote *projects* that have high levels of internal connectivity and are well connected to the community at large. To encourage development within *existing* communities, thereby conserving land and promoting multimodal transportation. To improve public health by encouraging daily physical activity and reducing the negative effects of motor vehicle emissions.

Requirements

Design and/or locate the project such that a through-street and/or nonmotorized right-of-way intersects or terminates at the *project boundary* at least every 400 feet or at existing abutting street intervals and intersections, whichever is the shorter distance. Include a pedestrian or bicycle through-connection in at least 90% of any new *culs-de-sac*. This does not apply to portions of the boundary where connections cannot be made because of physical obstacles, such as prior platting of property, construction of existing buildings or other barriers, slopes over 15%, *wetlands* and *water bodies*, railroad and utility rights-of-way, existing limited-access motor vehicle rights-of-way, and parks and dedicated open space.

Figure 1. Project site with right-of-way intersects on project boundary at least every 400 feet



AND

Locate and/or design the project such that its internal *connectivity* and/or the connectivity within a 1/4-mile distance of the project boundary falls within one of the ranges listed in Table 1.

Table 1. Points for connectivity

Street intersections per square mile	Points
> 300 and ≤ 400	1
> 400	2

All streets and sidewalks that are counted toward the connectivity requirement must be available for general public use and not gated. Gated areas are not considered available for public use, with the exception of education and health care campuses, and military bases where gates are used for security purposes.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

connectivity connectivity the number of publicly accessible intersections per square mile, including any combination of streets, dedicated alleys, transit rights-of-way, and nonmotorized rights-of-way. If one must both enter and exit an area through the same intersection, such an intersection and any intersections beyond that point are not counted; intersections leading only to culs-de-sac are also not counted. The calculation of square mileage excludes water bodies, parks larger than 1/2 acre, public facility campuses, airports, rail yards, slopes over 15%, and areas nonbuildable under codified law or the rating system. Street rights-of-way may not be excluded.

NPD Credit 7: Transit Facilities

1 point

Intent

To encourage transit use and reduce driving by providing safe, convenient, and comfortable transit waiting areas and safe and secure bicycle storage facilities for transit users.

Requirements

Work with the transit agency or agencies serving the *project* to identify transit stop locations within and/or bordering the *project boundary* where transit agency-approved shelters and any other agency-required improvements, including bicycle racks, will be installed no later than construction of 50% of total project square footage. At those locations, install approved shelters and any required improvements, or provide funding to the transit agency for their installation. Shelters must be covered, be at least partially enclosed to buffer wind and rain, and have seating and illumination. Any required bicycle racks must have a two-point support system for locking the frame and wheels and be securely affixed to the ground or a building.

AND

Work with the transit agency or agencies serving the project to identify locations within and bordering the project boundary where the agency determines that transit stops will be warranted within two years of project completion, either because of increased ridership on *existing* service resulting from the project or because of planned future transit. At those locations, reserve space for transit shelters and any required improvements, including bicycle racks. In lieu of or in addition to new stops, this requirement can be satisfied with a commitment from the transit agency to provide increased service to the transit stops that will have been installed at the time of 50% *build-out*.

AND

Work with the transit agency or agencies serving the project to provide kiosks, bulletin boards, and/or signs that display transit schedules and route information at each public transit stop within and bordering the project.

NPD Credit 8: Transportation Demand Management

1–2 points

Intent

To reduce energy consumption, pollution from motor vehicles, and adverse public health effects by encouraging multimodal travel.

Requirements

FOR ALL PROJECTS

Earn one point for every two options achieved below, for a maximum of two points. For the purposes of this credit, *existing* buildings and their occupants are exempt from the requirements.

OPTION 1. TDM Program

Create and implement a comprehensive transportation demand management (TDM) program for the *project* that reduces weekday peak-period motor vehicle trips by at least 20% compared with a baseline case, and fund the program for a minimum of three years following *build-out* of the project. The TDM program must be prepared by a qualified transportation professional. Any trip reduction effects of Options 2, 3, 4, or 5 may not be included in calculating the 20% threshold.

OR

OPTION 2. Transit Passes

Provide transit passes valid for at least one year, subsidized to be half of regular price or cheaper, to each occupant locating within the project during the first three years of project occupancy (or longer). Publicize the availability of subsidized transit passes are available to project occupants;

OR

OPTION 3. Developer-Sponsored Transit

Provide year-round, *developer*-sponsored private transit service (with vans, shuttles, buses) from at least one central point in the project to other major transit facilities, and/or other destinations such as a retail or *employment center*, with service no less frequent than 45 daily weekday trips and 30 daily weekend trips. The service must begin by the time the project total square footage is 20% occupied and must be guaranteed for at least three years beyond project build-out. Twenty percent occupancy is defined as residents living in 20% of the *dwelling units* and/or employees working in 20% of the total nonresidential square footage.

Provide transit stop shelters and bicycle racks adequate to meet projected demand but no less than one shelter and one bicycle rack at each transit stop. Shelters must be covered, be at least partially enclosed to buffer wind and rain, and have seating and illumination. Bicycle racks must have a two-point support system for locking the frame and wheels and must be securely affixed to the ground or a building.

OR

OPTION 4. Vehicle Sharing

Locate the project such that 50% of the dwelling units and nonresidential building entrances are within a 1/4 mile *walk distance* of at least one vehicle in a vehicle-sharing program. For each vehicle, dedicate one parking space accessible to vehicle-sharing members. Through signage and other means, publicize to project occupants the availability and benefits of the vehicle-sharing program. If the project has more than 100 dwelling units and/or employees and has a minimum transit service of 60 daily weekday trips and 40 daily weekend trips, at least one additional vehicle and parking space for every 100 dwelling units and/or employees must be available. If the project has more than 100 dwelling units and/or employees but does not have transit service at the frequencies specified above, at least one additional vehicle and parking space for every 200 dwelling units and/or employees must be available. Where new vehicle locations are created, a vehicle sharing program must begin by the time the project total square footage is 20% occupied; commit to providing vehicles to the locations for at least two years. Twenty percent occupancy is defined as residents living in 20% of the project dwelling units and/or employees working in 20% of the total nonresidential square footage of the project.

OR

OPTION 5. Unbundling of Parking

For 90% of *multiunit residential* units and/or nonresidential square footage, the associated parking spaces are sold or rented separately from the dwelling units and/or nonresidential square footage.

NPD Credit 9: Access to Civic and Public Space

1 point

Intent

To improve physical and mental health and social capital by providing a variety of open spaces close to work and home to facilitate social networking, civic engagement, physical activity, and time spent outdoors.

Requirements

Locate and/or design the *project* such that a civic or passive-use space, such as a square, *park*, or *plaza*, at least 1/6 acre in area lies within a 1/4-mile *walk distance* of 90% of planned and *existing dwelling units* and nonresidential building entrances. Spaces less than 1 acre must have a proportion no narrower than 1 unit of width to 4 units of length.

AND

For projects larger than 7 acres, locate and/or design the project such that the median size of civic or passive-use spaces within and/or contiguous to the project is at least 1/2 acre.

NPD Credit 10: Access to Recreation Facilities

1 point

Intent

To improve physical and mental health and social capital by providing a variety of recreational facilities close to work and home to facilitate physical activity and social networking.

Requirements

Locate and/or design the *project* so that a publicly accessible outdoor recreation facility at least 1 acre in area, or a publicly accessible indoor recreational facility of at least 25,000 square feet, lies within a 1/2-mile *walk distance* of 90% of new and *existing dwelling units* and nonresidential building entrances. Outdoor recreation facilities must consist of physical improvements and may include "tot lots," swimming pools, and sports fields, such as baseball diamonds.

NPD Credit 11: Visitability and Universal Design

1 point

Intent

To enable the widest spectrum of people, regardless of age or ability, to more easily participate in community life by increasing the proportion of areas usable by people of diverse abilities.

Requirements

OPTION 1. Projects with Dwelling Units

For each new *project dwelling unit* of the following residential building types, design to the applicable requirements specified:

Single dwelling unit buildings. Design a minimum of 20% of the dwelling units (and not less than one) in accordance with ICC/ANSI A117.1, Type C, Visitable Unit, each of which has an open-space plan for primary functions (an area for cooking, eating, and social gathering), as well as a sleeping area and a full bathroom.

Multiunit building with two or three dwelling units. Design a minimum of 20% of the dwelling units (and not less than one) in accordance with ICC/ANSI A117.1, Type C, Visitable Unit, each of which has a kitchen, dining area, living area, full bathroom, and bedroom on the accessible level. If a project has both attached and detached single dwelling unit buildings, the requirements apply to each type separately. Similarly, if a project has both 2- and 3- dwelling unit buildings, the requirements apply to each type.

Multiunit buildings with four or more dwelling units. This category includes mixed-use buildings with dwelling units. Design a minimum of 20% of the dwelling units (and not less than one) to incorporate the universal design requirements stated below, or comply with Option 2. Choose at least one of the following three strategies for universal design:

a. Throughout the home, include at least five of the following universal design features to facilitate universal function, access, and user ability:

- Easy-to-grip lever door handles.
- Easy-to-grip cabinet and drawer loop handles.
- Easy-to-grip locking mechanisms on doors and windows.
- Easy-to-grip single-lever faucet handles.
- Easy-touch rocker or hands-free switches.
- Motion-detector lighting at entrance, in hallways and stairwells, and in closets, and motion-detector light switches in garages, utility spaces, and basements.
- Large, high-contrast print for controls, signals, and the house or unit numbers.
- A built-in shelf, bench, or table with knee space below, located outside the entry door with weather protection overhead, such as porch or stoop with roof, awning, or other overhead covering.
- A minimum 32-inch clear door opening width for all doorways.

- Tread at the entrance, on stairs, and other areas where slipping is common, with color contrast difference between stair treads and risers.
- Interior floor surfaces (e.g., low-pile carpets, hard-surface flooring) that provide easy passage for a wheelchair or walker, with color contrast between floor surfaces and trim. No carpet is permitted in a kitchen, bathroom, or other wet areas of the dwelling unit.

OR

b. On the main floor of the home (or on another floor, if an elevator or stair lift is provided), provide a kitchen with hard-surface flooring, plumbing with single-lever controls, a 5-foot turning radius, and at least four of the following universal design features to facilitate universal function, access, and user-ability:

- Variable-height (28- to 42-inch) or adjustable work surfaces, such as countertops, sinks, and/or cooktops.
- Clear knee space under sink and cooktops (this requirement can be met by installing removable base cabinets or fold-back or self-storing doors), cooktops and ranges with front or side-mounted controls, and wall-mounted ovens at a height to accommodate a seated adult.
- A toe kick area at the base of lower cabinets with a minimum height of 9 inches, and full-extension drawers and shelves in at least half (by volume) of the cabinets.
- Contrasting color treatment between countertops, front edges, and floor.
- Adjustable-height shelves in wall cabinets.
- Glare-free task lighting to illuminate work areas without too much reflectivity.

OR

c. On the main floor of the building (or on another floor, if an elevator or stair lift is provided), include all of the following:

In at least one accessible bedroom,

- Size the room to accommodate a twin bed with a 5-foot turning radius around the bed.
- Install a clothes closet with a 32-inch clear opening with adjustable-height closet rods and shelves.

In at least one full bathroom on the same floor as the bedroom,

- Provide adequate maneuvering space with a 30-by-48-inch clear floor space at each fixture.
- Center the toilet 18 inches from any side wall, cabinet, or tub, and allow a 3-foot clear space in front.
- Install broad blocking in walls around toilet, tub, and/or shower for future placement and relocation of grab bars
- Provide knee space under the lavatory (this requirement may be met by installing removable base cabinets or fold-back or self-storing doors).
- Install a long mirror whose bottom is no more than 36 inches above the finished floor and whose top is at least 72 inches high.

In addition, all bathrooms must have hard-surface flooring, all plumbing fixtures must have single-lever controls, and tubs or showers must have hand-held shower heads.

OR

OPTION 2. Projects with Noncompliant Public Rights-of-Way or Accessible Travel Routes

For projects with only nonresidential components, or residential components that are not within the scope of Option 1, but have public rights-of-way or other publicly accessible travel routes within the project that are not in compliance with Americans with Disabilities Act (for private sector and local and state government facilities) or the Architectural Barriers Act (for federally funded facilities), design, construct, and/or retrofit 100% of the rights-of-way and/or travel routes in accordance with the ADA-ABA Accessibility Guidelines, as applicable.

NPD Credit 12: Community Outreach and Involvement

1–2 points

Intent

To encourage responsiveness to community needs by involving the people who live or work in the community in *project* design and planning and in decisions about how it should be improved or how it should change over time.

Requirements

OPTION 1. Community Outreach (1 point)

Meet with adjacent property owners, residents, business owners, and workers; local planning and community development officials; and any current residents or workers at the project site to solicit and document their input on the proposed project prior to commencing a design.

AND

Work directly with community associations and/or the local government to advertise an open community meeting, other than an official public hearing, to generate comments on project design from the beginning.

AND

Host an open community meeting, other than an official public hearing, to solicit and document public input on the proposed project at the beginning of project design.

AND

Modify the project's conceptual design as a direct result of community input, or if modifications are not made, explain why community input did not generate design modifications.

AND

Establish ongoing means for communication between the *developer* and the community throughout the design and construction phases and, in cases where the developer maintains any control during the postconstruction phase.

OR

OPTION 2. Charrette (2 points)

Comply with Option 1 and conduct a design charrette or interactive workshop of at least two days and open to the public that includes, at a minimum, participation by a representative group of nearby property owners, residents, business owners, and workers in the preparation of conceptual project plans and drawings.

OR

OPTION 3. Local Endorsement Pursuant to Evaluation Program (2 points)

Comply with Option 1 and obtain an endorsement from an ongoing local or regional nongovernmental program that systematically reviews and endorses smart growth development projects under a rating and/or jury system.

NPD Credit 13: Local Food Production

1 point

Intent

To promote community-based food production, improve nutrition through increased access to fresh produce, support preservation of small farms producing a wide variety of crops, reduce the negative environmental effects of large-scale industrialized agriculture, and support local economic development that increases the economic value and production of farmlands and community gardens.

Requirements

FOR ALL PROJECTS

Establish *covenants, conditions, and restrictions* (CC&R) or other forms of deed restrictions which state that the growing of produce is not prohibited in *project* areas, including greenhouses, any portion of residential front, rear, or side yards; or balconies, patios, or rooftops. Greenhouses but not gardens may be prohibited in front yards that face the *street*.

AND

OPTION 1. Neighborhood Farms and Gardens

Dedicate permanent and viable growing space and/or related facilities (such as greenhouses) within the project according to the square footage areas specified in Table 1 (exclusive of *existing* dwellings). Provide solar access, fencing, watering systems, garden bed enhancements (such as raised beds), secure storage space for tools, and pedestrian access for these spaces. Ensure that the spaces are owned and managed by an entity that includes occupants of the project in its decision making, such as a community group, homeowners' association, or public body.

Table 1. Minimum garden space, by project density

Project density (DU/acre)	Growing space (sf/DU)
> 7 and ≤14	200
> 14 and ≤ 22	100
> 22 and ≤ 28	80
> 28 and ≤ 35	70
> 35	60
DU = dwelling unit; sf = square feet.	

Established community gardens outside the *project boundary* but within a 1/2 mile *walk distance* of the project's geographic center can satisfy this option if the garden otherwise meets all of the option requirements.

OR

OPTION 2. Community-Supported Agriculture

Purchase shares in a *community-supported agriculture* (*CSA*) program located within 150 miles of the project site for at least 80% of *dwelling units* within the project (exclusive of existing dwelling units) for two years, beginning with each dwelling unit's occupancy until the 80% threshold is reached. Shares must be delivered to a point within 1/2 mile of the project's geographic center on a regular schedule not less than twice per month at least four months of the year.

OR

OPTION 3. Proximity To Farmers' Market

Locate the project's geographic center within a 1/2-mile walk distance of an existing or planned farmers' market that is open or will operate at least once weekly for at least five months annually. Farmers' market vendors may sell only items grown within 150 miles of the project site. A planned farmers' market must have firm commitments from farmers and vendors that the market will meet all the above requirements and be in full operation by the time of 50% occupancy of the project's total square footage.

NPD Credit 14: Tree-Lined and Shaded Streets

1–2 points

Intent

To encourage walking, bicycling, and transit use and discourage excessive motoring speeds. To reduce urban heat island effects, improve air quality, increase evapotranspiration, and reduce cooling loads in buildings.

Requirements

OPTION 1. Tree-Lined Streets (1 point)

Design and build the *project* to provide street trees on both sides of at least 60% of new and *existing streets* within the project and on the project side of bordering streets, between the vehicle travel way and walkway, at intervals averaging no more than 40 feet (excluding driveways and utility vaults).

AND/OR

OPTION 2. Shaded Streets (1 point)

Trees or other structures provide shade over at least 40% of the length of sidewalks on streets within or contiguous to the project. Trees must provide shade within ten years of landscape installation. Use the estimated crown diameter (the width of the shade if the sun is directly above the tree) to calculate the shaded area.

AND

FOR ALL PROJECTS INVOLVING STREET TREE PLANTINGS

Obtain a registered landscape architect's determination that planting details are appropriate to growing healthy trees, taking into account tree species, root medium, and width and soil volume of planter strips or wells, and that the selected tree species are not considered *invasive* in the project context according to USDA or the state agricultural extension service.

NPD Credit 15: Neighborhood Schools

1 point

Intent

To promote community interaction and engagement by integrating *schools* into the neighborhood. To support students' health by encouraging walking and bicycling to school.

Requirements

Include in the *project* a residential component that constitutes at least 30% of the project's total building square footage, and locate or design the project such that at least 50% of the *dwelling units* are within a 1/2-mile *walk distance* of an *existing* or new elementary or middle school building entrance or within a 1-mile walk distance of an existing or new high school building entrance. For any new school, the school district or equivalent organization must commit in a legally binding warrant that the school will be open by the time of occupancy of 50% of the project dwelling units.

Streets within and/or bordering the *project boundary* that lead from dwelling units to the school site must have a complete network of sidewalks on both sides and either bicycle lanes or traffic control and/or calming measures. If the school is planned as part of the project, it must be designed such that pedestrians and cyclists can easily reach building entrances without crossing bus zones, parking entrances, and student drop-off areas.

AND

New school campuses must not exceed the following:

- High schools, 15 acres.
- Middle schools, 10 acres.
- Elementary schools, 5 acres.

Schools combining grade levels from more than one category may use the grade level with the higher allowable acreage.

Facilities on the school site for which there is a formal joint-use agreement with another entity, such as athletic facilities, playgrounds, and multipurpose spaces in buildings, may be deducted from the total site area of the school.

GREEN INFRASTRUCTURE AND BUILDINGS

GIB Prerequisite 1: Certified Green Building

Required

Intent

To encourage the design, construction, and retrofit of buildings that utilize green building practices.

Requirements

Design, construct, or retrofit one whole building within the *project* to be certified through LEED for New Construction, LEED for Existing Buildings: Operations & Maintenance, LEED for Homes, LEED for Schools, LEED for Retail: New Construction, or LEED for Core and Shell (with at least 75% of the floor area certified under LEED for Commercial Interiors or LEED for Retail: Commercial Interiors), or through a green building rating system requiring review by independent, impartial, third-party certifying bodies that have either been accredited by an IAF accreditation body to, or could demonstrate compliance to, ISO 17021 or ISO/IEC Guide 65, and, when subsequently available, ISO/IEC 17065.

GIB Prerequisite 2: Minimum Building Energy Efficiency

Required

Intent

To encourage the design and construction of energy-efficient buildings that reduce air, water, and land pollution and adverse environmental effects from energy production and consumption.

Requirements

The following requirement applies to 90% of the building floor area (rounded up to the next whole building) of all nonresidential buildings, mixed-use buildings, and *multiunit residential* buildings four stories or more constructed as part of the *project* or undergoing major renovations as part of the project.

New buildings must demonstrate an average 10% improvement over ANSI/ASHRAE/IESNA Standard 90.1–2007 (with errata but without addenda). Buildings undergoing major renovations must demonstrate an average 5% improvement over ANSI/ASHRAE/IESNA Standard 90.1–2007.

Projects must document building energy efficiency using one or a combination of the following:

a. Produce a LEED-compliant energy model following the methodology outlined in the LEED rating system appropriate to each building's scope, including demonstration by a whole building project computer simulation using the building performance rating method in Appendix G of ANSI/ASHRAE/IESNA Standard 90.1–2007. Appendix G requires that the energy analysis done for the building performance rating method include all energy costs associated with the building project. Projects in California may use Title 24–2005, Part 6, in place of ANSI/ASHRAE/IESNA Standard 90.1–2007.

b. Comply with the prescriptive measures of the ASHRAE Advanced Energy Design Guide listed below, appropriate to each building's scope. Comply with all applicable criteria as established in the guide for the climate zone in which the project is located.

   - ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004 (office occupancy buildings less than 20,000 square feet).
   - ASHRAE Advanced Energy Design Guide for Small Retail Buildings 2006 (retail occupancy buildings less than 20,000 square feet).
   - ASHRAE Advanced Energy Design Guide for Small Warehouses and Self-Storage Buildings 2008 (warehouse or self-storage occupancy less than 50,000 square feet).
   - ASHRAE Advanced Energy Design Guide for K–12 School Buildings (K–12 school occupancy less than 200,000 square feet).

c. For buildings less than 100,000 square feet, comply with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute, as follows:

   - Comply with Section 1, Design Process Strategies, and Section 2, Core Performance Requirements, of the Core Performance Guide.
   - Health care, warehouse and laboratory projects are ineligible for this path.

If method (a) is used for all of the floor area evaluated in this prerequisite, the total percentage improvement is calculated as a sum of energy costs for each building compared with a baseline. If any combination of methods (a), (b), and (c) is used, the total percentage improvement is calculated as a weighted average based on building floor area. In determining the weighted average, buildings pursuing (a) will be credited at the percentage value determined by the energy model. Buildings pursuing (b) or (c) will be credited at 12% better than ANSI/ASHRAE/IESNA Standard 90.1–2007 for new buildings and 8% better for *existing* building renovations.

AND

For new *single-family residential* buildings and new multiunit residential buildings three stories or fewer, 90% of the buildings must meet ENERGY STAR or equivalent criteria. Projects may demonstrate compliance with ENERGY STAR criteria through the prescriptive requirements of a Builder Option Package, the *Home Energy Rating System* (*HERS*) index, or a combination of the two.

Project teams wishing to use ASHRAE-approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.

GIB Prerequisite 3: Minimum Building Water Efficiency

Required

Intent

To reduce effects on natural water resources and reduce burdens on community water supply and wastewater systems.

Requirements

For nonresidential buildings, mixed-use buildings, and multifamily residential buildings four stories or more:

Indoor water usage in new buildings and buildings undergoing major renovations as part of the *project* must be an average 20% less than in baseline buildings. The baseline usage is based on the requirements of the Energy Policy Act of 1992 and subsequent rulings by the Department of Energy, the requirements of the Energy Policy Act of 2005, and the fixture performance standards in the 2006 editions of the Uniform Plumbing Code or International Plumbing Code as to fixture performance. Calculations are based on estimated occupant usage and include only the following fixtures and fixture fittings (as applicable to the project scope): water closets (toilets), urinals, lavatory faucets, showers, kitchen sink faucets, and prerinse spray valves.

The water efficiency threshold is calculated as a weighted average of water usage for the buildings constructed as part of the project based on their conditioned square footage. Projects may also follow the LEED for Multiple Buildings and On-Campus Building Application Guide alternative calculation methodology to show compliance with this prerequisite.

Table 1. National efficiency baselines

Commercial fixtures, fittings, or appliances	Baseline water usage
Commercial toilet	1.6 gpf[1] Except blow-out fixtures, 3.5 gpf
Commercial urinal	1.0 gpf
Commercial lavatory (restroom) faucet	2.2 gpm at 60 psi, private applications only (hotel-motel guest rooms, hospital patient rooms) 0.5 gpm at 60 psi[2] all others except private applications 0.25 gallons per cycle for metering faucets
Commercial prerinse spray valve (for food service applications)	Flow rate ≤ 1.6 gpm (no pressure specified; no performance requirement)

[1] EPAct 1992 standard for toilets applies to both commercial and residential models.
[2] In addition to EPAct requirements, the American Society of Mechanical Engineers standard for public lavatory faucets is 0.5 gpm at 60 psi (ASME A112.18.1-2005). This maximum has been incorporated into the national Uniform Plumbing Code and the International Plumbing Code.

Residential Fixtures, Fittings, and Appliances	Baseline water usage
Residential toilet	1.6 gpf[3]
Residential lavatory (bathroom) faucet	2.2 gpm at 60 psi
Residential kitchen faucet	
Residential showerhead	2.5 gpm at 80 psi per shower stall4

gpf = gallons per flush; psi = pounds per square inch.
Source: Adapted from information developed and summarized by the U.S. EPA Office of Water.
[3] EPAct 1992 standard for toilets applies to both commercial and residential models.
[4] Residential shower compartment (stall) in dwelling units: The total allowable flow rate from all flowing showerheads at any given time, including rain systems, waterfalls, bodysprays, bodyspas, and jets, shall be limited to the allowable showerhead flow rate as specified above (2.5-gpm) per shower compartment, where the floor area of the shower compartment is less than 2,500 sq.in. For each increment of 2,500 sq.in. of floor area thereafter or part thereof, an additional showerhead with total allowable flow rate from all flowing devices equal to or less than the allowable flow rate as specified above shall be allowed. Exception: Showers that emit recirculated non-potable water originating from within the shower compartment while operating are allowed to exceed the maximum as long as the total potable water flow does not exceed the flow rate as specified above.

The following fixtures, fittings, and appliances are outside the scope of the water use reduction calculation:

a. Commercial steam cookers.
b. Commercial dishwashers.
c. Automatic commercial ice makers.
d. Commercial (family-sized) clothes washers.
e. Residential clothes washers.
f. Standard and compact residential dishwashers.

AND

For new *single-family residential* buildings and new *multiunit residential* buildings three stories or fewer, 90% of buildings must use a combination of fixtures that would earn 3 points under LEED for Homes 2008 WE Credit 3, Indoor Water Use.

GIB Prerequisite 4: Construction Activity Pollution Prevention

Required

Intent

To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust generation.

Requirements

Create and implement an erosion and sedimentation control plan for all new construction activities associated with the *project*. The plan must incorporate practices such as phasing, seeding, grading, mulching, filter socks, stabilized site entrances, preservation of *existing* vegetation, and other best management practices (BMPs) to control erosion and sedimentation in runoff from the entire project site during construction. The plan must list the BMPs employed and describe how they accomplish the following objectives:

a. Prevent loss of soil during construction by stormwater runoff and/or wind erosion, including but not limited to stockpiling of topsoil for reuse.

b. Prevent sedimentation of any affected stormwater conveyance systems or receiving streams.

c. Prevent polluting the air with dust and particulate matter.

The erosion and sedimentation control plan must describe how the project team will do the following:

a. Preserve vegetation and mark clearing limits.

b. Establish and delineate construction access.

c. Control flow rates.

d. Install sediment controls.

e. Stabilize soils.

f. Protect slopes.

g. Protect drain inlets.

h. Stabilize channels and outlets.

i. Control pollutants.

j. Control dewatering.

k. Maintain the BMPs.

l. Manage the erosion and sedimentation control plan.

The BMPs must be selected from the Washington State Department of Ecology's *Stormwater Management Manual for Western Washington, Volume II, Construction Stormwater Pollution Prevention* (2005 edition), or a locally approved equivalent, whichever is more stringent, and must comply with all federal, state, and local erosion and sedimentation control regulations.

GIB Credit 1: Certified Green Buildings

1–5 points

Intent

To encourage the design, construction, and retrofit of buildings that utilize green building practices.

Requirements

OPTION 1. Projects with 10 or Fewer Habitable Buildings

Design, construct, or retrofit one building as part of the *project*, beyond the prerequisite, to be certified under one of the following LEED green building rating systems: LEED for New Construction, LEED for Existing Buildings, LEED for Homes, LEED for Schools, LEED for Retail: New Construction, or LEED for Core & Shell (with at least 75% of the floor area certified under LEED for Commercial Interiors or LEED for Retail: Commercial Interiors) or through a green building rating system requiring review by independent, impartial, third-party certifying bodies that have either been accredited by an IAF accreditation body to, or could demonstrate compliance to, ISO 17021 or ISO/IEC Guide 65, and, when subsequently available, ISO/IEC 17065.

OR

OPTION 2. Projects of All Sizes

Design, construct, or retrofit a percentage of the total project building square footage, beyond the prerequisite requirement, to be certified under one of the LEED green building rating systems listed above or through a green building rating system requiring review by independent, impartial, third-party certifying bodies that have either been accredited by an IAF accreditation body to, or could demonstrate compliance to, ISO 17021 or ISO/IEC Guide 65, and, when subsequently available, ISO/IEC 17065.

Table 1. Points for green building certification

Percentage of square footage certified	Points
≥ 10% and < 20%	1
≥ 20% and < 30%	2
≥ 30% and < 40%	3
≥ 40% and < 50%	4
≥ 50%	5

AND

FOR ALL PROJECTS

Detached *accessory dwelling units* must be counted as separate buildings. Accessory dwellings attached to a main building are not counted separately.

GIB Credit 2: Building Energy Efficiency

2 points

Intent

To encourage the design and construction of energy-efficient buildings that reduce air, water, and land pollution and adverse environmental effects from energy production and consumption.

Requirements

The following requirement applies to 90% of the building floor area (rounded up to the next whole building) of all nonresidential buildings, mixed-use buildings, and *multiunit residential* buildings four stories or more constructed as part of the *project* or undergoing major renovations as part of the project.

New buildings must demonstrate an average 18% (1 point) or 26% (2 points) improvement over ANSI/ASHRAE/IESNA Standard 90.1–2007 (with errata but without addenda). Buildings undergoing major renovations as part of the project must demonstrate an average 14% (1 point) or 22% (2 points) improvement over ANSI/ASHRAE/IESNA Standard 90.1–2007.

Projects must document building energy efficiency using one or a combination of the following:

a. Produce a LEED-compliant energy model following the methodology outlined in the LEED rating system appropriate to each building's scope, including demonstration by a whole building project computer simulation using the building performance rating method in Appendix G of ANSI/ASHRAE/IESNA Standard 90.1–2007. Appendix G requires that the energy analysis done for the building performance rating method include all energy costs associated with the building project. Projects in California may use Title 24–2005, Part 6, in place of ANSI/ASHRAE/IESNA Standard 90.1–2007.

b. Comply with the prescriptive measures of the ASHRAE Advanced Energy Design Guide listed below, appropriate to each building's scope. Comply with all applicable criteria as established in the guide for the climate zone in which the project is located.

   - ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004 (office occupancy buildings less than 20,000 square feet).
   - ASHRAE Advanced Energy Design Guide for Small Retail Buildings 2006 (retail occupancy buildings less than 20,000 square feet).
   - ASHRAE Advanced Energy Design Guide for Small Warehouses and Self-Storage Buildings 2008 (warehouse or self-storage occupancy less than 50,000 square feet).
   - ASHRAE Advanced Energy Design Guide for K–12 School Buildings (K–12 school occupancy less than 200,000 square feet).

c. For buildings less than 100,000 square feet, comply with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute, as follows:

   - Comply with Section 1, Design Process Strategies, and Section 2, Core Performance Requirements, of the Core Performance Guide.
   - Health care, warehouse and laboratory projects are ineligible for this path.

If method (a) is used for all of the floor area evaluated in this prerequisite, the total percentage improvement is calculated as a sum of energy costs for each building compared with a baseline. If any combination of methods (a), (b), and (c) is used, the total percentage improvement is calculated as a weighted average based on building floor area. In determining the weighted average, buildings pursuing (a) will be credited at the percentage value determined by the energy model. Buildings pursuing (b) or (c) will be credited at 12% better than ANSI/ASHRAE/IESNA Standard 90.1–2007 for new buildings and 8% better for *existing* building renovations.

AND

For new *single-family residential* buildings and new multiunit residential buildings three stories or fewer, 90% of the buildings must achieve a *Home Energy Rating System* (*HERS*) index score of at least 75.

Project teams wishing to use ASHRAE-approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.

GIB Credit 3: Building Water Efficiency

1 point

Intent

To reduce effects on natural water resources and reduce burdens on community water supply and wastewater systems.

Requirements

For nonresidential buildings, mixed-use buildings, and multifamily residential buildings four stories or more:

Indoor water usage in new buildings and buildings undergoing major renovations as part of the *project* must be an average 40% less than in baseline buildings. The baseline usage is based on the requirements of the Energy Policy Act of 1992 and subsequent rulings by the Department of Energy, the requirements of the Energy Policy Act of 2005, and the fixture performance standards in the 2006 editions of the Uniform Plumbing Code or International Plumbing Code as to fixture performance. Calculations are based on estimated occupant usage and include only the following fixtures and fixture fittings (as applicable to the project scope): water closets (toilets), urinals, lavatory faucets, showers, kitchen sink faucets, and prerinse spray valves.

The water efficiency threshold is calculated as a weighted average of water usage for the buildings constructed as part of the project based on their conditioned square footage. Projects may also follow the LEED for Multiple Buildings and On-Campus Building Application Guide alternative calculation methodology to show compliance with this credit.

Table 1. National efficiency baselines

Commercial fixtures, fittings, or appliances	Baseline water usage
Commercial toilet	1.6 gpf[1] Except blow-out fixtures, 3.5 gpf
Commercial urinal	1.0 gpf
Commercial lavatory (restroom) faucet	2.2 gpm at 60 psi, private applications only (hotel-motel guest rooms, hospital patient rooms) 0.5 gpm at 60 psi[2] all others except private applications 0.25 gallons per cycle for metering faucets
Commercial prerinse spray valve (for food service applications)	Flow rate ≤ 1.6 gpm (no pressure specified; no performance requirement)

[1] EPAct 1992 standard for toilets applies to both commercial and residential models.
[2] In addition to EPAct requirements, the American Society of Mechanical Engineers standard for public lavatory faucets is 0.5 gpm at 60 psi (ASME A112.18.1-2005). This maximum has been incorporated into the national Uniform Plumbing Code and the International Plumbing Code.

Residential Fixtures, Fittings, and Appliances	Baseline water usage
Residential toilet	1.6 gpf[3]
Residential lavatory (bathroom) faucet	2.2 gpm at 60 psi
Residential kitchen faucet	
Residential showerhead	2.5 gpm at 80 psi per shower stall4

gpf = gallons per flush; psi = pounds per square inch.
Source: Adapted from information developed and summarized by the U.S. EPA Office of Water.
[3] EPAct 1992 standard for toilets applies to both commercial and residential models.
[4] Residential shower compartment (stall) in dwelling units: The total allowable flow rate from all flowing showerheads at any given time, including rain systems, waterfalls, bodysprays, bodyspas, and jets, shall be limited to the allowable showerhead flow rate as specified above (2.5-gpm) per shower compartment, where the floor area of the shower compartment is less than 2,500 sq.in. For each increment of 2,500 sq.in. of floor area thereafter or part thereof, an additional showerhead with total allowable flow rate from all flowing devices equal to or less than the allowable flow rate as specified above shall be allowed. Exception: Showers that emit recirculated non-potable water originating from within the shower compartment while operating are allowed to exceed the maximum as long as the total potable water flow does not exceed the flow rate as specified above.

The following fixtures, fittings, and appliances are outside the scope of the water use reduction calculation:

a. Commercial steam cookers.
b. Commercial dishwashers.
c. Automatic commercial ice makers.
d. Commercial (family-sized) clothes washers.
e. Residential clothes washers.
f. Standard and compact residential dishwashers.

AND

For new *single-family residential* buildings and new *multiunit residential* buildings three stories or fewer, 90% of buildings must use a combination of fixtures that would earn 5 points under LEED for Homes 2008 WE Credit 3, Indoor Water Use.

GIB Credit 4: Water-Efficient Landscaping

1 point

Intent

To limit or eliminate the use of *potable water* and other natural surface or subsurface water resources on *project* sites, for landscape irrigation.

Requirements

Reduce water consumption for outdoor landscape irrigation by 50% from a calculated midsummer baseline case. Reductions may be attributed to any combination of the following strategies, among others:

a. Plant species, plant density, and microclimate factor.

b. Irrigation efficiency.

c. Use of captured rainwater.

d. Use of recycled wastewater.

e. Use of water treated and conveyed by a public agency specifically for nonpotable uses.

f. Use of other nonpotable water sources, such as stormwater, air-conditioning condensate, and foundation drain water.

Projects with no new or *existing* landscape irrigation requirements automatically meet the credit requirements.

Groundwater seepage that is pumped away from the immediate vicinity of buildings slabs and foundations can be used for landscape irrigation and meet the intent of this credit. However, it must be demonstrated that doing so does not affect site stormwater management systems.

GIB Credit 5: Existing Building Reuse

1 point

Intent

To extend the life cycle of *existing* building stock to conserve resources, reduce waste, and reduce adverse environmental effects of new buildings related to materials manufacturing and transport.

Requirements

Reuse the existing *habitable building* stock, achieving the greater of the following two benchmarks (based on surface area):

a. 50% of one existing building structure (including structural floor and roof decking) and envelope (including exterior skin and framing but excluding window assemblies and nonstructural roofing material).

b. 20% of the total existing building stock (including structure and envelope, as defined above).

Hazardous materials that are remediated as a part of the *project* scope must be excluded from the calculations.

AND

FOR ALL PROJECTS

Do not demolish any *historic buildings*, or portions thereof, or alter any *cultural landscapes* as part of the project.

An exception is granted only if such action has been approved by an appropriate review body. For buildings listed locally, approval must be granted by the local historic preservation review board, or equivalent. For buildings listed in a state register or in the National Register of Historic Places, approval must appear in a programmatic agreement with the State Historic Preservation Office.

GIB Credit 6: Historic Resource Preservation and Adaptive Use

1 point

Intent

To encourage the preservation and adaptive use of *historic buildings* and *cultural landscapes* that represent significant embodied energy and cultural value, in a manner that preserves historic materials and character-defining features.

Requirements

To achieve this credit, at least one historic building or cultural landscape must be present on the *project* site.

Do not demolish any historic buildings, or portions thereof, or alter any cultural landscapes as part of the project.

An exception is granted only if such action has been approved by an appropriate review body. For buildings or landscapes listed locally, approval must be granted by the local historic preservation review board, or equivalent. For buildings or landscapes listed in a state register or in the National Register of Historic Places, approval must appear in a programmatic agreement with the State Historic Preservation Office.

If any historic building in the project site is to be rehabilitated, rehabilitate in accordance with local review or federal standards for rehabilitation, whichever is more restrictive, using one of the following approaches:

a. Obtain approval, in the form of a "certificate of appropriateness," from a locally appointed historic preservation commission or architectural review board for any exterior alterations or additions.

b. If federal funds are used for the project, obtain confirmation from a state historic preservation office or the National Park Service that the rehabilitation satisfies the Secretary of the Interior's Standards for Rehabilitation.

c. If a building or site is listed in or determined eligible for the National Register of Historic Places but is not subject to federal or local review board review, include on the project team a preservation professional who meets the federal qualifications for historic architect and attests to conformance to the Secretary of the Interior's Standards for the Treatment of Historic Properties.

GIB Credit 7: Minimized Site Disturbance in Design and Construction

1 point

Intent

To preserve *existing* noninvasive trees, *native plants*, and pervious surfaces.

Requirements

OPTION 1. Development Footprint on Previously Developed Land

Locate 100% of the *development footprint* on areas that are *previously developed* and for which 100% of the *construction impact zone* is previously developed.

OR

OPTION 2. Undeveloped Portion of Project Left Undisturbed

Depending on the *density* of the *project*, do not develop or disturb a portion of the land that has not been previously developed on the site, exclusive of any land preserved by codified law or a prerequisite of LEED for Neighborhood Development; or exempt areas designated as nonbuildable in land-use comprehensive plans and stipulate in *covenants, conditions, and restrictions* (CC&R) or other binding documents that the undisturbed area will be protected from development in perpetuity. Densities and minimum percentages are as follows (mixed-use projects must use the lowest applicable density or calculate a weighted average per the methodology in NPD Credit 2, Compact Development):

Table 1. Minimum undeveloped area, by project density

Residential density (DU/acre)	Nonresidential density (FAR)	Minimum area left undisturbed
< 15	< .50	20%
15 – 21	.50 – 1.0	15%
> 21	> 1.0	10%
DU = dwelling unit; FAR = floor-area ratio.		

For portions of the site that are not previously developed, identify construction impact zones that limit disturbance to a minimum of 40 feet beyond the building perimeter; 10 feet beyond surface walkways, patios, surface parking and utilities less than 12 inches in diameter; 15 feet beyond *street* curbs and main utility branch trenches; and 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater retention facilities, and playing fields) that require additional staging areas to limit compaction in the constructed zone.

AND

FOR ALL PROJECTS

Survey the site to identify the following:

a. Trees in good or excellent condition, as determined by an arborist certified by the International Society of Arboriculture (ISA).

b. Any heritage or champion trees of special importance to the community because of their age, size, type, historical association, or horticultural value, as defined by a government forester.

c. All trees larger than 6 inches in diameter at breast height (dbh, 4 feet 6 inches above ground).

d. Any *invasive* tree species present on the site, and whether those trees threaten the health of other trees to be preserved on the site, as determined by an ISA-certified arborist.

Preserve the following trees that are also identified as in good or excellent condition:

a. All heritage or champion trees and trees whose dbh exceeds 50% of the state champion dbh for the species.

b. A minimum of 75% of all noninvasive trees (including the above) larger than 18 inches dbh.

c. A minimum of 25% of all noninvasive trees (including the above) larger than 12 inches dbh if deciduous, and 6 inches dbh if coniferous.

Tree condition ratings must be based on assessment by an ISA-certified arborist using ISA-approved assessment measures.

Develop a plan, in consultation with and approved by an ISA-certified arborist, for the health of the trees, including fertilization and pruning, and for their protection during construction. The plan must include protective fencing located 1 foot for each 1-inch caliper from the trunk or at the tree drip line, whichever is larger, and specify that if trenching or other disturbance is necessary within the protected zone, this work must be done by hand. If disturbance includes a permanent excavation of 3 feet or deeper, the excavation must start from a point not closer than 15 feet from the tree's drip line. If an ISA-certified arborist has determined that any trees to be preserved are threatened by invasive vegetation, develop a plan to reduce the invasive vegetation to the maximum extent possible. Stipulate in CC&R or other binding documents that the undisturbed area of the preserved trees will be protected from development in perpetuity.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

previously developed altered by paving, construction, and/or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Previously developed land includes a platted lot on which a building was constructed if the lot is no more than 1 acre; previous development on lots larger than 1 acre is defined as the *development footprint* and land alterations associated with the footprint. Land that is not previously developed and altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land. The date of previous development permit issuance constitutes the date of previous development, but permit issuance in itself does not constitute previous development.

GIB Credit 8: Stormwater Management

1–4 points

Intent

To reduce pollution and hydrologic instability from stormwater, reduce flooding, promote aquifer recharge, and improve water quality by emulating natural hydrologic conditions.

Requirements

Implement a comprehensive stormwater management plan for the *project* that retains on-site, through infiltration, evapotranspiration, and/or reuse, the rainfall volumes listed in Table 1. Rainfall volume is based on the project's *development footprint*, any other areas that have been graded so as to be effectively impervious, and any pollution-generating pervious surfaces, such as landscaping, that will receive treatments of fertilizers or pesticides.

The percentile rainfall event (Table 1) is the total rainfall on a given day in the record that is greater than or equal to X percent of all rainfall events over a 20- to 40+-year period. For example, a 95th percentile event in a particular region might be 1.5 inches, which would then be the volume to retain. To determine the volume to be retained, projects may use NOAA's published national rainfall data, run an approved stormwater model, or independently gather local rain gauge data and rank rainfall events. One hundred percent of the water volume from rainfall events up to the X percentile event must not be discharged to surface waters unless the harvested and reused runoff is authorized for discharge or allowed to be discharged into sanitary treatment systems.

Table 1. Points for retaining stormwater on-site

Percentile rainfall event (determines total volume from development footprint to be retained)	Points
80th percentile	1
85th percentile	2
90th percentile	3
95th percentile	4

Projects that earn at least 2 points under this credit may earn 1 additional point by meeting one of the following site characteristics:

a. The project is located on a *previously developed site* (1 point).

b. The project is located on a site that meets the definition of *brownfield* in SLL Credit 2, Brownfields Redevelopment (1 point).

c. The project is designed to be transit ready by achieving the following (1 point):

- At least 2 points under NPD Credit 1, Walkable Streets.
- At least 2 points under NPD Credit 2, Compact Development.
- At least 2 points under NPD Credit 3, Mixed-Use Neighborhood Centers.

Select BMPs from the *Washington State Department of Ecology's Stormwater management Manual for Western Washington, Volume V, Run off Treatment (2005 edition)*, or locally approved equivalent, whichever is more stringent. If the BMPs are comparable in stringency, choose BMPs that are most appropriate to the project site and region. BMPs must also comply with all federal, state, and local regulations.

For stormwater reuse systems not on a combined stormwater and sewer system, the total water reused for indoor use must not exceed 90% of the average annual rainfall.

Stormwater BMPs (except cisterns) must be designed to drain down within 72 hours.

GIB Credit 9: Heat Island Reduction

1 point

Intent

To reduce heat islands to minimize effects on the microclimate and human and wildlife habitat.

Requirements

OPTION 1. Nonroof Measures

Use any combination of the following strategies for 50% of the nonroof site hardscape (including roads, sidewalks, courtyards, parking lots, parking structures, and driveways):

a. Provide shade from open structures, such as those supporting solar photovoltaic panels, canopied walkways, and vine pergolas, all with a solar reflectance index (SRI) of at least 29.

b. Use paving materials with an SRI of at least 29.

c. Install an open-grid pavement system that is at least 50% pervious.

d. Provide shade from tree canopy (within ten years of landscape installation).

OR

OPTION 2. High-Reflectance and Vegetated Roofs

Use roofing materials that have an SRI equal to or greater than the values in Table 1 for a minimum of 75% of the roof area of all new buildings within the *project*; or install a vegetated ("green") roof for at least 50% of the roof area of all new buildings within the project. Combinations of SRIcompliant and vegetated roofs can be used provided they satisfy the equation in Option 3.

Table 1. Minimum solar reflectance index value, by roof slope

Roof slope	SRI
Low (≤ 2:12)	78
Steep (> 2:12)	29

OR

OPTION 3. Mixed Nonroof and Roof Measures

Use any of the strategies listed under Options 1 and 2 that in combination meet the following criterion:

$$\frac{\text{Area of Nonroof Measures}}{0.5} + \frac{\text{Area of SRI Roof}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Site Hardscape Area} + \text{Total Roof Area}$$

GIB Credit 10: Solar Orientation

1 point

Intent

To encourage energy efficiency by creating optimum conditions for the use of passive and active solar strategies.

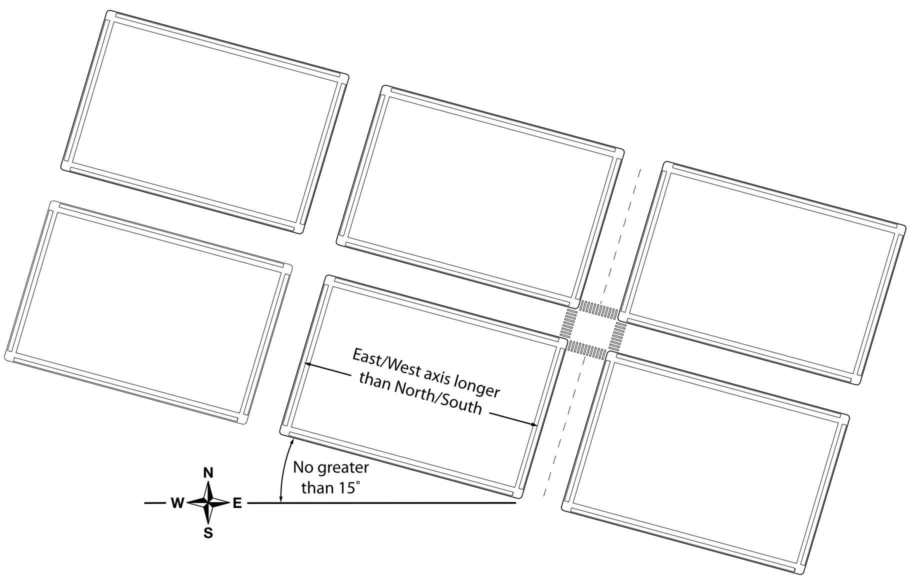
Requirements

OPTION 1. Block Orientation (For Projects Earning at Least 2 Points Under NPD Credit 2, Compact Development)

Locate the *project* on *existing block*s or design and orient the project such that 75% or more of the blocks have one axis within plus or minus 15 degrees of geographical east-west, and the east-west lengths of those blocks are at least as long as the north-south lengths of the blocks.

Earn at least 2 points under NPD Credit 2, Compact Development.

Figure 1. Solar-oriented blocks with east-west lengths equal to or greater than north-south lengths, and east-west axis within 15 degrees of geographic east-west

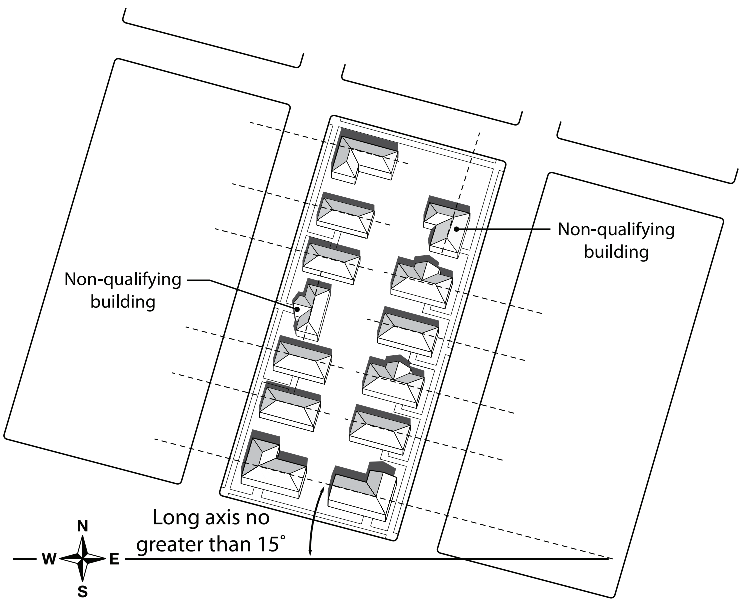


OR

OPTION 2. Building Orientation (Available For All Projects)

Design and orient 75% or more of the project's total building square footage (excluding existing buildings) such that one axis of each qualifying building is at least 1.5 times longer than the other, and the longer axis is within 15 degrees of geographical east-west. The length-to-width ratio applies only to walls enclosing conditioned spaces; walls enclosing unconditioned spaces, such as garages, arcades, or porches, cannot contribute to credit achievement. The surface area of equator-facing vertical surfaces and slopes of roofs of buildings counting toward credit achievement must not be more than 25% shaded at the time of initial occupancy, measured at noon on the winter solstice.

Figure 2. Solar-oriented buildings with longer axis (at least 1.5 times length of other axis) within 15 degrees of geographic east-west



GIB Credit 11: On-Site Renewable Energy Sources

1–3 points

Intent

To encourage on-site renewable energy production to reduce the adverse environmental and economic effects associated with fossil fuel energy production and use.

Requirements

Incorporate on-site nonpolluting renewable energy generation, such as solar, wind, geothermal, small-scale or micro hydroelectric, and/or biomass, with production capacity of at least 5% of the *project's* annual electrical and thermal energy cost (exclusive of *existing* buildings), as points are awarded as listed in Table 1.

Table 1. Points for on-site renewable energy generation

Percentage of annual electrical and thermal energy cost	Points
5%	1
12.5%	2
20%	3

GIB Credit 12: District Heating and Cooling

2 points

Intent

To encourage the development of energy-efficient neighborhoods by employing district heating and cooling strategies that reduce energy use and adverse energy-related environmental effects.

Requirements

Incorporate a district heating and/or cooling system for space conditioning and/or water heating of new buildings (at least two buildings total) such that at least 80% of the *project's* annual heating and/or cooling consumption is provided by the district plant. *Single-family residential* buildings and *existing* buildings of any type may be excluded from the calculation.

Each system component that is addressed by ANSI/ASHRAE/IESNA Standard 90.1–2007 must have an overall efficiency performance at least 10% better than that specified by the standard's prescriptive requirements. Additionally, annual district pumping energy consumption that exceeds 2.5% of the annual thermal energy output of the heating and cooling plant (with 1 kWh of electricity equal to 3,413 Btus) must be offset by increases in the component's efficiency beyond the specified 10% improvement. Combined heat and power (CHP) district systems can achieve this credit by demonstrating equivalent performance.

GIB Credit 13: Infrastructure Energy Efficiency

1 point

Intent

To reduce adverse environmental effects from energy used for operating public infrastructure.

Requirements

Design, purchase, or work with the municipality to install all new infrastructure, including but not limited to traffic lights, *street* lights, and water and wastewater pumps, to achieve a 15% annual energy reduction below an estimated baseline energy use for this infrastructure. The baseline is calculated with the assumed use of lowest first-cost infrastructure items.

GIB Credit 14: Wastewater Management

1–2 points

Intent

To reduce pollution from wastewater and encourage water reuse.

Requirements

Design and construct the *project* to retain on-site at least 25% of the average annual wastewater generated by the project (exclusive of *existing* buildings), and reuse that wastewater to replace *potable water*. An additional point may be awarded for retaining and reusing 50%. Provide on-site treatment to a quality required by state and local regulations for the proposed reuse. The percentage of wastewater diverted and reused is calculated by determining the total wastewater flow using the design case after the GIB Prerequisite 3 calculations, and determining how much of that volume is reused on-site.

Table 1. Points for reusing wastewater

Percentage of wastewater reused	Points
25%	1
50%	2

GIB Credit 15: Recycled Content in Infrastructure

1 point

Intent

To use recycled and reclaimed materials to reduce the adverse environmental effects of extracting and processing virgin materials.

Requirements

Use materials for new infrastructure such that the sum of *postconsumer* recycled content, on-site reused materials, and one-half of the *preconsumer* recycled content constitutes at least 50% of the total mass of infrastructure materials.

Count materials in all of the following infrastructure items as applicable to the *project*:

a. Roadways, parking lots, sidewalks, unit paving, and curbs.

b. Water retention tanks and vaults.

c. Base and subbase materials for the above.

d. Stormwater, sanitary sewer, steam energy distribution, and water piping.

Recycled content is defined in accordance with ISO/IEC 14021, Environmental labels and declaration, Self-declared environmental claims (Type II environmental labeling).

GIB Credit 16: Solid Waste Management Infrastructure

1 point

Intent

To reduce the volume of waste deposited in landfills. To promote the proper disposal of hazardous wastes.

Requirements

Meet at least four of the following five requirements and publicize their availability and benefits:

a. Include as part of the *project* at least one recycling or reuse station, available to all project occupants, dedicated to the separation, collection, and storage of materials for recycling; or locate the project in a local government jurisdiction that provides recycling services. The recyclable materials must include, at a minimum, paper, corrugated cardboard, glass, plastics and metals.

b. Include as part of the project at least one drop-off point, available to all project occupants, for potentially hazardous office or household wastes; or locate the project in a local government jurisdiction that provides collection services. Examples of potentially hazardous wastes include paints, solvents, oil, and batteries. If a plan for postcollection disposal or use does not exist, establish one.

c. Include as part of the project at least one compost station or location, available to all project occupants, dedicated to the collection and composting of food and yard wastes; or locate the project in a local government jurisdiction that provides composting services. If a plan for postcollection use does not exist, establish one.

d. On every mixed-use or nonresidential *block* or at least every 800 feet, whichever is shorter, include recycling containers adjacent to other receptacles or recycling containers integrated into the design of the receptacle.

e. Recycle and/or salvage at least 50% of nonhazardous construction and demolition debris. Develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and specifies whether the materials will be stored on-site or commingled. Excavated soil and land-clearing debris do not contribute to this credit. Calculations can be done by weight or volume but must be consistent throughout.

GIB Credit 17: Light Pollution Reduction

1 point

Intent

To minimize light trespass from *project* sites, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction, and reduce adverse effects on wildlife environments.

Requirements

"Shared areas" of a project are spaces and facilities dedicated to common use (publicly or privately owned).

In residential areas, at least 50% of the external luminaires must have fixture-integrated lighting controls that use motion sensors to reduce light levels by at least 50% when no activity has been detected for 15 minutes.

AND

In all shared areas, install automatic controls that turn off exterior lighting when sufficient daylight is available and when the lighting is not required during nighttime hours; these lights must meet the total exterior lighting power allowance requirements in Table 3.

AND

Document which lighting zone or zones (Table 1) describe the project, and for all shared areas, follow the requirements in Table 2. If two or more different zones border the project, use the most stringent uplight requirements, and use light trespass requirements for the adjacent zone. Roadway lighting that is part of the project must meet the requirements for the appropriate zone.

For illuminance generated from a single luminaire placed at the intersection of a private vehicular driveway and public roadway accessing the site, project teams may use the centerline of the public roadway as the site boundary for a length of two times the driveway width centered at the centerline of the driveway when complying with the trespass requirements.

Compliance with the light trespass requirements may alternatively be met by using only luminaires that comply with Table 4 ratings for backlight and glare.

AND

Stipulate *covenants, conditions, and restrictions* (CC&R) or other binding documents to require continued adherence to the requirements.

Table 1. Lighting zones

Zone	Definition
LZ0	Undeveloped areas within national parks, state parks, forest land and rural areas and sites immediately adjacent to areas officially recognized as ecologically sensitive by the local zoning authority.
LZ1	Developed areas within national parks, state parks, forest land and rural areas.
LZ2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use, and residential mixed-use areas.
LZ3	All other areas not included in LZ0, LZ1, LZ2, or LZ4 (including commercial-industrial and high-density residential).
LZ4	High-activity commercial districts in major metropolitan areas (as designated by local jurisdiction, such as local zoning authority).

Table 2. Allowable light trespass and uplight, by lighting zone

Lighting zone	Maximum horizontal and vertical illuminance (fc) at site boundary	Maximum horizontal and vertical illuminance (fc) at specified distance beyond site boundary	Maximum percentage of fixture lumens emitted above 90º or higher from nadir (straight down)
LZ0	0	0 at 0 ft.	0%
LZ1	0.01	.01 at 0 ft.	0%
LZ2*	0.10	.02 at 10 ft.	1%
LZ3*	0.20	.05 at 15 ft.	2%
LZ4*	0.60	.05 at 15 ft.	5%

fc = footcandle.
* In LZ2, LZ3, and LZ4, for project boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the project boundary.

Table 3. Allowable lighting power densities, by lighting zone

	Lighting zone				
	LZ0	LZ1	LZ2	LZ3	LZ4
All exterior improved areas (except those listed below)	0.04 W/sf	0.04 W/sf	0.06 W/sf	0.10 W/sf	0.13 W/sf
Walkways	0.7 W/lf	0.7 W/lf	0.7 W/lf	0.8 W/lf	1.0 W/lf
Landscaping	No allowance	0.04 W/sf	0.05 W/sf	0.05 W/sf	0.05 W/sf
Entrance door (per linear foot of doorway)	20W	20W	20W	30W	30W
Entry canopy	0.25 W/sf	0.25 W/sf	0.25 W/sf	0.40 W/sf	0.40 W/sf
Illuminated building façade	No allowance	No allowance	2.5W/lf	3.75W/lf	5.0W/lf

sf = square feet; lf = linear feet.
Note: The total exterior lighting power density allowance for all shared exterior applications is the sum of the specified allowances for individual illuminated areas. The following lighting is exempted when its controls meet the above requirements and are independent of the controls for nonexempt lighting:

a. Specialized signal, directional, and marker lighting associated with transportation.
b. Advertising and directional signage.
c. Lighting integral to equipment or instrumentation and installed by its manufacturer.
d. Lighting for theatrical purposes, including performance, stage, film, and video.
e. Lighting for athletic playing fields.
f. Temporary lighting (installed for no more than 30 days and then removed for at least 30 days).
g. Lighting for industrial production, material handling, transportation sites, and associated storage areas.
h. Theme elements in theme or amusement parks.
i. Lighting to highlight features of public monuments and registered *historic buildings* or landmark structures.

Alternative method for meeting light trespass requirements in Table 2

A luminaire may be used if it is rated as follows according to the lighting zone of the site. If the luminaire is installed in other than the intended manner, the rating must account for the actual photometric geometry. An exception applies if at least 98% of a luminaire's emitted lumens are intercepted by man-made structures within the project. In either case, luminaires equipped with adjustable mounting devices permitting alteration of luminaire aiming in the field are not permitted.

Table 4. Allowable backlight and glare, by lighting zone

	Lighting zone				
Backlight luminaire rating	LZ0	LZ1	LZ2	LZ3	LZ4
> 2 mounting heights from property line	B0	B1	B2	B3	B4
1 to 2 mounting heights from property line and properly oriented*	B0	B1	B2	B3	B3
0.5 to 1 mounting height to property line and properly oriented*	B0	B0	B1	B2	B2
< 0.5 mounting height to property line adjacent to street and properly oriented*	B0	B0	B1	B2	B2
< 0.5 mounting height to property line and properly oriented*	B0	B0	B0	B1	B2
Glare luminaire rating	G0	G1	G2	G3	G4

* The luminaire must be mounted with backlight toward the property line.
Note: Backlight and glare ratings are defined based on specific lumen limits for IESNA TM-15-07 solid angles, Addendum A.

INNOVATION AND DESIGN PROCESS

IDP Credit 1: Innovation and Exemplary Performance

1–5 points

Intent

To encourage exemplary performance above the requirements set by the LEED for Neighborhood Development Rating System and/or innovative performance in green building, smart growth, or new urbanist categories not specifically addressed by the LEED for Neighborhood Development Rating System.

Requirements

In writing, identify the intent of the proposed innovation credit, the proposed requirement for compliance, the proposed submittals to demonstrate compliance, and the design approach and strategies that might be used to meet the requirements.

One point is awarded for each IDP Credit 1 earned, up to a total of 5. No more than 3 exemplary performance credits will be awarded in the Innovation and Design Process category.

IDP Credit 2: LEED Accredited Professional

1 point

Intent

To support the integrated planning and design required for a LEED for Neighborhood Development *project* and to streamline the application and certification process.

Requirements

At least one principal member of the project team must be a LEED Accredited Professional.

OR

At least one principal member of the project design team must be a professional who is credentialed in smart growth as determined by the Natural Resources Defense Council in consultation with Smart Growth America.

OR

At least one principal member of the project design team must be a professional who is credentialed in new urbanism as determined by the Congress for the New Urbanism.

Note: A separate LEED Accredited Professional exam track for professionals wanting to specialize in the LEED for Neighborhood Development Rating System will be available in early 2010; this IDP credit can be achieved if a principal member of the project design team is accredited as a result of passing the exam.

REGIONAL PRIORITY CREDIT

RPC Credit 1: Regional Priority

1–4 points

Intent

To encourage strategies that address geographically specific environmental, social equity, and public health priorities.

Requirements

Earn up to four of the six Regional Priority credits. These credits have been identified by subject matter experts representing the U.S. Green Building Council (regional councils and chapters), the Congress for the New Urbanism (chapters and membership in regions without chapters), and Smart Growth America (members of Smart Growth America's State and Local Caucus or their designees) as having additional regional importance for the project's location. A database of Regional Priority credits and their geographic applicability will be available on the USGBC website, www.usgbc.org.

One point is awarded for each Regional Priority credit earned, up to a maximum of 4. Non-U.S. projects are not eligible for Regional Priority credits.

APPENDIX. DIVERSE USES

Food Retail

Supermarket
Other food store with produce

Community-Serving Retail

Clothing store or department store selling clothes
Convenience store
Farmer's market
Hardware store
Pharmacy
Other retail

Services

Bank
Gym, health club, exercise studio
Hair care
Laundry, dry cleaner
Restaurant, café, diner (excluding establishments with only drive-throughs)

Civic and Community Facilities

Adult or senior care (licensed)
Child care (licensed)
Community or recreation center
Cultural arts facility (museum, performing arts)
Educational facility (including K–12 school, university, adult education center, vocational school, community college)
Family entertainment venue (theater, sports)
Government office that serves public on-site
Place of worship
Medical clinic or office that treats patients
Police or fire station
Post office
Public library
Public park
Social services center

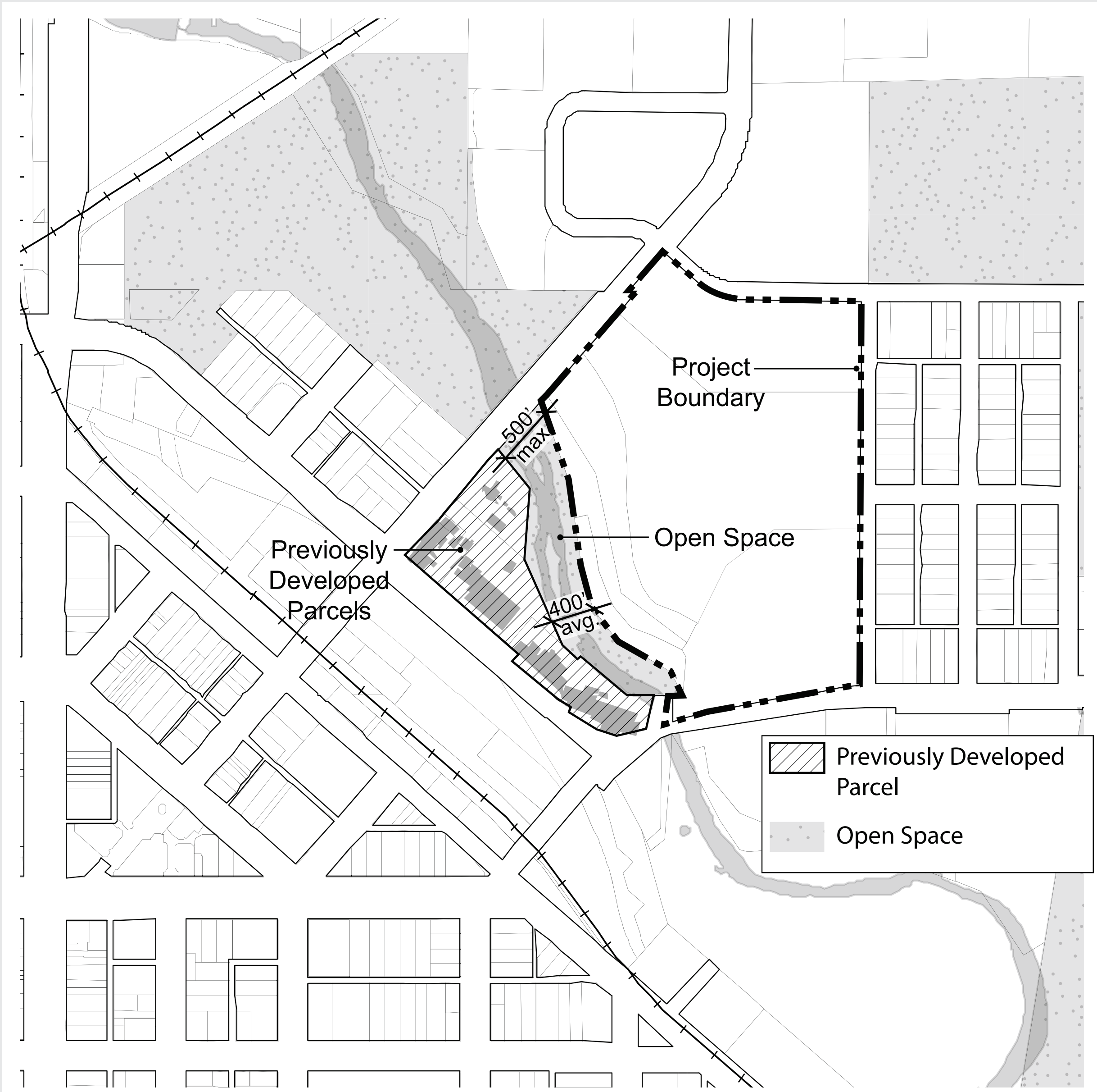
Adapted from Criterion Planners, INDEX neighborhood completeness indicator, 2005.

GLOSSARY

Key Definitions

adjacent site a site having at least 25% of its boundary bordering parcels that are each at least 75% *previously developed*. A *street* or other right-of-way does not constitute previously developed land; instead, it is the status of the property on the other side of the street or right-of-way that matters. Any fraction of the boundary that borders waterfront other than a stream is excluded from the calculation. A site is still considered adjacent if the 25% adjacent portion of its boundary is separated from previously developed parcels by undeveloped, permanently protected land averaging no more than 400 feet in width and no more than 500 feet in any one place. The undeveloped land must be permanently preserved as natural area, riparian corridor, *park*, greenway, agricultural land, or designated *cultural landscape*. Permanent pedestrian paths connecting the project through the protected parcels to the bordering site may be counted to meet the requirement of SLL Prerequisite 1, Option 2 (that the *project* be connected to the adjacent parcel by a through-street or nonmotorized right-of-way every 600 feet on average, provided the path or paths traverse the undeveloped land at no more than a 10% grade for walking by persons of all ages and physical abilities).

Adjacent project site based on minimum 25% of perimeter adjacent to previously developed parcels, including allowance for permanently protected land between project boundary and previously developed parcels



buildable land the portion of the site where construction can occur, including land voluntarily set aside and not constructed upon. When used in *density* calculations, buildable land excludes public rights-of-way and land excluded from development by codified law or LEED for Neighborhood Development prerequisites. An *applicant* may exclude additional land not exceeding 15% of the buildable land base defined above, provided the following conditions are present:

a. The land is protected from residential and nonresidential construction by easement, deed restriction, or other enforceable legal instrument.

AND

b. Either 25% or more of the boundary of each contiguous parcel proposed for exclusion borders a *water body* or areas outside the *project boundary* that are protected by codified law; or ownership of, or management authority over, the exclusion area is transferred to a public entity.

connectivity the number of publicly accessible *inter*sections per square mile, including any combination of streets, dedicated alleys, *transi*t rights-of-way, and nonmotorized rights-of-way. If one must both enter and exit an area through the same intersection, such an intersection and any intersections beyond that point are not counted; intersections leading only to culs-de-sac are also not counted. The cal*culation of* square mileage excludes water bodies, parks larger than 1/2 acre, *public facility ca*mpuses, airports, rail yards, slopes over 15%, and areas nonbuildable under codified law or the rating system. Street rights-of-way may not be excluded.

infill site a site that meets any of the following four conditions:

a. At least 75% of its boundary borders parcels that individually are at least 50% *previously developed,* and that in aggregate are at least 75% previously developed.

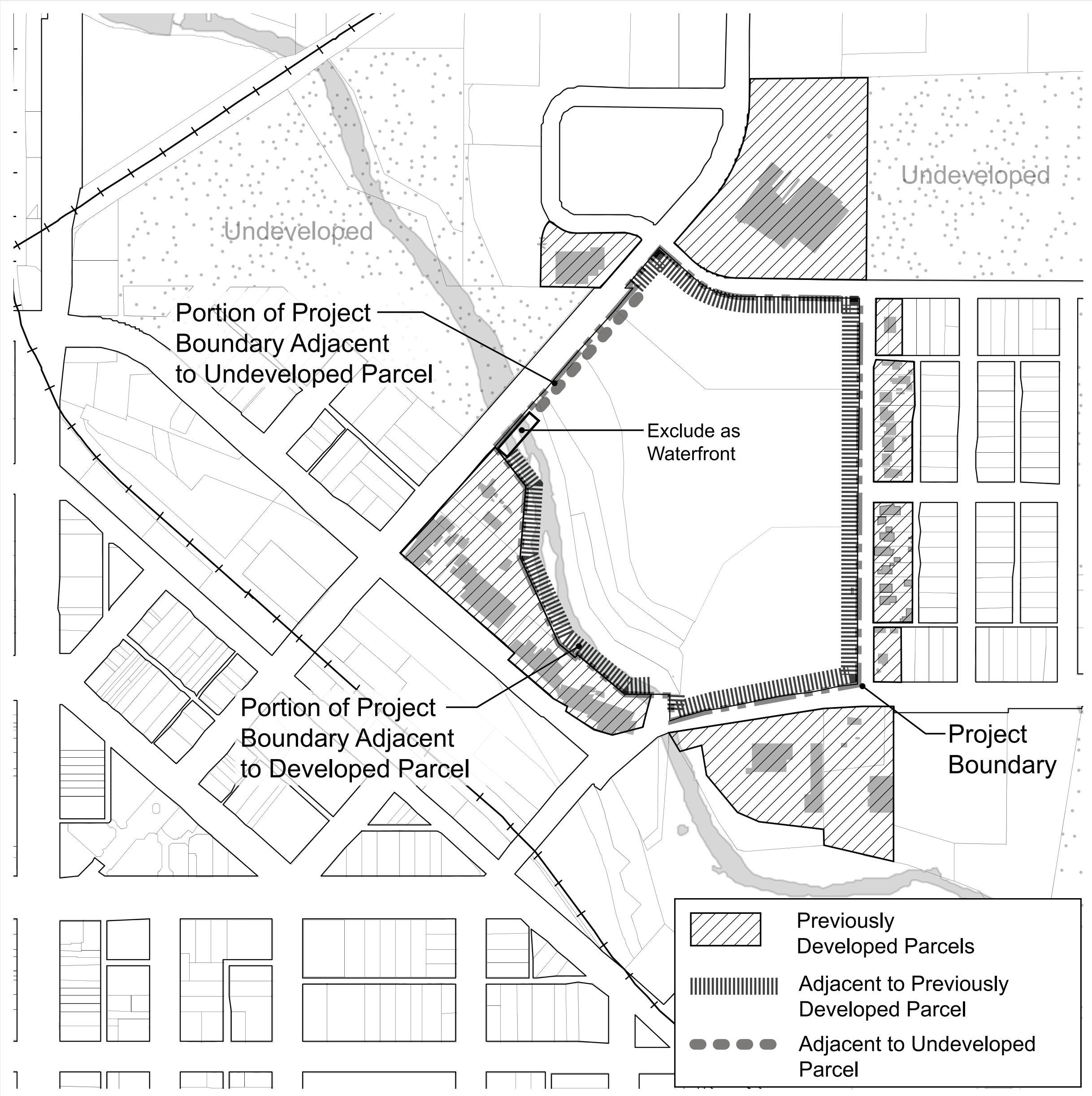
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

c. At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the *project boundary* is previously developed.

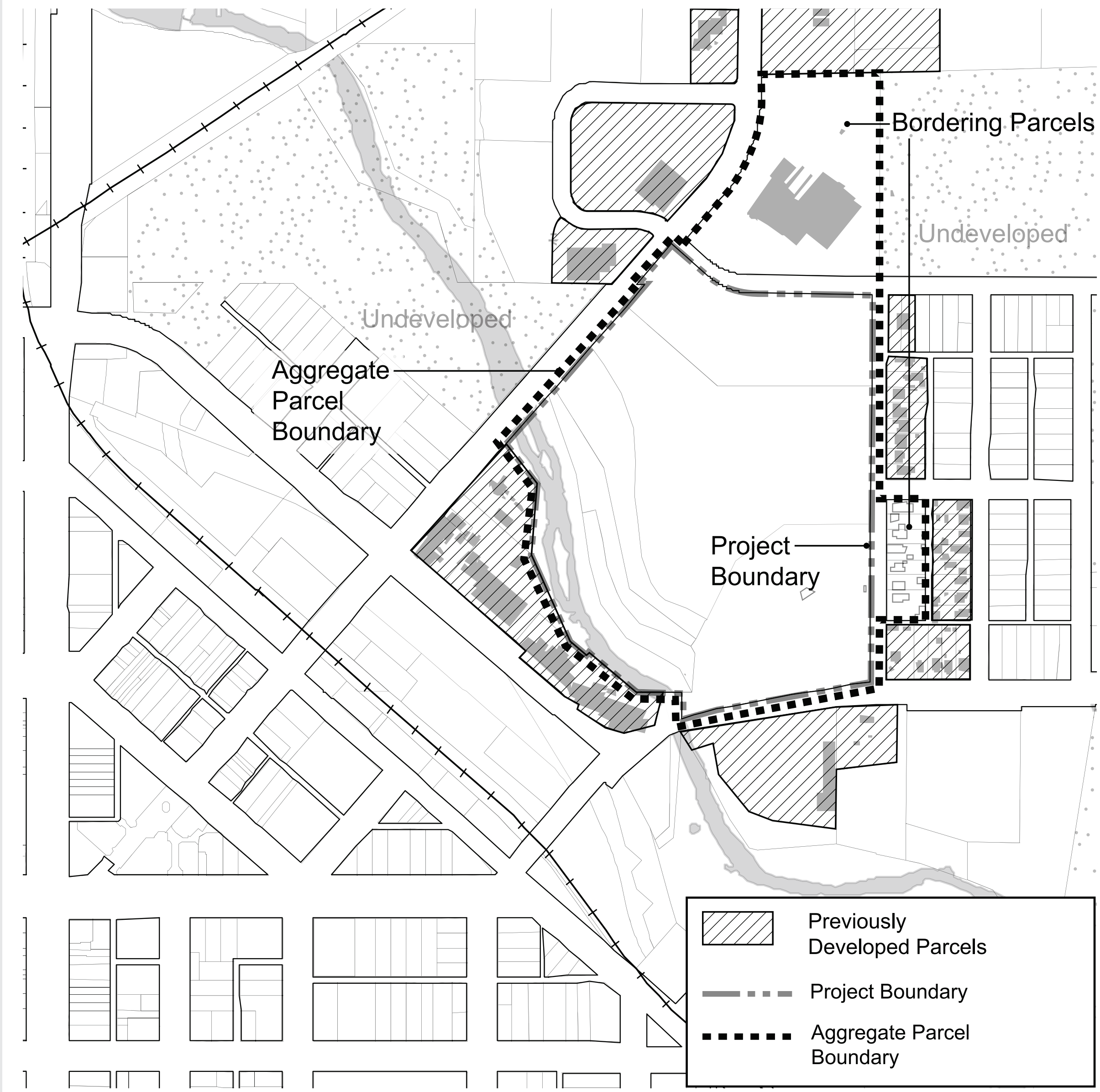
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

A *street* or other right-of-way does not constitute previously developed land; it is the status of property on the other side or right-of-way of the street that matters. For conditions (a) and (b) above, any fraction of the perimeter that borders waterfront other than a stream is excluded from the calculation.

(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels

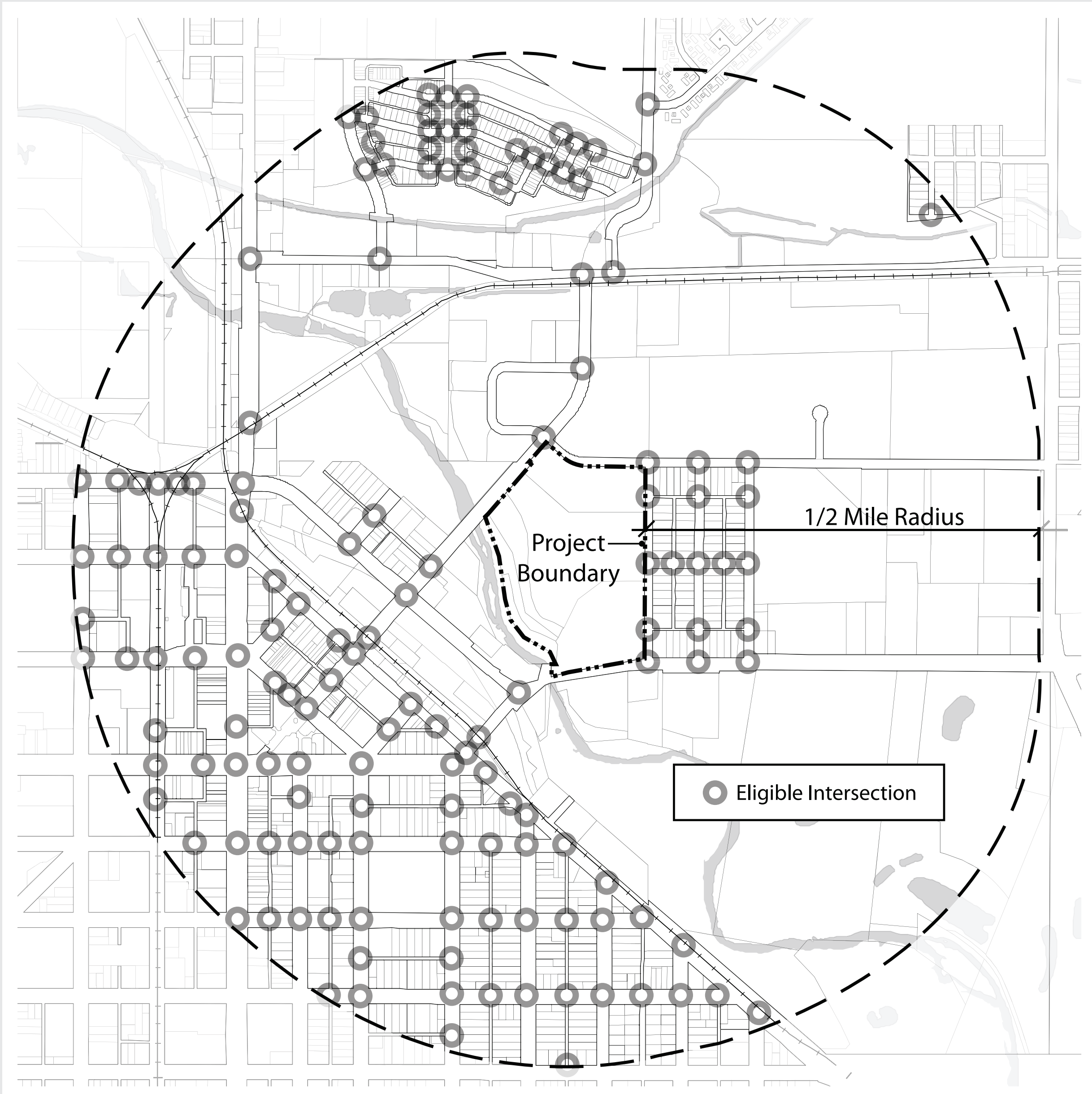


(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(c). Infill project site based on minimum 75% of land area within 1/2 mile of project boundary being previously developed

(d). Infill project site based on minimum 140 intersections/sq.mi. within 1/2 mile of project boundary



previously developed altered by paving, construction, and/or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Previously developed land includes a platted lot on which a building was constructed if the lot is no more than 1 acre; previous development on lots larger than 1 acre is defined as the *development footprint* and land alterations associated with the footprint. Land that is not previously developed and altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land. The date of previous development permit issuance constitutes the date of previous development, but permit issuance in itself does not constitute previous development.

ADDITIONAL DEFINITIONS

accessory dwelling unit a subordinate *dwelling unit* that is attached to a principal building or contained in a separate structure on the same property as the principal unit.

adapted (**or introduced**) **plant** a species that reliably grows well in a given habitat with minimal attention from humans in the form of winter protection, pest protection, water irrigation, or fertilization once its root systems are established in the soil. Adapted plants are low maintenance but not invasive.

alley a publicly accessible right-of-way, generally located midblock, that can accommodate slow-speed motor vehicles, as well as bicycles and pedestrians. An alley provides access to the side or rear of abutting properties for loading, parking, and other service functions, minimizing the need for these functions to be located along streets. It may be publicly dedicated or privately owned and deeded in perpetuity for general public use.

applicant the entity that prepares the LEED-ND *project* submission and is responsible for project implementation. An applicant may be the *developer* or another cooperating entity.

area median income the median income of a county as determined by the U.S. Department of Housing and Urban Development.

bicycle network a continuous network consisting of any combination of physically designated in-*street* bicycle lanes at least 5 feet wide, off-street bicycle paths or trails at least 8 feet wide for a two-way path and at least 5 feet wide for a one-way path, and/or streets designed for a target speed of 25 miles per hour or slower.

block land bounded by the *project boundary*, transportation or utility rights-of-way that may be publicly dedicated or privately owned and deeded in perpetuity for general public use, waterfront, and/or comparable land division features.

brownfield real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or possible presence of a hazardous substance, pollutant, or contaminate.

build-out the time at which all *habitable buildings* on the *project* are complete and ready for occupancy.

bus rapid transit an enhanced bus system that operates on exclusive bus lanes or other transit rights-of-way; it is designed to combine the flexibility of buses with the efficiency of rail.

community-supported agriculture (**CSA**) a farm operation for which a community of individuals pledges support so that the farmland becomes, either legally or informally, the community's farm. The growers and consumers provide mutual support, sharing the risks and benefits of food production. Consumers receive portions of the farm's harvest throughout the growing season.

construction impact zone the *project's development footprint* plus the areas around the improvement where construction crews, equipment, and/or materials are staged and moved during construction.

covenants, conditions, and restrictions limitations that may be placed on a property and its use and are made a condition of holding title or lease.

cul-de-sac a *street* segment that terminates without intersecting another street segment.

cultural landscape an officially designated geographic area that includes both cultural and natural resources associated with a historic event, activity, or person or that exhibits other significant cultural or aesthetic values.

density the amount of building structures constructed on the *project site*, measured for residential buildings as *dwelling units* per acre of *buildable land* available for residential uses, and for non-residential buildings as the *floor-area ratio* of buildable land area available for nonresidential uses. In both cases, structured parking is excluded.

developer a public and/or private entity that controls a majority of the *project's buildable land* and is committed to making a majority of the investments required for the project implementation described in the LEED-ND submission.

development footprint the total land area of a *project* site covered by buildings, *streets*, parking areas, and other typically impermeable surfaces constructed as part of the project.

dwelling unit living quarters intended for long-term occupancy that provide facilities for cooking, sleeping, and sanitation. This does not include hotel rooms.

employment center a nonresidential area of at least 5 acres with a job density of at least 50 employees per net acre.

existing present on the date of submission of LEED-ND certification documents; similarly, an element or condition that **exists** is present on the date that LEED-ND certification documents are submitted.

floor-area ratio (**FAR**) the *density* of nonresidential land use, exclusive of parking, measured as the total nonresidential building floor area divided by the total *buildable land* area available for nonresidential structures. For example, on a site with 10,000 square feet of buildable land area, an FAR of 1.0 would be 10,000 square feet of building floor area. On the same site, an FAR of 1.5 would be 15,000 square feet of built floor area; an FAR of 2.0 would be 20,000 built square feet and an FAR of 0.5 would be 5,000 built square feet.

functional entry a building opening designed to be used by pedestrians and open during regular business hours. This does not include any door exclusively designated as an emergency exit, or a garage door not designed as a pedestrian entrance.

graywater untreated wastewater that has not come into contact with toilet waste. Graywater includes used water from bathtubs, showers, bathroom washbasins, and water from clothes washers and laundry tubs. It does not include wastewater from kitchen sinks or dishwashers, unless a graywater definition established by the authority having jurisdiction in the area has precedence.

habitable building a structure intended for living, working, or other types of occupancy. Habitable structures do not include stand-alone garages and utility structures such as pump stations.

heat island thermal gradient differences between developed and undeveloped areas.

historic building a building or structure listed or determined to be eligible as a historic structure or building or structure or as a contributing building or structure in a designated historic district, due to its historic, architectural, engineering, archeological, or cultural significance. The building or structure must be designated as historic by a local historic preservation review board or similar body, be listed in a state register of historic places, be listed in the National Register of Historic Places, or have been determined eligible for listing in the National Register.

historic district a group of buildings, structures, objects, and sites, of varying sizes, that have been designated as historically and architecturally significant and categorized as either contributing or noncontributing.

Home Energy Rating System (**HERS**) **index** a scoring system established by the Residential Energy Services Network (RESNET) in which a home built to the specifications of the HERS Reference Home (based on the 2006 International Energy Conservation Code) scores 100, and a net zero energy home scores 0. The lower a home's HERS Index, the more energy efficient it is.

invasive plant either an indigenous or nonindigenous species or strain that is characteristically adaptable, aggressive, has a high reproductive capacity, and tends to overrun the ecosystems it inhabits.

major renovations extensive alteration work in addition to work on the exterior shell of the building and/or primary structural components and/or the core and peripheral MEP and service systems and/or site work. Typically, the extent and nature of the work is such that the primary function space cannot be used for its intended purpose while the work is in progress and where a new certificate of occupancy is required before the work area can be reoccupied.

metropolitan (**metro**) and **micropolitan** (**micro**) **statistical area** a geographic entity defined by the U.S. Office of Management and Budget for use by federal statistical agencies in collecting, tabulating, and publishing federal statistics. A metro area contains a core urban area with a population of 50,000 or more, and a micro area contains an urban core with a population between 10,000 and 50,000. Each metro or micro area consists of one or more counties and includes the counties containing the core urban area, as well as any adjacent counties that have a high degree of social and economic integration (as measured by commuting to work) with the urban core. "Core-based statistical area" (CBSA) encompasses both metro and micro areas.

multiunit residential consisting of four or more residential units sharing a common entry.

native (**or indigenous**) **plant** a plant species that did or would have occurred on the site or within the subject county prior to the widespread land alterations that accompanied European settlement. Cultivars of native plants may be considered native plants.

park a publicly accessible area that is permanently maintained in a seminatural condition for human recreation and relaxation; it has soil, grass, water, flora, and/or recreation improvements.

paseo a publicly accessible pedestrian path, at least 4 feet wide and no more than 12 feet wide, that provides shortcuts between buildings and through the block, connecting *street* frontages to rear parking areas, midblock courtyards, *alleys*, or other streets. A paseo may be roofed for up to 50% of its length and may be privately owned or publicly dedicated.

planned diverse use a shop, service, or facility that has received a building permit and is under construction at the time of the first certificate of occupancy is issued for any building in the LEED-ND *project*.

planned occupancy the highest estimate of building occupants based on planned use(s) and industry standards for square foot requirements per employee (see USDOE EIA CBECS survey for suggested default nonresidential occupancies). The minimum planned occupancy for *multiunit residential* buildings is 1 person for a studio unit, 1.5 persons for a one-bedroom unit, and 1.25 persons per bedroom for a two- bedroom or larger unit.

plaza a publicly accessible gathering space that is integrated into the street network and allows vehicular, bicycle, and/or pedestrian travel. A plaza is generally paved, is spatially defined by building fronts paralleling at least two-thirds of its perimeter, and may be privately owned or publicly dedicated.

postconsumer generated by households or commercial, industrial, or institutional facilities in their role as end-users of a product, which can no longer be used for its intended purpose.

potable water water that meets or exceeds EPA's drinking water quality standards and is approved for human consumption by the state or local authorities having jurisdiction; it may be supplied from wells or municipal water systems.

preconsumer diverted from the waste stream during the manufacturing process. It does not include the reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.

predevelopment before any development occurred on the site. Predevelopment conditions describe the natural conditions of the site prior to any human alteration, such as development of roads or buildings.

previously developed site a site that, *preproject*, consisted of at least 75% *previously developed* land.

preproject before the LEED-ND *project* was initiated, but not necessarily before any development or disturbance took place. Preproject conditions describe the state of the project site on the date the *developer* acquired rights to a majority of its *buildable land* through purchase or option to purchase.

prime soil earth with chemical, hydrographic, and topological properties that make it especially suited to the production of crops, as defined by the U.S. Natural Resources Conservation Service.

project the land, water, and construction that constitutes the project application. A project *applicant* does not have to own or control all land or water within a *project boundary*, but all the area within the project boundary must comply with prerequisites and attempted credits.

project boundary the platted property line of the *project* defining land and water within it. Projects located on publicly owned campuses that do not have internal property lines must delineate a sphere-of-influence line to be used instead. *Project site* is equivalent to the land and water inside the project boundary. The project must not contain noncontiguous parcels, but parcels can be separated by public rights-of-way. Projects may also have enclaves of nonproject properties that are not subject to the rating system, but such enclaves cannot exceed 2% of the total project area and cannot be described as certified.

school a kindergarten, elementary, or secondary institution for the academic instruction of children.

single-family residential any residential unit other than *multiunit residential*, including single, duplex, triplex, row house, townhouse and semiattached residential building types.

street a dedicated right-of-way that can accommodate one or more modes of travel, excluding *alleys* and *paseos*. A street is suitable for primary entrances and provides access to the front and/or sides of buildings and lots. A street may be privately owned as long as it is deeded in perpetuity for general public use. A street must be an addressable thoroughfare (for mail purposes) under the standards of the applicable regulating authority.

square (also **green**) a publicly accessible open area for gatherings that is wholly or partially bounded by segments of the *street* network. A square can be landscaped or landscaped and paved, is spatially defined by building fronts paralleling at least 45% of its perimeter, and may be privately owned or publicly dedicated.

unique soil earth with chemical, hydrographic, and topological properties that make it especially suited to specific crops, as defined by the U.S. Natural Resources Conservation Service.

walk distance the distance that a pedestrian must travel between origins and destinations without obstruction, in a safe and comfortable environment on a continuous network of sidewalks, all-weather-surface footpaths, crosswalks, *woonerfs*, or equivalent pedestrian facilities.

water body the surface water of a stream (first-order and higher, including intermittent streams), arroyo, river, canal, lake, estuary, bay, or ocean, excluding irrigation ditches

water and wastewater infrastructure publicly owned water and wastewater infrastructure; this excludes septic and mound wastewater treatment systems.

wetland an area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas, but exclude irrigation ditches unless delineated as part of an adjacent wetland.

woonerf a *street*, also known as a home zone, shared zone, or living street, where pedestrians have priority over vehicles and the posted speed limit is no greater than 10 miles per hour. Physical elements within the roadway, such as shared surfaces, plantings, street furniture, parking, and play areas, slow traffic and invite pedestrians to use the entire right-of-way.

vehicle miles traveled (**VMT**) the number of miles driven by motorists in a specified time period, such as a day or a year, in absolute or per capita terms.

Exhibit Q

Exhibit Q

COUNTY OF SAN DIEGO

GUIDELINES FOR DETERMINING SIGNIFICANCE
AND
REPORT FORMAT AND CONTENT REQUIREMENTS

WILDLAND FIRE AND FIRE PROTECTION

LAND USE AND ENVIRONMENT GROUP

Department of Planning and Land Use
Department of Public Works

Second Revision
August 31, 2010

APPROVAL

I hereby certify that these **Guidelines for Determining Significance and Report Format and Content Requirements for Wildland Fire and Fire Protection** are a part of the County of San Diego, Land Use and Environment Group's Guidelines for Determining Significance and Technical Report Format and Content Requirements and were considered by the Director of Planning and Land Use, in coordination with the Director of Public Works on the August 31, 2010.

ERIC GIBSON
Director of Planning and Land Use

JOHN SNYDER
Director of Public Works

I hereby certify that these **Guidelines for Determining Significance and Report Format and Content Requirements for Wildland Fire and Fire Protection** are a part of the County of San Diego, Land Use and Environment Group's Guidelines for Determining Significance and Technical Report Format and Content Requirements and have hereby been approved by the Deputy Chief Administrative Officer (DCAO) of the Land Use and Environment Group on the 31st of August, 2010. The Director of Planning and Land Use is authorized to approve revisions to these Guidelines for Determining Significance and Report Format and Content Requirements for Wildland Fire and Fire Protection, except any revisions to the Guidelines for Determining Significance presented in Chapter 4.0 must be approved by the DCAO.

Approved, August 31, 2010

Chandra Wallar

CHANDRA WALLAR
Deputy CAO

<u>Text</u>
Approved
March 19, 2007

First Revision
December 19, 2008

Second Revision
August 31, 2010

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COUNTY OF SAN DIEGO

GUIDELINES FOR DETERMINING SIGNIFICANCE

WILDLAND FIRE AND FIRE PROTECTION

LAND USE AND ENVIRONMENT GROUP

Department of Planning and Land Use
Department of Public Works

Second Revision
August 31, 2010

EXPLANATION

These Guidelines for Determining Significance for Wildland Fire and Fire Protection and information presented herein shall be used by County staff for the review of discretionary projects and environmental documents pursuant to the California Environmental Quality Act (CEQA). These Guidelines present a range of quantitative, qualitative, and performance levels for particular environmental effects. Normally, (in the absence of substantial evidence to the contrary), an affirmative response to any one Guideline will mean the project will result in a significant effect, whereas effects that do not meet any of the Guidelines will normally be determined to be "less than significant." Section 15064(b) of the State CEQA Guidelines states:

> "The determination whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on factual and scientific data. An ironclad definition of significant effect is not always possible because the significance of an activity may vary with the setting."

The intent of these Guidelines is to provide a consistent, objective and predictable evaluation of significant effects. These Guidelines are not binding on any decision-maker and do not substitute for the use of independent judgment to determine significance or the evaluation of evidence in the record. The County reserves the right to modify these Guidelines in the event of scientific discovery or alterations in factual data that may alter the common application of a Guideline.

LIST OF PREPARERS AND TECHNICAL REVIEWERS

<u>SECOND REVISION – AUGUST 31, 2010</u>

<u>County of San Diego</u>

Jeff Murphy, DPLU, Primary Author
Paul Dawson, DPLU, Contributing Author
James Pine, DPLU, Contributing Author
Ralph Steinhoff, DPLU, Technical Review
Ken Miller, DPLU, Technical Review

<u>FPP Technical Review Panel</u>

Robin Church, RC Biological Consulting
Rolland Crawford, Loma Linda Fire Department, Retired, Co-Chair of the Wildland-Urban Interface Committee, California Fire Chiefs Association, Fire Prevention Officers Section
Kathleen Edwards, Division Chief, Pre-Fire Division, CAL FIRE
Scott Franklin, Scott Franklin Consulting
Jim Hunt, Hunt Research Corp.

<u>FPP Technical Review Panel, continued</u>

Cliff Hunter, Fire Marshal, Rancho Santa Fe Fire Protection District, member of the ICC Wildland Committee
Doug Logan, Current President of the North County Civil Engineers and Land Surveyors Association
Sid Morel, Fire Marshal, North County Fire Protection District
Dennis Moser, Moser Ventures, Inc
Don Oaks, Santa Barbara County Fire Department, Retired, Co-Chair of the Wildland-Urban Interface Committee, California Fire Chiefs Association, Fire Prevention Officers Section
Thom Porter, Staff Chief, Resource Management, CAL FIRE
Gregory Schreiner, Fire Marshal, Lakeside Fire Protection District
Howard Windsor, Unit Chief, CAL FIRE

FIRST REVISION – DECEMBER 19, 2008

<u>County of San Diego</u>

Jeff Murphy, DPLU, Primary Author
Paul Dawson, DPLU, Contributing Author
Ralph Steinhoff, DPLU, Technical Review
Ken Miller, DPLU, Technical Review

<u>FPP Technical Review Panel</u>
Robin Church, RC Biological Consulting
Rolland Crawford, Loma Linda Fire Department, Co-Chair of the Wildland-Urban Interface Committee, California Fire Chiefs Association, Fire Prevention Officers Section
Scott Franklin, Scott Franklin Consulting
Jim Hollingsworth, Fire Marshal, Ramona Fire Department

<u>FPP Technical Review Panel, continued</u>

Jim Hunt, Hunt Research Corp.
Cliff Hunter, Fire Marshal, Rancho Santa Fe Fire Protection District, member of the ICC Wildland Committee
Dennis Moser, Moser Ventures, Inc.
Don Oaks, Santa Barbara County Fire Department, Retired, Co-Chair of the Wildland-Urban Interface Committee, California Fire Chiefs Association, Fire Prevention Officers Section
Thom Porter, Staff Chief, Resource Management, CAL FIRE
Mike Scott, Urban Forester, Rancho Santa Fe Fire Protection District
Pete Scully, Battalion Chief, Border Division, CAL FIRE

APPROVED – MARCH 19, 2007

County of San Diego

Jeff Murphy, DPLU, Primary Author
Paul Dawson, DPLU, Contributing Author
Ralph Steinhoff, DPLU, Technical Review
Ken Miller, DPLU, Technical Review

FPP Technical Review Panel

Bill Clayton, Division Chief, CDF
Robin Church, RC Biological Consulting
Rolland Crawford, Loma Linda Fire Department, Co-Chair of the Wildland-Urban Interface Committee, California Fire Chiefs Association, Fire Prevention Officers Section
Scott Franklin, Scott Franklin Consulting
Jim Hollingsworth, Fire Marshal Ramona Fire District

FPP Technical Review Panel, continued

Jim Hunt, Hunt Research Corp.
Cliff Hunter, Fire Marshal, Rancho Santa Fe Fire Protection District, member of the ICC Wildland Committee
Dennis Moser, Moser Ventures, Inc
Don Oaks, Santa Barbara County Fire Department, Retired, Co-Chair of the Wildland-Urban Interface Committee, California Fire Chiefs Association, Fire Prevention Officers Section
Thom Porter, Staff Chief, Resource Management, CAL FIRE
Mike Scott, Urban Forester, Rancho Santa Fe Fire Protection District
Pete Scully, Battalion Chief, Border Division, CAL FIRE
Andy Vanderlaan, Former Executive Director Western Fire Chief's Publishers of Uniform Fire Code, Current Chair LAFCO

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List of Acronyms

ALS	Advanced Life Support
AMR	American Medical Response
BLS	Basic Life Support
CBC	California Building Code
CCR	California Code of Regulations
CAL FIRE	California Department of Forestry and Fire Protection
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CFC	County of San Diego Consolidated Fire Code
CSA	County Service Area
EMS	Emergency Medical Services
EMT	Emergency Medical Technician
FAHJ	Fire Authority Having Jurisdiction
FPD	Fire Protection District
FPP	Fire Protection Plan
FMZ	Fuel Modification Zone
IAFC	International Association of Fire Chiefs
IBC	International Building Code
IFC	International Fire Code
IPCC	Intergovernmental Panel on Climate Change
ISO	Insurance Services Office
LAFCO	Local Agency Formation Commission
LBZ	Limited Building Zone
LRA	Local Responsibility Area
MOU	Memorandum of Understanding
MWD	Municipal Water District
NEC	National Electric Code
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
PAHJ	Planning Authority Having Jurisdiction
SANDAG	San Diego Association of Governments
SRA	State Responsibility Area
UBC	Uniform Building Code
UFC	Uniform Fire Code
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WFCA	Western Fire Chiefs Association
WUI	Wildland Urban Interface

INTRODUCTION

This document provides guidance to planners, applicants, consultants, fire professionals and other interested parties for evaluating adverse environmental effects that a proposed project may have from wildland fire and establishes standards to ensure that development projects do not unnecessarily expose people or structures to a significant risk of loss, injury or death involving wildland fires. Specifically, this document addresses the following questions listed in the California Environmental Quality Act (CEQA) Guidelines:

Appendix G, VIII. Hazards and Hazardous Materials

h) Would the project expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?

Appendix G, XIV. Public Services

a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance service ratios, response times or other performance objectives for any of the public services:

    i. Fire protection?

Appendix G, XVI. Transportation/Traffic

e) Would the project result in inadequate emergency access?

Appendix G, XVII. Utilities and Service Systems

d) Would the project have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?

1.0 GENERAL PRINCIPLES AND EXISTING CONDITIONS

1.1 Wildland-Urban Interface Ignition Factors

Fires can ignite naturally or be caused by people. In the montane coniferous forests of the Southwest, lightning-ignited fires are abundant and human ignitions are far less important than in lower-elevation shrublands of southern California where lightning is uncommon and humans cause most of the fires (Keeley and Fotheringham 2003). Over 95 percent of fires in southern California shrublands are started by people, which has increased fire frequency and increased the chances of ignitions during Santa Ana winds (Keeley and Fotheringham 2003). In general, more people move to the shrublands than to the forests, since most of the development in San Diego County is on the coastal plain and in the foothills. People living in the wildlands, traveling on roads built through the wildlands, and recreating in the wildlands can ignite wildland fires inadvertently. In addition, wildland fires are sometimes ignited by arsonists. All these situations create more opportunities for potential wildland fire danger to people and their structures.

Wildland fires only spread if the wildfire meets the oxygen, fuel and heat requirements for ignition and continued combustion. In wildland fires oxygen is not limited, so the continuation of wildfire combustion relies on fuel and heat. Fuel, as mentioned above, is commonly the wildland vegetation and landscaping, but structures and accessories such as projections (i.e. decks & patio covers) can add to the fuel source. Burning fuel creates heat and heat allows fires to spread when there is sufficient fuel. Three primary means of heat transfer can result in ignition: conduction, convection and radiation.

1.1.1 Conduction

Conduction is heat transfer through a solid or from the heated surface to the interior of a solid. An example of heat conduction resulting in structure ignition would be flame impinging on the exterior metal siding of a mobile home. Like a frying pan, heat is transferred to structural components inside, resulting in ignition.

1.1.2 Convection

Convection is defined as transfer of heat by a circulating fluid – either gas or liquid. Heat rises from a wildland fire and is transferred by air currents to other objects, such as a house on a ridge top. Winds can carry heat by convection to vegetation and structures. Sufficient fuel modification zones, building setbacks from slopes and ignition-resistive construction are all important factors in limiting this risk.

1.1.3 Radiation

Radiation is energy transfer that travels across space without the need for intervening medium such as air. Examples in wildfires include ignition of light combustibles in advance of the flame front, like dry fine grasses or curtains behind a window. Radiation does not require flames to strike a structure to cause ignition. The source of flame radiation is the flame-front. Dependent on the length, height, and width of the flame-front (the leading edge of a wildland fire), and the flame duration, an unprotected structure can be ignited by radiant heat.

1.1.4 Firebrands

Firebrands are burning embers that become airborne and are blown beyond the fire front. Firebrands can be created from virtually any fuel source that is light enough to be blown upwards; however, vegetation is the most common source of firebrands. A burning structure also creates burning embers, particularly at collapse. Firebrands combine heat transfer methods of conduction and convection. Firebrands extend the boundaries of wildland fire hazard zones and present a prominent threat to structures, especially homes. Dependent on weather and the size of the ember, a firebrand can be carried far ahead of the fire front. The hazard can be worsened if structures are not ignition-resistant and cannot repel the heat of a burning ember. Flammable vegetation adjacent to (within ten feet of) a structure and other combustible materials (wood piles, combustible fences, decks, etc.) acts as a receptacle for fire brands, and will impact the structure.

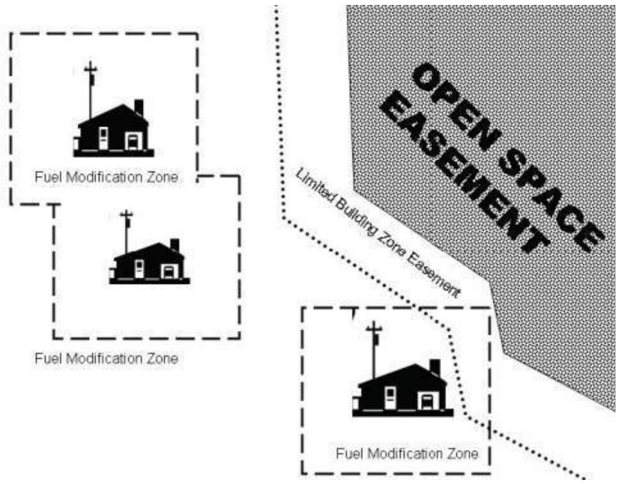
1.1.5 Flame Impingement

Flame impingement, a form of heat conduction, involves heat transfer from a flame that directly strikes a structure, potentially causing ignition of the structure. Flame size and the duration of flame impingement directly affect the potential for ignition of a structure.

1.2 Defensible Space

To improve the survivability of structures in a wildland fire, fire professionals recommend using defensible space around all structures occupied by humans or domestic animals. Defensible space creates a separation zone between wildlands and structures, a space where fuel is managed or modified to minimize the spread of fire to the structure and providing space for defending structures from burning vegetation. Fuel management includes keeping the area clear of flammable man-made materials and managing the vegetation to reduce its flammability. Vegetation management begins with correctly spacing plants to reduce fire risks to the home, and then by watering, pruning and thinning the vegetation regularly. The landscaping around a house in the WUI must be maintained. Defensible space reduces fire speed, intensity, and flame lengths, and limits the spread of a wildfire. This area is known as a fuel modification zone (FMZ), which is not to be confused with the limited building zone (LBZ). An FMZ is a protective buffer that surrounds a structure, while an LBZ is a protective buffer that surrounds a biological open space area. The FMZ and LBZ may completely overlap, partially overlap or not touch at all (Figure 2).

Figure 2. Fuel Modification Zone and Limited Building Zone



1.3 Defensible Structures

Wildfires are dangerous and unpredictable. In a wildfire, firefighting resources are often over-extended and may be unavailable. Defensible space alone does not ensure the safety of structures confronted by a wildfire. Many additional precautions will assist in the survival of structures from wildland fire threats. The California Department of Forestry and Fire Protection (CAL FIRE), County of San Diego, and local fire districts can provide guidance on preparing structures for wildfire including proper landscaping practices, construction standards and techniques, adequate emergency water supply needs and access.

2.0 EXISTING REGULATIONS AND STANDARDS

A number of existing laws, regulations, policies and programs have been enacted to prevent, manage or mitigate the threat of wildland fires to public health, safety and the environment. The following discussion is an overview of the primary existing regulations that affect wildland fire in San Diego County. The regulations discussed below have been chosen for their applicability to the typical development project encountered in San Diego County and for their usefulness in assessing potential adverse project impacts as defined by the California Environmental Quality Act (CEQA), focusing on the threat these fires would pose to people or structures.

It is important to note that the unincorporated area of the County is served by various independent fire districts, County Service Areas and CALFIRE. It is important for planners, applicants, consultants, fire professionals and other interested parties who are processing discretionary permits to understand the respective service areas and responsibilities as well as policies and procedures of the FAHJ that will eventually serve the proposed project. Communication early and often with the FAHJ throughout the entitlement process is encouraged.

2.1 Federal Regulations and Nationally Recognized Standards

[[Regulation]]

National Environmental Policy Act, [42 USC § 4321 et seq.] Federal agencies that implement the National Environmental Policy Act (NEPA) consider potential public health and safety hazards, including wildland fires, when considering the environmental impacts of proposed federal projects

[[Nationally Recognized Standard]]

International Fire Code Published by the International Code Council, it is a model code which may be adopted by a jurisdiction. It forms the basis for the current California Fire Code (CCR Title 24 part 9) The International Fire Code (IFC) is the underlying nationally recognized code that sets standards and requirements to safeguard against the threat fires may pose to public health, safety, and the environment. The IFC, when adopted by a jurisdiction, regulates the planning, construction and maintenance of development in all areas.

[[Nationally Recognized Standard]]

International Wildland-Urban Interface Code Published by the International Code Council, it is a model code addressing wildfire issues. It has not been adopted by the State of California or by the County of San Diego. It may be used as a reference for subjects not addressed within the California and County Fire Codes.

[[Nationally Recognized Standard]]

National Fire Protection Association Standards (http://nfpa.org/codes/index.asp) The National Fire Protection Association (NFPA) Standards are a product of the National Fire Protection Association (NFPA), a world-wide organization of fire industry, fire agencies, fire professionals and concerned individuals. These model standards are annually compiled from the standards, recommended practices, manuals, guides, and model laws that are prepared by the individual technical committees of the NFPA. Most are revised on a three-year cycle. The published standards are voted on by the members of the NFPA. The individual standards can be adopted by jurisdictions or modified and adopted as that jurisdiction's ordinance.

2.2 State Regulations and Standards

[[Regulation]]

California Environmental Quality Act and Guidelines [Public Resources Code, §§ 21000-21178; Guidelines for Implementation of CEQA, California Code of Regulations, Title 14, §§15000-15387, Appendix G.] Consideration of impacts relating to wildland fires is required by CEQA. The CEQA Guidelines are concerned with assessing impacts associated with exposing people or structures to wildland fires.

[[Regulation]]

California Building and Fire Codes [California Code of Regulations, Title 24 parts 2 & 9, http://osfm.fire.ca.gov/] Title 24 contains several International Codes that address fire safety including the International Fire Code, International Building Code. Additional safety regulations adopted by the California Building Standards Commission include the Uniform Mechanical Code, and Uniform Plumbing Code, which are also part of the California Code of Regulations.

[[Regulation]]
California Code of Regulations Title 14 (**SRA Fire Safe Regulations**) contains regulations that establish minimum wildfire protection standards in conjunction with building construction and development in the State Responsibility Area (SRA). Over 90 percent of the unincorporated area of the County is located within the SRA. The County has authority to approve subdivisions and issue building permits and, therefore, is the "inspection authority" authorized in Title 14 "SRA Fire Safe Regulations". However, since the state Board of Forestry and Fire Protection certified the County Fire Code and Consolidated Fire Code under 14 CCR section 1270.03, the County Fire Code and Consolidated Fire Code apply in lieu of the SRA Fire Safe Regulations.

[[Regulation]]
California Code of Regulations Title 19 (**State Fire Marshal**) contains regulations that have been developed by the State Fire Marshal for the purpose of establishing additional fire protection for group occupancies, such as places of assembly, schools, high rise buildings, hospitals and organized camps.

2.3 Local Regulations and Standards

[[Regulation]]
County of San Diego Building and Fire Codes (Title 9, Divisions 1, 2 and 6, San Diego County Code of Regulatory Ordinances).. Following the October 2003 and fall 2007 wildfires, assessments were made of damaged and destroyed homes in an effort to identify areas where codes could be strengthened in order to enhance the chances of a structure surviving a wildfire. As a result, in February 2008, the County amended the Fire Code and Building Code to include strengthened ignition-resistive construction requirements, modifying the previous two-tiered system and requiring "enhanced" standards for all new construction.

County Consolidated Fire Code (Based on Title 9, Division 6, Chapter 1 of the County Code) http://www.sdcounty.ca.gov/dplu/docs/2009_Consolidated_Fire_Code.pdf. The County Consolidated Code is based on the County Fire Code and incorporates local fire district fire codes as ratified by the Board of Supervisors into a single document. The County Consolidated Fire Code includes notations where the local fire district(s) requirements differ from the County Fire Code. The County Consolidated Fire Code is the current fire regulations approved by the Board of Supervisors that apply in the various fire districts. The County Consolidated Fire Code has been certified by the California Board of Forestry and Fire Protection for use in lieu of "SRA Fire Safe Regulations" in CCR title 14.

Memorandum of Understanding Agreement between the United States Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG), California

Department of Forestry and Fire Protection (CAL FIRE), San Diego County Fire Chief's Association and the Fire District's Association of San Diego County (http://www.sdcounty.ca.gov/dplu/Resource/docs/3~pdf/MemoofUnder.pdf). The MOU was created to establish guidelines by which fire agencies can continue to require abatement of flammable vegetation without violating environmental regulations for the protection of habitats and species.

[[Regulation]]
Combustible Vegetation and Other Flammable Materials Ordinance [San Diego County Code of Regulatory Ordinances, section 68.401 et seq., Removal of Combustible Vegetation and Other Flammable Materials, http://www.amlegal.com] This ordinance addresses the accumulation of weeds, rubbish, and other materials on private property found to create a fire hazard and be injurious to the health, safety, and general welfare of the public. The ordinance finds that the presence of such weeds, rubbish, and other materials is a public nuisance, which must be abated in accordance with the provisions of this ordinance.

Local Fire Agencies' Ordinances. Certain codes like the Fire Code can be amended to be more restrictive than state regulations based upon local climatic, geological and topographical features that can have a significant effect on fire protection and emergency services. These amendments are based on fire agencies' findings and local conditions within the County of San Diego. Per state law, local fire district fire code amendments are effective only after they are ratified or modified by the Board of Supervisors. Health and Safety Code, section 13869.7(a) and (c).

3.0 TYPICAL ADVERSE EFFECTS

Generally, two types of adverse effects are typically associated with wildland fires: the immediate effects that occur during a wildland fire and the effects that occur in the aftermath. During a wildfire, people and structures are exposed to risk of loss, injury or death. Assessing and ranking the level of risk is always relative; unwise human action, for example, could be life-threatening even with all other factors at reasonable levels.

Since the level and type of risk can vary from project to project, prioritizing the project deficiencies (or combination of deficiencies) that create the biggest risk is difficult. In general, however, the following circumstances can result in increased fire related risks to people and structures (not listed in any particular order):

- Projects located adjacent to and within the WUI and/or that incorporate large open space preserves within the project design;
- High population and density in the WUI;
- Responses of people during a wildland fire (human behavior);

- Emergency response services (fire stations, equipment and personnel) that are inadequate to serve the project;

- Development projects that are built without ignition-resistive construction, interior fire sprinklers, and/or sufficient water supply (volume) and pressure;

- Inadequate access and evacuation options;

- Insufficient maintenance of access roads, signage, gates; and

- Lack of appropriate landscaping restrictions, including monitoring and maintenance, FMZs, and periodic fuel management monitoring.

A wildfire's aftermath typically leaves land scorched and exposed. Until the land rehabilitates, the exposed soils may contribute to adverse environmental impacts including air and water pollution and unstable soils conditions (mudslides). The end result of uncontrolled wildfire also includes debris from burned homes, some of which can be highly toxic, and can adversely impact the environment by polluting local waterways (streams and rivers).

4.0 GUIDELINES FOR DETERMINING SIGNIFICANCE

Section 15382 of the State CEQA Guidelines states that a significant effect on the environment means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project including land, air and water. **An affirmative response to, or confirmation of any one of the following Guidelines, will generally be considered a significant impact related to Wildland Fire and Fire Protection as a result of the project, in the absence of evidence to the contrary:**

1. ***The project cannot demonstrate compliance with all applicable fire codes.***

2. ***A comprehensive Fire Protection Plan has been accepted, and the project is inconsistent with its recommendations.***

3. ***The project does not meet the emergency response objectives identified in the Public Facilities Element of the County General Plan or offer feasible alternatives that achieve comparable emergency response objectives."***

The significance guidelines listed above have been selected for the following reasons:

The **first** guideline for determining significance is based on compliance with existing wildland fire regulations. Since the applicable regulatory requirements for a project will differ based on use type and extent of the WUI, all discretionary projects may be required to prepare a Fire Protection Plan (FPP) designed to assess a project's compliance with current regulatory codes and ensure that impacts resulting from wildland fire hazards have been adequately mitigated. The FPP describes ways to minimize and mitigate the fire problems created by the project or development.

The FPP is similar in concept to a Technical Report as authorized in the Fire and Building Codes. The FPP is prepared by a wildland fire behavior and fire code expert for review by the County and FAHJ. A Technical Report, which focuses on fire code and other fire protection issues for a specific industrial, commercial or special risk occupancy, should accompany a FPP if a complex fire code issue makes it necessary. A Technical Report should be separate from, yet coordinated with, related provisions of the FPP. The County DPLU maintains a list of persons currently authorized to prepare FPPs for projects within its jurisdiction.

The authority to require FPP can be found in the County Fire Code and the County Consolidated Fire Code.

Examples of regulatory requirements that a project will be required to meet include the California Code of Regulations and County Fire Code. Given the complexity of wildland fire regulation and the numerous agencies that have regulatory responsibility related to wildland fires, applicable regulations will be determined on a project-by-project basis. Due to the potential severity of impacts from fire in wildland areas, the existing laws are stringent and regulate many aspects of wildland fire and their hazards, including building standards, fuel modification, water availability/flow, and/or access.

Because project site constraints vary from property to property, fire codes provide for modifications when the following requirements are met:

- Special individual reasons make the strict letter of the code impracticable;

- The modification is in compliance with the intent and purpose of the code; and,

- Such modification does not lessen health, life and fire safety standards.

Any project that does not show compliance with regulatory codes or does not include a valid risk assessment for the project site may result in a potentially significant impact of wildland fire hazard.

The **second** guideline applies to all projects that are required to model fire behavior in mature vegetation on and near the site (Fire Behavior Modeling) as part of its Fire Protection Plan. The Fire Behavior Model will evaluate a worst-case scenario wildland fire based on site topography, fuel loads, atmospheric conditions, and fire intensity. From the results of the model, combined with the consultant's expertise, minimum fuel modification and brush clearance distances can be determined to ensure relatively safe building sites. These fuel-modeling programs are widely accepted and used throughout the fire fighting profession as a planning tool. The models were developed by expert fire-research scientists, but do not provide a total analysis of the threat. Modeling program limitations must be taken into consideration. Fire behavior history and professional experience may require greater or lesser requirements for individual projects, and such justification should be clearly articulated in the FPP.

The fire model gives general guidance and typically calculates behavior under worst-case weather conditions over time. Any project that would not be consistent with the consultant/fire authority's recommendations based on the Fire Behavior Modeling, fire history, and personal experience or expertise for that site may result in a potentially significant impact and may present significant risk of loss, injury or death.

The **third** guideline for determining significance is based on the need to have adequate fire services available in order to provide sufficient emergency response in the event of a wildfire or other emergency. Applicants are required to obtain a Project Facility Availability Form (DPLU Form #399F) that is to be completed and signed by the Fire Authority Having Jurisdiction (FAHJ) prior to formally submitting the project application to the County. The FAHJ will review the project and determine whether existing fire services are adequate to serve the project. A Project Facility Availability Form that shows that a project is not located within the fire district boundaries and is not eligible for service, does not meet the travel time requirements specified under the County's General Plan, is unable to implement the required FMZ, or is unable to provide adequate water fireflow and pressure may result in a potentially significant impact and may present significant risk of loss, injury or death. Travel time is determined by measuring the most direct reliable route from the nearest fire station obligated to respond to the site to the most remote portion of the project with consideration given to safe operating speeds for heavy fire apparatus and the types of roads being used and neighborhoods traveled. Fire agencies typically encourage use of major roads versus traveling through private residential neighborhoods. Travel time does not include reflex or reaction time, or on-scene size-up and set-up prior to attacking the fire, all of which are critical precursors of actual fire fighting. Travel time may be calculated by using NFPA 1142 Table C.11 (b), SANDAG layering, DPLU-GIS software travel time mapping, actual emergency travel time run data, or actual driving tests using fire apparatus. Deference is typically given to the FAHJ.

4.1 FIRE PROTECTION PLANS

A Fire Protection Plan is a document that describes the level of fire hazard that would affect or be caused by a proposed development and the methods proposed to minimize that hazard. The FPP also evaluates the consistency of the proposed project with applicable fire protection regulations. In order to minimize hazards and meet fire code requirements, the FPP may include recommendations that involve limitations on future land use on the subject property, building construction standards, vegetation management, access improvements, installation of fire suppression facilities, and other design measures. The FPP must include measures to address the specific location, topography, geology, level of flammable vegetation and climate of the proposed project site. The FPP must be prepared consistent with applicable fire codes and be accepted by the FAHJ and County. The plan must demonstrate compliance with the applicable fire code or how the measures proposed to reduce fire hazards are adequate to meet the intent of the code. The following elements must be addressed in a FPP required as part of the review of a discretionary permit application:

- Emergency Services - Availability and Travel Time;
- Access for emergency services and evacuation of residents (primary and, if required, additional access);
- Firefighting Water Supply;
- Fire Sprinkler System;
- Ignition Resistant Construction; and,
- Defensible Space, Ornamental Landscaping and Vegetation Management

Each of these design considerations is detailed below and includes discussions on relevant Federal, State and local codes and the standards that are used to ensure compliance with the regulations. Failure to comply with either the fire code/regulations or the standards may result in a potentially significant impact. Refer to section 2 “Report Format and Content Requirements Wildland Fire and Fire Protection”.

4.2 PLAN ACCEPTANCE PROCESS

Fire Protection Plan preparers should work with the local FAHJ. Once the plan is prepared and submitted to the local fire agency, it will be reviewed for compliance with all applicable ordinances and regulations. If practical difficulties in achieving compliance have been identified and modifications or alternate methods are proposed, they must also be evaluated by the FAHJ. If the FAHJ determines that the plan is incomplete or inadequate, it should be sent back to the preparer with a letter explaining why. If the plan proposes modifications due to practical difficulties in meeting the code requirements, the FAHJ should determine whether to grant a modification. If the FAHJ approves a modification, the FAHJ should send a letter to the applicant and DPLU finding that special individual reasons make compliance with the strict letter of the code impracticable, the proposed modification complies with the intent and purpose of the code, and the modification does not lessen health, life and fire safety requirements. The FAHJ must include an explanation for each finding.

Concurrent with the process at the local FAHJ, the County DPLU will also review the plan. The plan will be reviewed for completeness and code compliance. If the plan is found to be complete, code compliant and to have been accepted by the FAHJ, an acceptance letter will be prepared. If the plan is found to be incomplete, to be inconsistent with code requirements or not to have been accepted by the FAHJ, DPLU will not accept the plan.

The County Fire Code and the County Consolidated Fire Code include a procedure for appealing the decision of the FAHJ relating to the application of the applicable fire code.

The County will make every effort to provide sufficient time for the FAHJ to review and comment on the proposed project and associated Fire Protection Plan. If comments are not received from the FAHJ in a timely manner, DPLU will assume that the FAHJ has no comments on the proposed Fire Protection Plan. DPLU will advise the final decision-making body of the FAHJ's failure to comment on the Fire Protection Plan.

5.0 STANDARD MITIGATION AND PROJECT DESIGN CONSIDERATIONS

To effectively mitigate wildland fire hazards in Southern California, a multi-lateral approach that involves Federal, State, and local governments and fire agencies is usually necessary. Collectively, the County and fire agencies work together to prevent the loss of life in wildland fires; prevent the ignition of structures by wildland fires; prevent the encroachment of wildland fire upon communities; prevent a wildland-caused structural conflagration; prevent the spread of a structure fire to the wildland; and to limit the size of wildland fires.

Wildland fire mitigation measures and design considerations used in the planning and land use approval process vary depending on the wildland characteristics of the site and surrounding area. In order to allow this flexibility in project design, many wildland fire regulations are written using language that is often subject to interpretation (e.g. water supply may consist of reservoirs, pressure tanks, elevated tanks, water mains or other fixed systems …") as opposed to codes that are absolute (e.g. "Class "A" roofing material shall be required"). This may allow some projects with unique geographic and topographic conditions to adequately mitigate wildland fire risks through project design.

5.1 Emergency Services

Fire protection and emergency services are among the most vital and basic of community needs. Firefighters, who are generally the first responders to disasters, must be prepared to respond quickly and effectively to all types of emergencies, including wildland fires. For this reason, the provision of adequate facilities for fire protection and emergency services is fundamental to protecting the health, safety and general welfare of the residents of San Diego County.

5.1.1 Emergency Fire Response

5.1.1.1 Applicable Codes/Regulations

San Diego County General Plan

5.1.1.2 Applied Standards

Projects must comply with the emergency travel time requirements specified in the County General Plan. Travel time is defined as the estimated time it will take for a responding agency to reach the furthest structure in a proposed development project. Travel time is determined by measuring the safest, most direct, appropriate and reliable route between the fire station and the project with consideration given to safe operating speeds for heavy fire apparatus. Travel time does not include reflex or reaction time, or on-scene size-up and set-up prior to attacking the fire, all of which are critical precursors to actual fire fighting. Travel time may be calculated by using NFPA 1142 Table C.11(b), SANDAG layering, DPLU-GIS software travel time mapping, actual emergency travel time run data or actual driving tests. If the travel time determined in the FPP is less than the travel time determined by the FAHJ, the travel time determined by the FAHJ shall take precedence.

NOTE: Stations that are seasonal (not open all year) or staffed with volunteers without legal responsibility to respond to emergencies, should not be used for determining consistency with travel time requirements of the County General Plan.

Where projects exceed these time requirements, the Director of Planning and Land Use may, upon concurrence with the FAHJ, accept mitigation measures. Acceptable mitigation may include, but is not limited to:

- Alternative construction methods and measures not otherwise required;
- Automatic Aid agreement(s);
- Upgrading existing facilities or infrastructure;
- Constructing new facilities; or
- Implementing a long-term binding agreement aimed at reducing the response time to acceptable limits

Proposed mitigation should be implemented prior to implementation of the discretionary permit (prior to recordation of the final map for subdivisions and prior to issuance of building permits or use and reliance for use permits/site plans).

If a modification is proposed, the requirements of the County Fire Code and County Consolidated Fire Code specific to modifications apply. Documentation of mitigation should appear not only in the FPP, but also in the files of the FAHJ as prescribed in the Fire Code.

5.2 Fire Access Roads

Developments with inadequate access (e.g. long roads with a single access point, roads over steep grades, improper road surfaces, and/or narrow roads) significantly contribute to the inability to effectively evacuate residents during a disaster (wildfire, earthquake, or flood) and provide necessary emergency access for fire, ambulance, or law enforcement personnel.

5.2.1 Maximum Length of Dead-End Roads

5.2.1.1 Applicable Codes/Regulations

County Fire Code and County Consolidated Fire Code [This code language coincides with the dead-end requirements found in the California Code of Regulations, Title 14, section 1273.09 (Dead-End Roads)]

5.2.1.2 Applied Standards

The intent of limiting the allowable length of a dead-end road is to ensure that firefighters have access flexibility to deal with changing dynamics in wildfires and other emergencies, and that civilians have safe, reliable and known evacuation alternatives during emergencies.

In part, the concept of dead-end road regulations relates to limiting the number of persons attempting to evacuate on the road and to limiting the time needed for safe evacuation. Steep, narrow and winding roads delay evacuation. Long dead-end roads in rural wildland areas place people and emergency personnel at increased risk. The following general standards apply to projects that utilize dead-end roads.

- Road length is measured from the beginning of the primary access road at a point where one can evacuate in two different directions (which may be off-site), measured to the end of the most remote cul-de-sac. Refer to Figure 3 for guidance on measuring dead-end road length.

- Projects with an access road that exceeds the regulations for dead-end roads should first consider providing an alternate means of access and egress before resorting to other possible alternatives (section 5.7 and 5.8).

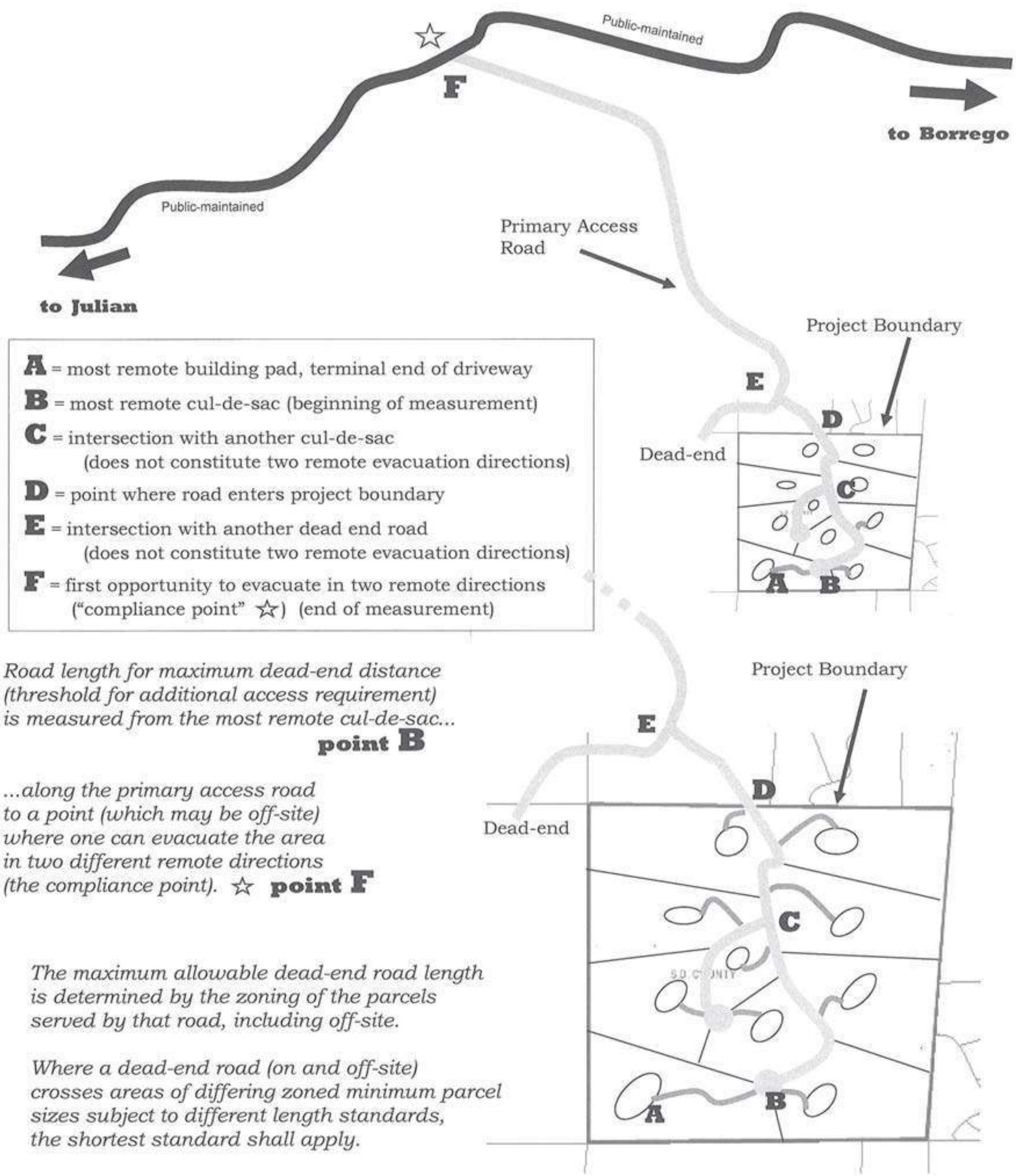
- An important factor in evaluating existing and proposed access roads is road connectivity. When feasible, projects should extend on-site roads to the edge of the property for possible future connectivity.

- In order to ensure that necessary access to the project site remains available in perpetuity, the applicant needs to provide evidence that a permanent and reliable right of access has been obtained. These rights would generally be in the form of an easement that runs with the land.

- Access may be proposed over tribal lands held in trust only if the Tribe waives its sovereign immunity and allows the Tribe to be sued in state court to enforce the right of access over the tribal lands. The requirement to waive sovereign immunity does not apply if the Bureau of Indian Affairs grants the access rights.

- Security (privacy) gates or other types of barricades are generally discouraged as they can obstruct civilian egress and responder ingress during a fire emergency. However, in certain circumstances, gates can be allowed if they provide a rapid and reliable means of firefighter ingress and unobstructed egress for civilian evacuation as determined by the FAHJ. For example, entry gates positioned at the entrance to a subdivision must provide for rapid entry by emergency responders. The rapid opening of the gate for responders may be activated by personnel stationed at the gate on a 24-hour basis, emergency vehicle traffic signal pre-emption strobe detectors, close proximity public safety radio transmissions, battery back-up with "lock open" on power failure, or key-operated electric override switch. In all cases, exiting from the subdivision through the gated entry should be unobstructed and not require any activation measures unless the FAHJ assumes responsibility to activate the gate during times of emergency. All gates must comply with County Fire Code and County Consolidated Fire Code.

Figure 3
Guidance for Determining Primary Access Road Length



5.2.2 Fire Access Road Width

5.2.2.1 Applicable Code/Regulations

County of San Diego Department of Public Works Public & Private Road Standards, County Fire Code and County Consolidated Fire Code

5.2.2.2 Applied Standards

The minimum width identified in the code section above should not be obstructed at any time. Parking should be outside the required fire access road width. The exception allowance under the code is often considered for reductions in width for a short section where extreme topographic constraints make it impossible to obtain the minimum required width or where impacts to sensitive biological resources can be avoided. This finding should be supported by the Director of Public Works, the FAHJ and the County Fire Marshal on the basis of extreme topographic or biological constraints.

5.2.3 Fire Access Road Grade

5.2.3.1 Applicable Code/Regulations

County Fire Code and County Consolidated Fire Code

5.2.3.2 Applied Standards

Full compliance with the code.

Exceptions would be considered where full compliance with the standard could not be achieved because of extremely steep terrain. An example of an exception would include a short (e.g. 100 feet) section of slightly more than 20% grade where the road is relatively straight before, during and after the exception, line-of-sight is maintained, and fire engine speed can be maintained. The grade requirement is based largely on the ability of an engine to get proper traction at a standstill and, to a lesser degree, on the potential for fire hose or other equipment to spill out of the engine because of extremes in grade.

5.2.4 Fire Access Road Surface Type

5.2.4.1 Applicable Code/Regulations

County Fire Code and County Consolidated Fire Code

5.2.4.2 Applied Standards

Full compliance with the code.

5.3 <u>Water</u>

Providing adequate water supply, volume and pressure, is crucial in fighting not only wildland fires, but smaller scale residential fires as well. History has shown that most fire related responses are to residential fires. In some cases, however, residential fires escape the confines of the house and become wildfires. As such, it is important that water resources are adequate to meet the volume and flow needs to properly fight fires either at an individual home or the surrounding neighborhood. A municipal water supply (waterlines and hydrants) is always preferable to on-site tanks.

5.3.1 Inside Water District

5.3.1.1 Applicable Code/Regulations

<u>County Fire Code and County Consolidated Fire Code</u>

5.3.1.2 Applied Standards

Full compliance with the code. (Exceptions are identified in the code.) For water main extensions, the measurement of distance to the water main should be taken from the existing main to the nearest portion of the subject parcel (to the property line), not to the proposed hydrant location.

5.3.2 Outside Water District

5.3.2.1 Applicable Code/Regulations

<u>County Fire Code and County Consolidated Fire Code</u>

5.3.2.2 Applied Standards

Full compliance with the code. Structures or clusters of structures substantially greater than roughly 5,000 square feet should provide additional water storage.

5.4 <u>Ignition-Resistive Building Construction and Fire Protection Systems</u>

Following the October 2003 wildfires, and again after the firestorm of fall 2007, the County assessed damaged and destroyed homes in an effort to identify areas where building codes could be strengthened to enhance the chances of a structure surviving a wildfire. As a result, in June 2004, and again in January 2008, the County amended the Fire Code and Building Code to improve the chances of a structure surviving a wildland fire.

5.4.1 Ignition-Resistant Construction

5.4.1.1 Applicable Code/Regulations

*County Building Code, County Fire Code and County Consolidated Fire Code*

5.4.1.2 Applied Standards

Full compliance with the code/regulations

5.5 Defensible Space, Ornamental Landscaping and Vegetation Management

History has shown through structural losses experienced in the Witch Creek, Harris, Rice, Poomacha, Cedar, Paradise, Otay, Harmony, Viejas, Gavilan and Pines Fires that defensible space is a critical factor of structure survival. By ensuring defensible space around structures, fire fighting teams are provided a line of defense to protect homes and other valued assets at risk of wildland fires. In February 2004, the Board of Supervisors adopted amendments to the County's Combustible Vegetation and Other Flammable Materials Ordinance in an effort to reduce the build-up of combustible vegetation and require adequate fuel modification around structures.

5.5.1 Fuel Modification and Setback from Property Line

5.5.1.1 Applicable Code/Regulations

*Chapter 4 of Division 8 of Title 6 of the San Diego County Code, Section 68.40 – Removal of Combustible Vegetation and other Flammable Materials;*

*County Fire Code and County Consolidated Fire Code*

*California Public Resource Code section 4291*

5.5.1.2 Applied Standards

Projects located in a Hazardous Fire Area need to include Fuel Management Zones (FMZ) surrounding all structures that are designed for human habitation or use or a building designed specifically to house farm animals. An FMZ is a 100-foot area surrounding and extending in all directions from all structures, in which all flammable vegetation or other combustible growth is managed to reduce the threat from wildfires.

The County and FAHJ may require additional FMZ or allow for modifications to the FMZ depending upon unique site characteristics. For example:

1) The FMZ should typically be accommodated within the boundaries of the project. However, where it is determined that practical difficulties make it infeasible to do that, offsite areas could be included, provided that offsite fuel

modification is assured by an enforceable easement from the neighboring property owner or another legally enforceable mechanism.

2) Normally, the FMZ will surround the immediate building area. However, a FMZ surrounding the entire development area may be considered on a project by project basis.

3) Any project that is required to prepare and implement a full FPP may also be required to prepare a **Fire Behavior Model** that evaluates a worst-case scenario wildfire based on site topography, weather and vegetation. The modeling, combined with the consultant/fire authority's expertise may result in the consultant proposing greater or lesser buffers to minimize building and occupant safety risks. Under no circumstances shall the FMZ be less than 30 feet wide.

Additionally, all ornamental landscaping needs to be consistent with County's Landscape Ordinance and Landscape Design Manual. Projects requiring landscape plans should clearly identify the type of plant materials, locations and spacing of plant materials, and irrigated and non-irrigated landscaping. The landscape consultant may recommend in the text the inclusion or exclusion of specific varieties for review by the County landscape architect.

Maintenance requirements and suggestions for landscaping in FMZs are provided in:

- The County Fire Code (http://www.amlegal.com)
- "Fire, Defensible Space *and You*…" (http://sdcounty.ca.gov/dplu/fire_resistant.html);
- "Fire-safe Landscaping Can Save your Home" (http://www.sdcounty.ca.gov/oes/docs/fswy12.pdf); and
- The California Native Plant Society's "Native Plant Landscaping to Reduce Wildfire Risk" (http://www.cnpssd.org/fire/ReduceFireRisk.pdf).
- "Ready, Set, Go" (http://www.readyforwildfire.org/)

5.6 Design Strategy – Sheltering

Shelter-in-Place Strategy. **Shelter-in-Place is a possible design concept with early relocation (early evacuation) of residents to a safe location being the preferred action.** All of the following minimum design standards must be implemented in order to qualify for consideration of a Shelter-in-Place concept. Additional standards, or modification to the standards below, may be required by the FAHJ or the Director of Planning and Land Use.

- The primary access roadway should meet or exceed minimum fire code requirements (in terms of width, paving, posting, etc.), and have no potential constraints or bottlenecks on or off-site until it reaches two directions of egress from the area;

- All new structures within the entire proposed project, regardless of distance to property line or WUI area, should be built using Ignition-Resistant Construction (County Building and Fire Codes), including fire sprinklers;

- The project should be designed with adequate and properly managed Fuel Modification Zones and properly maintained ornamental landscaping consistent with the County's Landscape Ordinance and Landscape Design Manual.

- The developer must provide evidence that resources exist to adequately and consistently enforce fuel management regulations for the life of the project (a funding mechanism should be implemented to ensure fire agency enforcement staffing in perpetuity);

- The developer must provide evidence that resources exist to provide substantial and effective annual public outreach to educate residents on fire safety and emergency response for the life of the project (a funding mechanism must be implemented to ensure fire agency has staffing for public education in perpetuity);

- Any flammable vegetation/habitat areas that are proposed within a shelter-in-place development should be carefully studied and evaluated as part of the FPP.

- Shelter-in-Place is more appropriate for projects that have a strong form of supervision and leadership, frequent and on-going fire safety training and drills, abundant fire safety measures, and full site management that is accountable for maintaining fire safety measures. Examples include organized camps or similar uses that can be regulated via an ongoing discretionary permit.

5.7 Alternatives to the Standards

Due to unique site characteristics, there may also be combinations of site/project improvements and opportunities that make adequate mitigation achievable. The standards listed below are considered a "starting point". Nothing in these standards precludes a FAHJ and/or the County from identifying other measures that would adequately mitigate unique site characteristics/conditions.

- The type and number of fire apparatus available to serve the project are reliable, well-staffed and redundant. Examples include multiple engines with full-time career or reserve staff, with travel times approximating the "first–in" engine.

- Adequate funding is legally committed in perpetuity to the fire authority for staffing inspections, enforcement and educational programs.

- Vegetation around the access and project has low fire-carrying potential and flame length.

- The project is supported with a public water system with fire hydrants along access roads at distances and with fireflow as prescribed in the fire code.

- An adequate fuel management zone separates the project and open space areas.

- The project is located in a developed area or an area with long-standing agricultural operations.

- The project provides funding in perpetuity to support adequate fire agency staffing for fire suppression, fire code enforcement and community safety education. An example would be the establishment of a Community Facilities District to assist in the long-term funding of fire district operations and management.

- An on-going discretionary permit that runs with the property that includes conditions that regulate activities/operations. An example would be a Major Use Permit or an Administrative Permit.

- Adequate road widening and improved road surfacing that generally improves the access to the subject property and surrounding uses.

- Security (privacy) gates or other types of barricades are generally discouraged as they can obstruct civilian egress and responder ingress during a fire emergency. However, in certain circumstances, gates can be allowed if they provide a rapid and reliable means of firefighter ingress and unobstructed egress for civilian evacuation as determined by the FAHJ. Refer to section 5.2.1.2 of these guidelines.

5.7.1 Required Findings for Alternatives to Standards

Certain site-specific situations may make the strict adherence to the County Fire Code or County Consolidated Fire Code either impracticable or infeasible. The fire code official is authorized to approve a modification to the fire code requirements, such as an alternative material or method of construction, where the fire code official finds that the proposed design is satisfactory and complies with the intent of the provisions of the code. If a modification is proposed, the requirements of the County Fire Code and County Consolidated Fire Code specific to modifications apply. Documentation of the modification must appear not only in the FPP, but also in the files of the FAHJ as prescribed in the Fire Code. The modification must be supported by “findings” including the following:

- That special individual reasons that make the strict letter of the code impracticable;
- That the modification is in compliance with the intent and purpose of the code; and,
- A map showing the proposed location of the mitigation/exception measures.
- That such modification does not lessen health, life and fire safety standards.

5.7.2 Scenarios where Acceptable Alternatives are Unlikely

There may be situations where a combination of site conditions/constraints, such as those listed below, are so severe that it is unlikely that sufficient mitigation could be provided.

- Project site is surrounded by large wildland areas with little existing or planned surrounding development.
- The primary access road is substandard with no proposal to adequately/reasonably improve it.
- Project site is surrounded by steep slopes and significant topographical constraints that could intensify fire behavior or limit fire suppression operational flexibility.
- Legal access rights have not been obtained for the primary access road and any necessary secondary access road.
- Fire stations available to serve the project site are located substantial distances from the project site such that response by multiple units is significantly delayed.
- The available water supply for fire suppression is limited to tanks, pools or ponds that have limited capacity and require pumping operations

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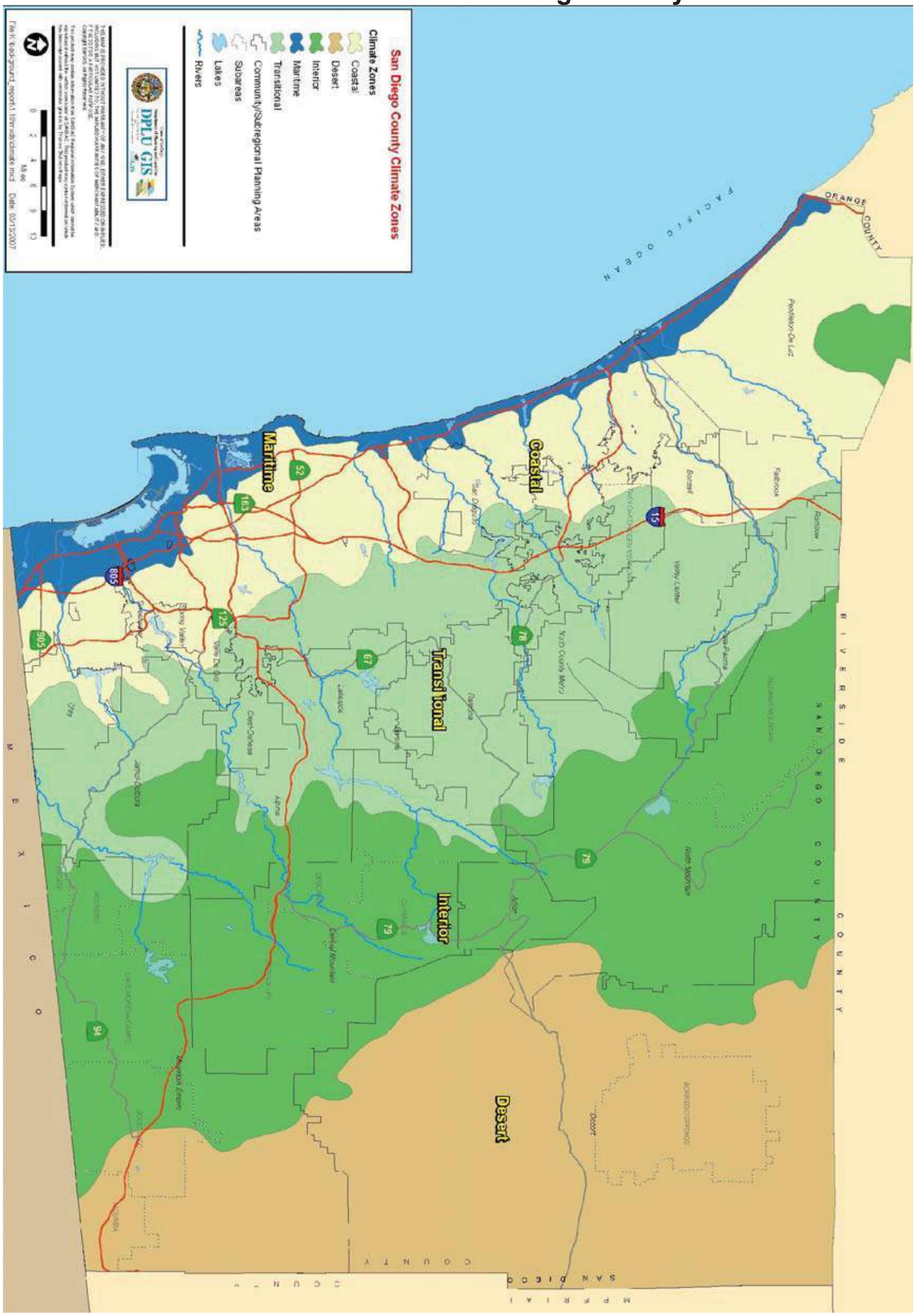
Figure 1
Climate Zones in San Diego County



[ATTACHMENT A]

DEFINITIONS

Defensible space – An area either natural or man-made, where material capable of allowing a fire to spread unchecked has been treated, cleared or modified to slow the rate and intensity of advancing wildfire. This will create an area for increased safety for emergency fire equipment and evacuating or sheltering civilians in place and a point for fire suppression to occur.

Fire authority having jurisdiction (FAHJ) – The designated entity providing enforcement of fire regulations as they relate to planning, construction and development. This entity may also provide fire suppression and other emergency services.

Fuel modification zone – A strip of land where combustible vegetation has been thinned, modified or both and partially or totally replaced with approved drought-tolerant, fire-resistant and/or irrigated plants to provide an acceptable level of risk from vegetation fires. Fuel modification reduces radiant and convective heat, thereby reducing the amount of heat exposure on the roadway or structure and providing fire suppression forces a safer area in which to take action.

Hazardous fire area – Any geographic area mapped by the State or local jurisdiction as a high, or very high fire hazard area, or as set forth by the FAHJ that contains the type and condition of vegetation, topography, weather, and structure density to potentially increase the possibility of vegetation conflagration fires shall be considered a hazardous fire area.

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Structure – A residence and attached garage, building or related facility that is designed primarily for human habitation or buildings designed specifically to house farm animals. Decking, fences, and similar facilities are not considered structures for the purposes of establishing the limits of the fuel modification zone. Sheds, gazebos, and detached garages less than 250 square feet which are located within the fuel modification zone, shall be designed, constructed and placed such that they do not require the fuel modification zone to be increased beyond that required for the primary structures on the property.

Vegetation Maintenance – The long-term proper care and upkeep of trees in order to reduce the flammability of a tree species. Maintenance includes, but is not limited to, the pruning and removal of dead twigs, leaves or fronds and branches.

Wildland fuel – Any timber, brush, grass, or other flammable vegetation, living or dead, standing or down, that is not classified as ignition-resistive.

Wildland-urban interface – The area where structures and other human developments meet or intermingle with undeveloped wildland (as defined in the County Fire Code, County Consolidated Fire Code and County Building Code.)

[Attachment B]

SUMMARY OF REVISIONS

Guidelines for Determining Significance and Report Format and Content Requirements for Wildland Fire and Fire Protection were originally approved on March 19, 2007. The following is a summary of revisions made since original document approval.

Second Revision, August 31, 2010

- Updated to incorporate changes to the County Fire Code and County Consolidated Fire Code
- Improved standards for dead end roads
- Improved standards for Shelter-in-Place
- Various editorial changes

First Revision, December 19, 2008

- Updated to incorporate changes to the Fire Code and the Building Code
- Updated to change California Department of Forestry (CDF) to CAL FIRE
- Added standards for dead end roads
- Various editorial changes

COUNTY OF SAN DIEGO

REPORT FORMAT AND CONTENT REQUIREMENTS

WILDLAND FIRE AND FIRE PROTECTION

LAND USE AND ENVIRONMENT GROUP

Department of Planning and Land Use
Department of Public Works

Second Revision
August 31, 2010

PURPOSE

The purpose of this document is to describe the format and content of a Fire Protection Plan. These guidelines apply to maps, spreadsheets and reports completed for all privately initiated discretionary projects reviewed by the Department of Planning and Land Use. These guidelines are designed to:

- Ensure the quality, accuracy and completeness of reports and to aid in staff's ability to review reports/assessments in a consistent manner

- Provide enough information to make appropriate planning decisions and to make determinations regarding conformance with applicable regulations

- Increase the efficiency of the environmental review process and to avoid unnecessary time delays

TABLE OF CONTENTS

TABLES

1.0 INTRODUCTION

The Fire Protection Plan (FPP) shall follow the formats and guidance in this document. The overall length of the FPP and the amount of information included will vary depending on the size and scope of the project, the combustible vegetation threat, the unique topographical/geographical conditions of the site, and the type of emergency response (i.e. fire or medical). Following the submittal of a discretionary project, the County's Scoping Letter may require that one or more of the following be submitted:

- <u>Fire Protection Plan (Full Report)</u>
  May be required, pursuant to the County Fire Code and County Consolidated Fire Code, for larger projects or where the site has topographic, geographic, and/or combustible vegetation conditions that require detailed review and analysis.

- <u>Fire Fuel Assessment (Fire Behavior Model)</u>
  May be required in conjunction with a Fire Protection Plan (Full Report) for larger projects and/or projects with high fuel loads and/or steep topography.

- <u>Fire Protection Plan (Letter Report</u>)
  Can be authorized by the County for projects that are located within the State Responsibility Areas and limited to infill projects with virtually no wildlands in the immediate vicinity. The FPP – Letter Report fulfills the requirements of the County Fire Code and County Consolidated Fire Code and may be prepared by the project applicant or the applicant's representative. The FPP – Letter Report is a simple narrative documenting site information and fire code compliance, and is not intended to require the services of a Fire Consultant. If upon review of the FPP – Letter Report code issues are determined to be unresolved or inadequately addressed, a Full Report will be required.

1.1 <u>General Guidelines for Writing a Fire Protection Plan</u>

Contents

- The overall content of an FPP is outlined in the County Fire Code and the County Consolidated Fire Code.

Format

- Unless an exception is granted by the County, every draft FPP shall have the components described in this Report Format and Content Requirements document.

- **DOCUMENTS THAT DO NOT CONTAIN ALL OF THE MANDATORY SECTIONS DESCRIBED IN THIS DOCUMENT WILL NOT BE ACCEPTED AS COMPLETE BY COUNTY STAFF UNLESS AN EXCEPTION IS APPROVED BY THE DIRECTOR OF THE DEPARTMENT OF PLANNING AND LAND USE (DPLU).**

Electronic Format

- Any draft text submitted electronically to the County for comment and review shall be formatted in Microsoft Word (2003 version or later). Staff may also request draft text to be submitted in PDF files. The electronic submission of draft text should be placed on a CD.

Document Length

- The length of the draft FPP must be kept to the absolute minimum. The document shall be only as long as required to accurately convey the pertinent fire code issues and to contain the level of analysis required to legally comply with the CEQA. Extraneous and "filler" material must always be omitted from the FPP.

Editorial Matters

- The draft FPP must be properly edited for correct format, spelling, grammar, page numbering, internal consistency and other editorial matters. It must also be consistent with project submittals. The draft FPP must be prepared in a clear format, written in clear language for review and understanding by decision-makers and the public (see CEQA Guidelines, § 15140). Complex and extremely analytical materials must be summarized and simplified, with the details and harder to comprehend materials placed in the technical appendices.

- The draft FPP must be written in a factual and objective manner. The document must provide a good-faith effort of full disclosure (e.g. if code requirements are not met, that information must be stated, accompanied by proposed mitigation measures).

- The draft FPP must cite all documents used in its preparation including, the section number of any relevant codes or regulations. Other documents may be incorporated by reference, provided that the referenced document is summarized in the draft FPP and is made available for public inspection at a public place identified in the draft FPP, which shall include a County office.

1.2 General Guidance and Key Compliance Points for Preparing a Fire Protection Plan

- Include only information that is directly pertinent to the FPP. Do not include extraneous, surplus, and anecdotal information.

- Instead of simply referring to "County Policy ...," specify whether the cited document is an official Board of Supervisors Policy, a Departmental Policy, or an informal policy or practice.

- Use consistent terminology. For example, do not refer to “Fire Behavior Model” in one section of the report and “Fire Model” in another.

- Present discussion and analysis with a tone that is professional, academic and impartial, rather than argumentative or project advocacy.

- Where other documents are incorporated by reference, explain the purpose for doing so and briefly describe or summarize the part or parts incorporated. The reference should be placed in the applicable narrative sections.

- Provide factual SUPPORT and RATIONALE for all conclusions stated.

- Check the accuracy of all factual statements. For example, do not state that a County regulation sets forth a particular requirement if, in fact, it does not.

- With the exception of the FPP – Letter Report, reports should be technical in nature.

- Reports should be concise and written in a professional manner suitable for peer review. Staff may reject reports based on quality if the report is written in such a manner that a timely and accurate review cannot be completed.

- Attached plot plans and maps must be to standard engineering scale and contain a north arrow and both number and bar scales. A scale of *1" = 160 feet, or 1" = 80 feet* would not be acceptable. When maps are reduced, they must be scalable by using a standard engineering scale (e.g. 1" = 10' (or 100) thru 60' (or 600') in 10 foot intervals). Irrespective of scale, all maps and plot plans must be **clearly legible** to County staff.

- In draft copies of the report, all changes made in response to staff comments must be shown in strikeout/underline form. "Strikeout/underline" draft and "clean" copies should be submitted simultaneously. Final copies of the report must be clean, with all editing marks removed.

- The Draft Fire Protection Plan will be reviewed for technical accuracy and completeness by a County Fire Code Specialist and the fire district's Fire Marshal, if appropriate. The plan is considered to be draft until County staff determines the report to be complete.

- The FPP shall use mandatory, not permissive language, as the document will be binding on the project if the project is approved.

2.0 REPORT FORMATS

2.1 <u>Fire Protection Plan – Full Report Outline</u>

BINDER COVER & COVER PAGE

The Cover Page of the FPP Full Report shall include the following information:

- Project common name
- Project applications numbers. Must include all associated discretionary permit numbers (e.g.TM XXXX, TPM XXXXX, ZAPXX-XXX) and the environmental log number (Log No. XX-XX-XXX)
- Date of the original report, followed by the date(s) of all iterations
- Principal author's name, firm name and address
- Signature of principal author
- Project applicants' names and addresses
- A statement that reads: "*Prepared for the County of San Diego*"
- Color photo of the project site

TABLE OF CONTENTS AND HEADINGS

The table of contents must follow the order and format outlined in this document. Page numbers should be assigned when possible. Titles of each attachment/appendix should be listed in the order in which they are found in the document. The Table of Contents must be formatted in the following manner:

CHAPTER I. CHAPTERS SHALL BE SPECIFIED BY NUMBER AND SHALL BE PRESENTED IN BOLD AND IN ALL CAPS

I.I <u>First level subchapters shall be specified by number and shall be presented in upper and lower case, bold, and underlined</u>

I.I.I Second level subchapters shall be specified by number and shall be presented in upper and lower case, and bold.

I.I.I.I Third level subchapters shall be specified by number and shall be presented in upper and lower case, italics, and bold.

EXECUTIVE SUMMARY

The purpose of the Executive Summary is to provide a quick reference for the public and decision-makers. Therefore, the language should be less technical than that used in the remainder of the document and should be no more than one page in length. The Executive Summery should include a brief summary of the project, the topographic/geographic and combustible vegetation conditions/challenges of the site and surrounding areas, existing fire related services, potential project impacts/issues and proposed mitigation. The summary should include a brief discussion of anticipated fire behavior in the vicinity, based in part on fire behavior modeling (expanded in the body of the FPP). No information should be provided in the summary that is not further explained elsewhere in the document.

Chapter 1. INTRODUCTION

Every Fire Protection Plan shall include the following introductory language:

This Fire Protection Plan (FPP) has been prepared for the (***insert common name of the project here***). The purpose of the FPP is to assess the potential impacts resulting from wildland fire hazards and identify the measures necessary to adequately mitigate those impacts. As part of the assessment, the plan has considered the property location, topography, geology, combustible vegetation (fuel types), climatic conditions, and fire history. The plan addresses water supply, access (including secondary/emergency access where applicable), structural ignitability and fire resistive building features, fire protection systems and equipment, impacts to existing emergency services, defensible space, and vegetation management. The plan identifies and prioritizes areas for hazardous fuel reduction treatments and recommends the types and methods of treatment that will protect one or more at-risk communities and essential infrastructures. The plan recommends measures that property owners will take to reduce the probability of ignition of structures throughout the area addressed by the plan.

1.1 <u>Project Location, Description and Environmental Setting</u>

1.1.1 Project Location

Discuss the project location in the local and regional context. Include a copy of the site plan/plot plan with topographical overlay. If the subject site is adjacent to steep topography or dangerous fuels, additional mapping information may be required.

1.1.2 Project Description

Provide a very detailed description of the project, including all on-site and off-site components. An 8.5”x11” or 11”x17” copy of the proposed subdivision map/plot plan must be attached to the report as a numbered figure(s). The project description should be as detailed as possible and, at a minimum, include the following information (additional information may be required):

- Size of project site and area proposed for development.

- Purpose and scale of proposed uses associated with the project, such as residential development or recreational camping.
- Proposed structures (size, location, purpose, etc.).
- Location of all easements, including those for biological open space, steep slopes, riparian areas, limited building zones, utilities and roads.
- Proposed or potential uses within open space or riparian areas.
- Off-site improvements, such as for roads or utility extensions, and brief analysis of existing off-site road conditions (e.g. width, grade, and paving).

1.1.3 Environmental Setting

Describe the physical characteristics of the subject site and surrounding areas. At a minimum, the Environmental Setting section must include the following information:

- Dates of all site inspections/visits conducted
- Topography
- Vegetation (type and density)
- Fuel loads
- Fire history for the area
- Elevation
- Climate (general and seasonal)
- Public and private ownership of land in the vicinity, particularly any preserved lands adjacent or contiguous to the site
- A description of the existing land uses on site and on surrounding lands

Chapter 2. GUIDELINES FOR THE DETERMINATION OF SIGNIFICANCE

Detailed guidelines for the determination of significance are identified in section 4 of the Wildland Fire and Fire Protection Guidelines for Determining Significance. This section of the FPP must list those thresholds as described under section 4 and explain how the project complies with those thresholds.

Chapter 3. ANTICIPATED FIRE BEHAVIOR IN THE VICINITY

The applicant should provide a fairly brief narrative of anticipated fire behavior in the project vicinity in terms of fuels, terrain, weather, and intensity, both before and after mitigation (if any). This narrative should include a brief summary of fire behavior modeling results, and set the tone for project analysis and mitigation measures that follow. This is the appropriate chapter in which to review FIRE HISTORY.

Chapter 4. ANALYSIS OF PROJECT EFFECTS

This section must include an evaluation of project compliance with the Significance Guidelines listed in section 2.0, above. The project must be analyzed to identify potential adverse impacts and to identify adequate mitigation measures for impacts resulting from wildland fire hazards. At a minimum, an analysis must include an evaluation of the following areas:

4.1 Adequate Emergency Services

This section of the report must discuss the following:

- Fire jurisdiction providing service, location of the nearest fire station obligated to respond, and its emergency responsibility
- Travel distance and travel time (include methodology used)
- Compliance/non-compliance with the San Diego County General Plan
- First alarm response to wildland fire and to structure fire

4.2 Fire Access

The analysis must include a description of the existing off-site and proposed on-site road network, including the following:

- Main/additional access
- Road widths, angles of approaches/departures, obstructions (gates), fire lane marking and turnarounds, including analysis of off-site roads from a public-way and all deviations from fire code requirements
- Road grades and surface improvements
- On-going road maintenance (identify entity responsible and private funding mechanism)
- Compliance/non-compliance with codes/regulations and significance standards

4.3 Water

4.3.1 For projects inside a Public or Private Water District:

- Provide a copy of the Water Service Availability Form along with a map that shows existing and proposed hydrant locations and spacing
- Fireflow in mains in wildland areas for new development must be a minimum 2500 GPM, unless reduced by the fire authority having jurisdiction, consistent with code
- Compliance/non-compliance with codes/regulations and significance standards

4.3.2 For projects outside a Public or Private Water District:

- Demonstrate compliance with County Fire Code or Consolidated Fire Code

4.4 Ignition-Resistant Construction and Fire Protection Systems

- County Building Code specifies construction standards for all structures located within the Wildland-Urban Interface areas. Provide a list of the structures and their uses and clearly identify proposed deviations from applicable sections of the applicable codes. Justification must be provided for alternatives to code requirements; DO NOT simply repeat the code.

- Identify fire sprinkler requirements.

4.5 Fire Fuel Assessment

- Summarize the wildland and non-native fuels on and adjacent to the site and their potential threat of burning, prior to Vegetation Management.

4.6 Fire Behavior Modeling

- Summarize fire behavior modeling results, linking the results to fuel assessment and defensible space. (Details, such as data input and output, should be presented in the Technical Appendices.)

4.7 Defensible Space and Vegetation Management

This section of the report must:

- Provide an overview of flammable vegetation within and adjacent to the project site (type and density, and location relative to specific lots)
- Identify Fuel Modification Zones (with dimensions) for building pads and access roads and link to Fire Fuel Assessment, Fire Behavior Modeling.
- Include vegetation management (clearing) practices that will be implemented during the life of the project and the organization responsible for maintenance.
- Identify how boundaries of vegetation management zones will be permanently identified in the field.
- Identify plant species that are proposed as part of new landscaping, if known.
- Demonstrate compliance/non-compliance with codes/regulations and significance standards.

4.8 Cumulative Impact Analysis

This and other projects may have a cumulative impact on the ability to protect residents from wildfires. This project and other development in the area will increase the population in the rural areas, which may increase the chances of a wildfire and increase the number of people and structures exposed to risk of loss, injury or death.

Explain how the project and other proposed development in the area may contribute to this cumulative impact and what mitigation measures are proposed to address this impact (e.g. establishing/participating in a Community Facility District, project compliance with or exceeding codes/standards).

Chapter 5. MITIGATION MEASURES AND DESIGN CONSIDERATIONS

Briefly describe proposed mitigation measures and design considerations. For each measure, state the impact being mitigated. Some mitigation measures MAY require additional details or analysis of potential impacts.

Chapter 6. CONCLUSION

For each significant impact, determine if the proposed mitigation measures have reduced the significance level to “less than significant” in accordance with the stated Significance Guidelines and, if so, explain why.

Chapter 7. LIST OF PREPARERS AND PERSONS AND ORGANIZATIONS CONTACTED

Provide a list of preparers, noting each person included on the County list of approved consultants. Note that the principal author must be on the County list or the report will not be accepted.

Chapter 8. REFERENCES

Include a list of all references used in the report (not personal references for the preparer.)

TECHNICAL APPENDICES

The Table of Contents for the Appendices must list each document attached to the report in the order in which it is included. The following documents must be included in the report, either in the text (if size is appropriate) or as an appendix:

- Site Map/Plot Plan with topography overlay
- Aerial photo of site and immediate vicinity – with property lines shown
- Photos of the site at ground level
- Fire Model (if required)
- Completed and signed form “DPLU #399F – Project Facility Availability Form for Fire”

2.2 Fire Behavior Model

Summary Narrative
As part of the Fire Behavior Model, a Summary Narrative must be included that provides an overview of the assumptions and findings. Please ensure that the narrative includes discussion of wind compression, spotting potential, fire location/direction, assessment of neighboring fuel beds, and topographical impacts. The language should be less technical than that used in the Fire Model Report and should be no more than one page in length.

Use of Model Inputs - Caveat
The Fire Behavior Model is a tool for fire authorities to estimate the behavior of fire that is moving towards a structure given certain assumptions. The Fire Behavior Model is only an estimate and not designed to replace eye-witness accounts or the experience of the local FAHJ who is familiar with wildland fire behavior.

The standard weather parameters that are discussed below are designed to provide local FAHJ and fire consultants with a generally accepted set of model inputs to ensure overall fire modeling consistency for certain fuel types. The inputs are not stagnate and will constantly be revised and amended as additional information becomes available and modeling software changes. The County will post changes to these standard weather parameters on DPLU's website as the changes occur. Before finalizing modeling inputs, fire consultants must contact the local FAHJ to confirm that the model inputs proposed are reasonably accurate for the area being considered.

Note that BehavePlus is not the only recognized fire model that is available; it is identified in this report only because it is a model currently most used by fire consultants. Three fuel models are listed as a comparison of fire behavior values under BehavePlus, but other recognized models may be used. Use of these alternative models will be accepted if the consultant provides documentation that supports and justifies the assumptions that are used.

Model Inputs – Historical Background
The requirement to submit a Fire Protection Plan for development in wildland areas has demonstrated a need for a generally accepted set of weather parameters for extreme fire conditions during summer time and Santa Ana fire weather patterns.

Analysis of 44 years of weather data (1961-2005) from the USDA Forest Service's Weather Information Management System (WIMS) provides a sampling of weather patterns across San Diego County. The County is divided into five climate zones from the coast to the desert. (Climates of San Diego County, Agricultural Relationships, University of California, Agricultural Extension Service, and U.S. Weather Bureau.) Daily afternoon weather observations were manually taken at selected fire stations across the county between 1961 and the early 1990's. Remote Automated Weather Stations (RAWS) replaced manual observations beginning in 1992. http://famweb.nwcg.gov/weatherfirecd/

Fire Family Plus software (USDA Forest Service) was used to summarize and analyze historical daily fire weather observations and to compute fire danger indices based on the National Fire Danger Rating System (NFDRS).

Weather data from April 15th through December 31st was chosen to represent the general limits of the fire season. Fires have occurred between January 1st and April 14th, but while dangerous fire weather conditions occur during this period, they typically are not as severe as September and October weather conditions. Including winter weather records would dilute the data and add numerous winter storms that require manual interpretation. Summer fire conditions were derived from records beginning on June 15th and ending September 15th.

Maximum wind speed data was checked for reasonableness by comparing speed with surrounding stations. Winds associated with winter storms were identified by cross checking with precipitation and relative humidity observations and then excluded. Santa Ana wind season is assumed to start on September 15th. Wind speed is measured at 20 feet above the ground and averaged for at least 10 minutes.

Maximum wind speed was calculated by taking the difference between the maximum recorded wind speed and the 99th percentile wind speed, adding this difference to the 99th percentile wind, adding 10 percent for a safety margin, and rounding the answer up. This had the effect of throwing out the outliers while including the highest reasonable winds. A table showing days with winds over the 99th percentile is included for each zone. Peak wind for each zone is the highest recorded wind by a RAWS during the Cedar fire (October 26, 2003).

The program for calculating fire behavior and spread requires temperature and relative humidity ranges as inputs. Temperature ranges of 90°-109°F and relative humidities of 5%-9% are reasonable for most areas of the county under Santa Ana conditions.

The Burning Index graph is included for reference. It represents the relative difficulty of controlling a wildfire and is calculated from temperature, wind, relative humidity, fuel (vegetation) moisture and wind.

Actual weather records may be used in lieu of these numbers if they can be demonstrated to be representative of the actual site, recorded by a recognized system, and represent at least five years of data.

Table 1
BEHAVE Plus 5.0.1
Worst case sustained winds (10 minute average and peak) Fuel Model 1 at 50% slope

Zone	Period	Temperature	Relative Humidity	Sustained Wind Speed	Burning Index (99%)	Rate of Spread Feet/min	Flame length
	Summer	70-89°F	30-34%	17 mph	41	300	8
Maritime	Santa Ana	90-109°F	5-9%	18 mph	64	470	10
	Peak	90-109°F	5-9%	22 mph	-	550	11
	Summer	90-109°F	10-14%	19 mph	57	430	9
Coastal	Santa Ana	90-109°F	0-4%	21 mph	112	600	12
	Peak	90-109°F	0-4%	26 mph	-	730	13
	Summer	90-109°F	10-14%	19 mph	119	430	9
Transitional	Santa Ana	90-109°F	5-9%	28 mph	145	730	13
	Peak	90-109°F	5-9%	41 mph	-	730	13
	Summer	90-109°F	5-9%	18 mph	153	470	10
Interior	Santa Ana	90-109°F	5-9%	24 mph	168	730	13
	Peak	90-109°F	5-9%	56 mph	-	730	13
Desert	Summer	90-109°F	5-9%	18 mph	153	470	10
	Santa Ana	90-109°F	5-9%	24 mph	168	730	13
	Peak	90-109°F	5-9%	56 mph	-	730	13

Table 2
BEHAVE Plus 5.0.1
Worst case sustained winds (10 minute average and peak) Fuel Model 4 at 50% slope

Zone	Period	Temperature	Relative Humidity	Sustained Wind Speed	Burning Index (99%)	Rate of Spread Feet/min	Flame length
Maritime	Summer	70-89°F	30-34%	17 mph	41	480	47
	Santa Ana	90-109°F	5-9%	18 mph	64	620	56
	Peak	90-109°F	5-9%	22 mph	-	700	60
Coastal	Summer	90-109°F	10-14%	19 mph	57	989	50
	Santa Ana	90-109°F	0-4%	21 mph	112	740	61
	Peak	90-109°F	0-4%	26 mph	-	870	65
Transitional	Summer	90-109°F	10-14%	19 mph	119	615	54
	Santa Ana	90-109°F	5-9%	28 mph	145	1100	73
	Peak	90-109°F	5-9%	41 mph	-	1600	87
Interior	Summer	90-109°F	5-9%	18 mph	153	620	56
	Santa Ana	90-109°F	5-9%	24 mph	168	870	66
	Peak	90-109°F	5-9%	56 mph	-	2400	105
Desert Chaparral	Summer	90-109°F	5-9%	18 mph	153	620	56
	Santa Ana	90-109°F	5-9%	24 mph	168	870	66
	Peak	90-109°F	5-9%	56 mph	-	2400	105

Table 3
BEHAVE Plus 5.0.1
Worst case sustained winds (10 minute average and peak) Fuel Model 10* at 50% slope

Zone	Period	Temperature	Relative Humidity	Sustained Wind Speed	Burning Index (99%)	Rate of Spread Feet/min*	Flame length*
Maritime	Summer	70-89°F	30-34%	17 mph	41	-	-
	Santa Ana	90-109°F	5-9%	18 mph	64	-	-
	Peak	90-109°F	5-9%	22 mph	-	-	-
Coastal	Summer	90-109°F	10-14%	19 mph	57	-	-
	Santa Ana	90-109°F	0-4%	21 mph	112	-	-
	Peak	90-109°F	0-4%	26 mph	-	-	-
Transitional	Summer	90-109°F	10-14%	19 mph	119	-	-
	Santa Ana	90-109°F	5-9%	28 mph	145	-	-
	Peak	90-109°F	5-9%	41 mph	-	-	-
Interior	Summer	90-109°F	5-9%	18 mph	153	30	10
	Santa Ana	90-109°F	5-9%	24 mph	168	40	11
	Peak	90-109°F	5-9%	56 mph	-	100	17
Desert	Summer	90-109°F	5-9%	18 mph	153	-	-
	Santa Ana	90-109°F	5-9%	24 mph	168	-	-
	Peak	90-109°F	5-9%	56 mph	-	-	-

* Surface Fire Only. Behave does not model crown fires in timber fuel types

.
2.3 Fire Protection Plan – Letter Report Outline

The Fire Protection Plan (**FPP**) – **Letter Report** is for project applicants who are processing minor projects that have little to no anticipated risk of loss, injury or death involving wildland fires. Discretionary permits that may qualify for a FPP – Letter Report include projects that are located within the State Responsibility Areas and are "infill" projects with virtually no wildlands in the immediate vicinity. The FPP – Letter Report may be prepared by the applicant or the applicant's representative, instead of a fire consultant. However, the applicant may employ the services of a fire consultant to prepare a Letter Report FPP. The Letter Report FPP preparer does not have to be on the County's approved list of consultants.

If upon review of the completed FPP - Letter Report, the County determines that code issues are unresolved or inadequately addressed or the project cannot comply with required conditions that are specified in the "Project Exposure to Wildland Fires" section below, the project does not qualify for a FPP – Letter Report, and a FPP – Full Report will be required. The Full FPP Report must be prepared by a consultant currently approved by the County for such reports, and must follow the prescribed format.

The FPP – Letter Report must be written in the following format. Guidance on how to complete certain sections of the report is shown in *(italics)*. Questions on how to complete the form can be directed to the DPLU Fire Service Section at (858) 694-2960.

(Date)

County of San Diego
Department of Planning and Land Use
5201 Ruffin Road, Suite B
San Diego, CA 92123

(Local Fire Agency/District Having Jurisdiction)
(Address)
(City, State, Zip)

SUBJECT: FIRE PROTECTION PLAN – LETTER REPORT
(Project Common Name)
(Project Application Number – e.g. TPM ####)
(Assessor Parcel Numbers e.g. ###-###-##-00)

This Fire Protection Plan (FPP) – Letter Report is submitted pursuant to the County Fire Code and County Consolidated Fire Code, to address the adverse environmental effects that a proposed project may have from wildland fire and to provide mitigation of those impacts to ensure that the project does not expose people or structures to a significant risk of loss, injury or death involving wildland fires.

PROJECT DESCRIPTION

(Briefly describe the project being proposed – acreage, parcel size range (e.g. "24.5 acre parcel in A-72 zone divided into four 4.0 to 6.5 acre residential lots")

ENVIRONMENTAL SETTING

1. **Location:** *(give the community where the project is located [e.g. Fallbrook] and describe the character of the area that surrounds the subject property , i.e. how it is currently developed)*
2. **Topography:** *(generally identify the terrain of the site and adjacent properties (e.g. land is generally flat immediately off Access Street for 100 yards followed by rolling hills. Unusually high steep terrain can be found in the northwestern corner of the site and beyond)*
3. **Geology:** *(describe any geological features that might affect access roads or building pad design, or increase or reduce wildfire potential on the site.)*
4. **Flammable Vegetation:** *(discuss the type and density of vegetation – this information is typically available in the project Biology Report. If a Biology Report is not required for your project, generally describe the types of plants that are found on the property and the density of vegetation.)*
5. **Climate:** *(identify general climate and seasonal events – e.g. "coastal or west sloping valley or mountainous or desert climate – subject to Santa Ana wind events, flash flooding", etc.)*

PROJECT EXPOSURE TO WILDLAND FIRES

1. **Water Supply:** *(Describe how water is going to be supplied to the project. NOTE: If the project is outside the boundaries of a water district, include the following language in this section of the FPP – Letter Report: "All proposed structures shall have a water tank, with size, location and fire department connection (FDC) consistent with the County and Consolidated Fire Code."*

   If the project is inside the boundaries of a water district, a copy of the Service Availability Form for water must be attached to this FPP – Letter Report. Furthermore, include the following language in this section of the FPP – Letter Report: "Hydrants shall be located along fire access roadways as determined by the Fire Marshal to meet operational needs, at intersections, at cul-de-sacs, and at intervals pursuant to the County and Consolidated Fire Code. Required fireflow in water main is 2500 gallons per minute.

2. **Fire Access Roads**

   Location. *(Describe the location of all access roads and the number of parcels that will access each road, include development pads and driveways). Explain how the primary access road complies with the distance thresholds specified under the County Fire Code and County Consolidated Fire Code.*

   Width: *(Describe the width of all access roads. NOTE: All fire access roads including driveways must be improved to a minimum 16' width all-weather surface suitable for travel by 50,000 lb. fire apparatus. Fire access roads serving more than two single-family dwellings shall be a minimum 24' wide with all-weather surface suitable for travel by 50,000 lb. fire apparatus.*

   Vertical Clearance: *(Include a statement that "minimum vertical clearance of 13 feet 6 inches must be maintained for the entire required width of fire access roads".)*

   Grade: *(Describe the maximum grade in percent for the roads and driveways. NOTE: Grades greater than 15% are not permitted without mitigation; grades greater than 20% are prohibited.)*

   Surface: (Describe the surface improvements for all roads and driveways. Be specific rather than quoting this entire code section).

3. **Setback from Property Lines:** *(The minimum setback from any property line in high hazard areas is 30 feet (even though Zoning Setback may be less). Exceptions may be allowed if parcels are smaller than one acre, upon review and approval from the FAHJ and County. Minimum setback from property lines abutting national forests, open space preserves, and designated riparian areas is 100 feet. The applicable statement must appear in this section, and any such forest, preserve or riparian areas must be identified.)*

4. **Building Construction:** *(The Report must include the following statement: "All structures shall comply with the ignition-resistive construction requirements: Wildland-Urban Interface areas of Chapter 7A of the County Building Code.")*

5. **Fire Protection Systems:** *(The Report must include the following statement: "All habitable structures and attached garages shall have residential fire sprinklers per County Code or County Consolidated Code requirements.")*

6. **Defensible Space:** *(The Report must include the following statement: "A minimum 100-foot Fuel Management Zone will be established and maintained around all structures over 250 square feet in size. No off-site clearing is required or authorized.")*

7. **Vegetation Management:** *(The Report must include the following statement: "Prescribed Defensible Space (fuel management zones) will be maintained by the property owners at least annually or more often as needed. Boundaries of fuel*

management zones will be clearly and permanently marked. Plants used in the Defensible Space will be from an approved fire resistant planting materials list that is maintained by County of San Diego, Department of Planning and Land Use.")

8. **Fire Behavior Computer Modeling:** Based on preliminary evaluation by the County Fire Marshal, Computer Fire Behavior Modeling is not required for this **FPP – Letter Report**-*(Note: Contact the Fire Authority Having Jurisdiction [FAHJ] to confirm).*

Prepared By (Signature)[1]	Date	Printed Name	Title
Property Owner (Signature)[1]	Date	Printed Name	

[1] The FPP – Letter Report will not be accepted without original signatures.

Exhibit R

Exhibit R

SUPERIOR COURT OF THE STATE OF CALIFORNIA

COUNTY OF RIVERSIDE

FRIENDS OF THE NORTHERN SAN JACINTO VALLEY and SIERRA CLUB, Petitioners, vs. COUNTY OF RIVERSIDE and BOARD OF SUPERVISORS OF RIVERSIDE COUNTY, and DOES 1-20, Respondents.	CASE NO.: RIC10007572 ~~[PROPOSED]~~ PEREMPTORY WRIT OF MANDATE
NUEVO DEVELOPMENT COMPANY, LLC, and DOES 21-40, Real Party in Interest.	

TO: Defendants and Respondents, County of Riverside and Board of Supervisors of Riverside County (collectively, "County").

The Court having entered a judgment in this proceeding directing that a peremptory writ of mandate issue from this Court,

YOU ARE HEREBY COMMANDED to comply with the following:

1. Within forty five (45) days of the service of this Writ, the County shall set aside all approvals relating to Resolution Nos. 2010-88 and 2010-89 and Ordinance No. 348.4679, and shall refrain from approving these same or new approvals relating to or implementing

the Villages of Lakeview Project ("Project") until such time as the County fully complies with CEQA and State Planning and Zoning Law.

2. Under Public Resources Code §21168.9(c), this Court does not direct the County to exercise its lawful discretion in any particular way.

3. Under Public Resources Code §21168.9(b) and Code of Civil Procedure §1097, this Court will retain jurisdiction over the County's proceedings related to this Project by way of a return to this Writ until the Court has determined that the County has complied with the provisions of CEQA, State Planning and Zoning Law.

You are further commanded to make and file a return to this writ within 60 days from the date a copy of this writ is served on you, showing what you have done to comply with this writ.

Witness the Honorable Sharon J. Waters, Judge of the Superior Court. Attest my hand and the seal of this Court this 11 day of July, 2012.

Sherri R. Carter
Clerk

By: [signature]
Deputy Clerk LETICIA HALL

Exhibit T

Exhibit T

Smart Growth America

Making Neighborhoods Great Together

Measuring Sprawl 2014

April 2014

Acknowledgments

Smart Growth America is the only national organization dedicated to researching, advocating for and leading coalitions to bring smart growth practices to more communities nationwide. From providing more sidewalks to ensuring more homes are built near public transportation or that productive farms remain a part of our communities, smart growth helps make sure people across the nation can live in great neighborhoods. Learn more at www.smartgrowthamerica.org.

This report is based on original research published by the Metropolitan Research Center at the University of Utah, prepared for the National Cancer Institute at the National Institutes of Health, as well as the Ford Foundation.

The Metropolitan Research Center conducts basic and applied research on the built environment at the metropolitan scale, focusing on key forces shaping metropolitan form such as demographics, environment, technology, design, transportation, arts and culture and governance. It seeks to expand knowledge in city and metropolitan affairs to improve policy and practice and educate the general public on important issues facing communities. Learn more at www.arch.utah.edu/cgi-bin/wordpress-metroresearch/.

This report was made possible with support from the National Institutes of Health and the Ford Foundation.

Researchers

Reid Ewing, Professor of City and Metropolitan Planning, University of Utah
Shima Hamidi, Graduate Research Assistant, University of Utah

Project team

Sarah Absetz, Policy Associate, Smart Growth America
Geoff Anderson, President and CEO, Smart Growth America
David Berrigan, Applied Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute
Craig Chester, Press Manager, Smart Growth America
Alex Dodds, Deputy Director of Communications, Smart Growth America
Ilana Preuss, Vice President and Chief of Staff, Smart Growth America
Zaria Tatalovich, Health Statistician and Geospatial Scientist, National Cancer Institute

Special thanks to David Goldberg, Transportation for America; Chris Zimmerman, Smart Growth America; Gail Meakins, Martin Buchert, and Allison Spain, Metropolitan Research Center; Professor William Greene, New York University; and James B. Grace, U.S. Geological Survey.

Table of Contents

Executive Summary

Some places in the United States are sprawling out and some places are building in compact, connected ways. The difference between these two strategies affects the lives of millions of Americans.

In 2002, Smart Growth America released *Measuring Sprawl and Its Impact*, a landmark study that has been widely used by researchers to examine the costs and benefits of sprawling development. In peer-reviewed research, sprawl has been linked to physical inactivity, obesity, traffic fatalities, poor air quality, residential energy use, emergency response times, teenage driving, lack of social capital and private-vehicle commute distances and times.

Measuring Sprawl 2014 updates that research and analyzes development patterns in 221 metropolitan areas and 994 counties in the United States as of 2010, looking to see which communities are more compact and connected and which are more sprawling. Researchers used four primary factors—residential and employment density; neighborhood mix of homes, jobs and services; strength of activity centers and downtowns; and accessibility of the street network—to evaluate development in these areas and assign a Sprawl Index score to each. This report includes a list of the most compact and most sprawling metro areas in the country.

This report also examines how Sprawl Index scores relate to life in that community. The researchers found that several quality of life factors improve as index scores rise. Individuals in compact, connected metro areas have greater economic mobility. Individuals in these areas spend less on the combined cost of housing and transportation, and have greater options for the type of transportation to take. In addition, individuals in compact, connected metro areas tend to live longer, safer, healthier lives than their peers in metro areas with sprawl. Obesity is less prevalent in compact counties, and fatal car crashes are less common.

Finally, this report includes specific examples of how communities are building to be more connected and walkable, and how policymakers at all levels of government can support their efforts.

Introduction

As regions grow and develop, residents and their elected leaders have many decisions to make. What kind of street network should they build, and how extensive should it be? Should neighborhoods have a mix of homes, shops and offices, or should different types of buildings be kept separate? Will people be able to walk, ride a bicycle or take public transportation through the community, or will driving be the only realistic way for people to get around?

Everyone experiences the outcomes associated with these development decisions. How much families pay for housing and transportation, how long workers spend commuting home, the economic opportunities in communities and even personal health are all connected to how neighborhoods and surrounding areas are built.

Measuring Sprawl 2014 analyzes development in 221 metropolitan areas across the United States, as well as the relationship between development and quality of life indicators in those areas. This report includes a list of the most compact and most sprawling metro areas in the country.

About the research

In 2002, Smart Growth America released *Measuring Sprawl and Its Impact*, a landmark study that has been widely used by researchers to examine the costs and benefits of sprawling development. That report was made available to researchers and has been used in peer-reviewed research in the years since. From that original analysis, sprawl has been linked to physical inactivity, obesity, traffic fatalities, poor air quality, residential energy use, emergency response times, teenage driving, lack of social capital, and commute distances and times.

Measuring Sprawl 2014 is an update and refinement of that research. This report is based on research originally published in the Metropolitan Research Center at the University of Utah in April 2014. The University of Utah's report, titled *Measuring Urban Sprawl and Validating Sprawl Measures,* represents the most comprehensive effort yet undertaken to define, measure and evaluate metropolitan sprawl and its impacts. The first peer-reviewed article based on this research was published in October 2013 in the journal *Health & Place*.

The data from 2010 used in this analysis are the most recent available. The complete analysis, methodology and databases included in the University of Utah's research are available at http://gis.cancer.gov/tools/urban-sprawl/.

Measuring “sprawl”

This study analyzed development in 193 census-defined Metropolitan Statistical Areas (MSAs)—or metro areas—as well as 28 census-defined Metropolitan Divisions, which comprise MSAs, in the largest 11 MSAs. All of the analyzed areas had at least 200,000 people in 2010. MSAs with populations less than 200,000 people were not included in the study.[1] This study also analyzed development in 994 metropolitan counties.

The four factors

Development in both MSAs and metropolitan counties was evaluated using four main factors: 1) development density; 2) land use mix; 3) activity centering; and 4) street accessibility. These factors are briefly explained below.[2]

Development density
Development density is measured by combining six major factors: 1) total density of the urban and suburban census tracts; 2) percent of the population living in low-density suburban areas; 3) percent of the population living in medium- to high-density areas; 4) urban density within total built-upon land; 5) the relative concentration of density around the center of the MSA; and 6) employment density.

Land use mix
Land use mix is also measured through a combination of factors: the balance of jobs to total population and mix of job types within one mile of census block groups, plus the WalkScore of the center of each census tract.

Activity centering
The proportion of people and businesses located near each other is also a key variable to define an area. Activity centering is measured by looking at the range of population and employment size in different block groups. MSAs with greater variation (i.e., a wider difference between blocks with a high population and a low one) have greater centering. This factor also includes a measure of how quickly population density declines from the center of the MSA, and the proportion of jobs and people within the MSA’s central business district and other employment centers.

Street accessibility
Street accessibility is measured by combining a number of factors regarding the MSA’s street network. The factors are average length of street block; average block size; percent of blocks that are urban in size; density of street intersections; and percent of four-way or more intersections, which serves as a measure of street connectivity.

Scoring

Researchers used these factors to evaluate development in all 221 MSAs and 994 counties. These four factors are combined in equal weight and controlled for population to calculate each area’s Sprawl Index score. The average index is 100, meaning areas with scores higher than 100 tend to be more compact and connected and areas with scores lower than 100 are more sprawling.

MSA versus county scales

Census-defined MSAs and the Metropolitan Divisions within them include a wide variety of places within a given region. An MSA's boundaries may include one county (like the Detroit, MI Metropolitan Division, which includes only Wayne County) or many counties (like the Washington, DC MSA, which contains 16 counties).[3]

This difference has a significant impact on how a given region scores on the index, and it is important to note that these census-defined divisions create some counterintuitive outcomes. For example, the greater Washington, DC area ranks 91st on the index based on its MSA. Evaluated at the county level, however, Washington, DC ranks 6th. Many other communities face similar distinctions between scores at the MSA level versus the county level.

Our findings are presented at the MSA scale because much of the data, such as economic mobility, is only available at this level. Health data is available at the county level, so in those cases we provide analysis at that scale. Future versions of this analysis would benefit from economic mobility, transportation and housing costs and health databases available at more refined scales. For more information about index scores and findings at the county scale, see Appendix B. For information about the data sources available at different geographic scales, see Appendix C.

The 2014 Sprawl Index rankings

Based on the index standards described in the previous section, we evaluated development in 221 metro areas in the United States.

The most compact, connected metro area in the United States is, perhaps not surprisingly, New York, NY, with an index score of 203.4. The country's most sprawling metro area is Hickory, NC, with an index score of 24.9.

To provide a more comprehensive look at how communities compare, we also present here the most compact and most sprawling MSAs by size. Among large metro areas (defined as having a population more than one million people), New York, the national leader, is the most compact and connected. Atlanta, GA, is the most sprawling, with a score of 41.0.

Of medium metro areas (defined as having a population between 500,000 and 1 million), Madison, WI, is the most compact and connected with a score of 136.7 and Baton Rouge, LA, is the most sprawling, with a score of 55.6. Of small metro areas (defined as having a population less than 500,000), Atlantic City, NJ, is the most compact and connected, with a score of 150.4, whereas Hickory, NC, is the most sprawling.[4]

Most compact, connected metro areas

Tables 1–4 rank metro areas that are more compact and connected, with homes and jobs closer together.

TABLE 1

Most compact, connected metro areas, nationally

Rank	Metro area	Index score
1	New York/White Plains/Wayne, NY-NJ	203.4
2	San Francisco/San Mateo/Redwood City, CA	194.3
3	Atlantic City/Hammonton, NJ	150.4
4	Santa Barbara/Santa Maria/Goleta, CA	146.6
5	Champaign/Urbana, IL	145.2
6	Santa Cruz/Watsonville, CA	145.0
7	Trenton/Ewing, NJ	144.7
8	Miami/Miami Beach/Kendall, FL	144.1
9	Springfield, IL	142.2
10	Santa Ana/Anaheim/Irvine, CA	139.9

TABLE 2

Most compact, connected large metro areas

Large metro areas are defined as having a population more than one million.

Rank	Metro area	Index score
1	New York/White Plains/Wayne, NY-NJ	203.4
2	San Francisco/San Mateo-Redwood City, CA	194.3
8	Miami/Miami Beach/Kendall, FL	144.1
10	Santa Ana/Anaheim/Irvine, CA	139.9
12	Detroit/Livonia/Dearborn, MI	137.2
15	Milwaukee/Waukesha/West Allis, WI	134.2
21	Los Angeles/Long Beach/Glendale, CA	130.3
24	San Jose/Sunnyvale/Santa Clara, CA	128.8
25	Oakland/Fremont/Hayward, CA	127.2
26	Chicago/Joliet/Naperville, IL	125.9

TABLE 3

Most compact, connected medium metro areas

Medium metro areas are defined as having a population between 500,000 and 1 million.

Rank	Metro area	Index score
13	Madison, WI	136.7
28	Allentown/Bethlehem/Easton, PA-NJ	124.4
37	Bridgeport/Stamford/Norwalk, CT	121.7
41	Stockton, CA	120.3
52	New Haven/Milford, CT	116.3
54	Scranton/Wilkes-Barre, PA	115.8
64	Oxnard/Thousand Oaks/Ventura, CA	113.8
66	Modesto, CA	113.3
67	Wilmington, DE-MD-NJ	112.9
68	Lancaster, PA	112.6

TABLE 4

Most compact, connected small metro areas

Small metro areas are defined as having a population less than 500,000.

Rank	Metro area	Index score
3	Atlantic City/Hammonton, NJ	150.4
4	Santa Barbara/Santa Maria/Goleta, CA	146.6
5	Champaign/Urbana, IL	145.2
6	Santa Cruz/Watsonville, CA	145.0
7	Trenton/Ewing, NJ	144.7
9	Springfield, IL	142.2
11	Reading, PA	137.9
14	Burlington/South Burlington, VT	135.1
16	Boulder, CO	133.7
17	Appleton, WI	132.7

Most sprawling metro areas

Tables 5–8 rank communities that are the least dense, least connected and most likely to separate land uses.

TABLE 5

Most sprawling metro areas, nationally

Rank	Metro area	Index score
212	Kingsport/Bristol/Bristol, TN-VA	60.0
213	Augusta/Richmond County, GA-SC	59.2
214	Greenville/Mauldin-Easley, SC	59.0
215	Riverside-San Bernardino/Ontario, CA	56.2
216	Baton Rouge, LA	55.6
217	Nashville-Davidson/Murfreesboro/Franklin, TN	51.7
218	Prescott, AZ	49.0
219	Clarksville, TN-KY	41.5
220	Atlanta/Sandy Springs/Marietta, GA	41.0
221	Hickory/Lenoir/Morganton, NC	24.9

TABLE 6

Most sprawling large metro areas

Large metro areas are defined as having a population more than one million.

Rank	Metro area	Index score
182	Houston/Sugar Land/Baytown, TX	76.7
184	Richmond, VA	76.4
189	Rochester, NY	74.5
192	Birmingham-Hoover, AL	73.6
196	Memphis, TN-MS-AR	70.8
197	Charlotte/Gastonia-Rock Hill, NC-SC	70.5
201	Warren/Troy/Farmington Hills, MI	67.0
215	Riverside-San Bernardino/Ontario, CA	56.3
217	Nashville/Davidson/Murfreesboro/Franklin, TN	51.7
220	Atlanta-Sandy Springs/Marietta, GA	41.0

TABLE 7

Most sprawling medium metro areas

Medium metro areas are defined as having a population between 500,000 and 1 million.

Rank	Metro area	Index score
185	Little Rock/North Little Rock/Conway, AR	76.1
191	Durham/Chapel Hill, NC	73.8
195	Jackson, MS	72.3
199	Knoxville, TN	68.2
200	Columbia, SC	67.5
207	Chattanooga, TN-GA	63.6
208	Greensboro/High Point, NC	63.5
213	Augusta/Richmond County, GA-SC	59.1
214	Greenville/Mauldin-Easley, SC	59.0
216	Baton Rouge, LA	55.6

TABLE 8

Most sprawling small metro areas

Small metro areas are defined as having a population less than 500,000.

Rank	Metro area	Index score
204	Green Bay, WI	65.4
205	Fort Smith, AR-OK	64.8
206	Lynchburg, VA	64.0
209	Winston-Salem, NC	63.4
210	Florence, SC	61.1
211	Lake Havasu City-Kingman, AZ	60.1
212	Kingsport/Bristol/Bristol, TN-VA	60.0
218	Prescott, AZ	49.0
219	Clarksville, TN-KY	41.5
221	Hickory/Lenoir/Morganton, NC	24.9

What sprawl means for everyday life

The researchers found that as Sprawl Index scores improved—that is, as areas became less sprawling—several quality of life factors improved along with them.[5]

- People have greater economic opportunity in compact and connected metro areas.
- People spend less of their household income on the combined cost of housing and transportation in these areas.
- People have a greater number of transportation options available to them.
- And people in compact, connected metro areas tend to be safer, healthier and live longer than their peers in more sprawling metro areas.

The researchers controlled for socioeconomic factors. Below is more information about each of these quality of life indicators.

People in more compact, connected metro areas have greater economic mobility.
Could metro areas with homes and jobs far apart and limited connections between those areas directly affect the ability of low-income children to get ahead as adults?

The researchers compared the 2014 Sprawl Index scores to models of upward economic mobility from Harvard and the University of California at Berkeley.[6] They examined the probability of a child born to a family in the bottom quintile of the national income distribution reaching the top quintile of the national income distribution by age 30, and whether communities' index score was correlated with that probability.

Compactness has a strong direct relationship to upward economic mobility.

The researchers found that compactness has a strong direct relationship to upward economic mobility. In fact, for every 10 percent increase in an index score, there is a 4.1 percent increase in the probability that a child born to a family in the bottom quintile of the national income distribution reaches the top quintile of the national income distribution by age 30.

For example, the probability of an individual in the Baton Rouge, LA area (index score: 55.6) moving from the bottom income quintile to top quintile is 7.2 percent. In the Madison, WI area (index score: 136.7) that probability is 10.2 percent.

People in more compact, connected metro areas spend less on the combined expenses of housing and transportation.
The cost of housing is often higher in compact areas compared with sprawling ones. However, families' transportation costs are often significantly lower in these places. Shorter distances to travel and a wider range of low-cost travel options means individuals and families in these places spend a smaller portion of their household budget on transportation. How do the two expense categories relate in compact areas versus sprawling ones?

The researchers found that the average percentage of income spent on housing is indeed greater in compact communities than in sprawling areas. Each 10 percent increase in an index score was associated with a 1.1 percent increase in housing costs relative to income.[7]

The researchers also found that the average percentage of income spent on transportation is smaller in compact areas than sprawling ones. Each 10 percent increase in an index score was associated with a 3.5 percent decrease in transportation costs relative to income.[8] For instance, households in the San Francisco, CA area (index score: 194.3) spend an average of 12.4 percent of their income on transportation. Households in the Tampa, FL metro area (index score: 98.5) spend an average of 21.5 percent of their income on transportation.[9]

The combined cost of housing and transportation declines as an index score increases.

Perhaps the most notable finding was that the combined cost of housing and transportation declines as an index score increases. As metropolitan compactness increases, transportation costs decline faster than housing costs rise, creating a net decline in household costs.[10] An average household in the San Francisco, CA metro area (index score: 194.3) spends 46.7 percent of its budget on housing and transportation, while an average household in the Tampa, FL metro area (index score: 98.5) spends 56.1 percent of its budget on the same items.[11]

People in more compact, connected metro areas have more transportation options.
Part of the reason transportation costs are lower in more compact areas is that these areas have a wider range of options for how to get around—nearly all of which cost less than driving or are even free.

The researchers found that people in metro areas with higher index scores walk more: For every 10 percent increase in an index score, the walk mode share (i.e., the portion of travelers who choose to walk) increases by 3.9 percent.

The researchers found that people in high-scoring metro areas take transit more: For every 10 percent increase in an index score, transit mode share (i.e., the portion of travelers who choose to use transit) increases by 11.5 percent. This means, for example, that a person in the Lincoln, NE metro area (index score: 132.0) is two and a half times more likely to choose transit for his or her transportation needs than a similar person in the Greenville, SC area (index score: 59.0).

The researchers also found that people in high-scoring metro areas own fewer cars and spend less time driving. For every 10 percent increase in an index score, vehicle ownership rates decline by 0.6 percent and drive time declines by 0.5 percent.[12]

Data about transportation options are even more compelling at the county level. See Appendix B for that information.

People in more compact, connected areas have longer, healthier and safer lives.
Health data are available at the county level; for this reason, health outcomes are assessed at this scale rather than the MSA level. At the county level, an area's compactness is also related to individuals' health.[13]

First and foremost, people in compact, connected counties tend to live longer. For every doubling in an index score, life expectancy increases by about four percent.[14] For the average American with a life expectancy of 78 years, this translates into a three-year difference in life expectancy between people in a less compact versus a more compact county.

Driving rates (and their associated risk of a fatal collision), body mass index (BMI), air quality and violent crime all contribute to this difference, albeit in different ways. Counties with less sprawl have more car crashes, but fewer of those crashes are fatal. For every 10 percent increase in an index score, fatal crashes decrease by almost 15 percent. That means a person in Walker County, GA, for example, has nearly three times the chance of being in a fatal crash as compared with a similar person in Denver County, CO.

The researchers found that BMI is strongly and negatively related to index scores. As a county's index score decrease (that is, as a metro area sprawls more), the BMI of its population increases, after accounting for sociodemographic differences. For example, a 5'10" man living in Arlington County, VA is likely to weigh four pounds less than the same man living in Charles County, MD.[15] Similarly, the likelihood of obesity increases. People in less sprawling counties also have significantly lower blood pressure and rates of diabetes.

Exhibit U

Exhibit U

Humboldt County General Plan Update Health Impact Assessment

March 2008

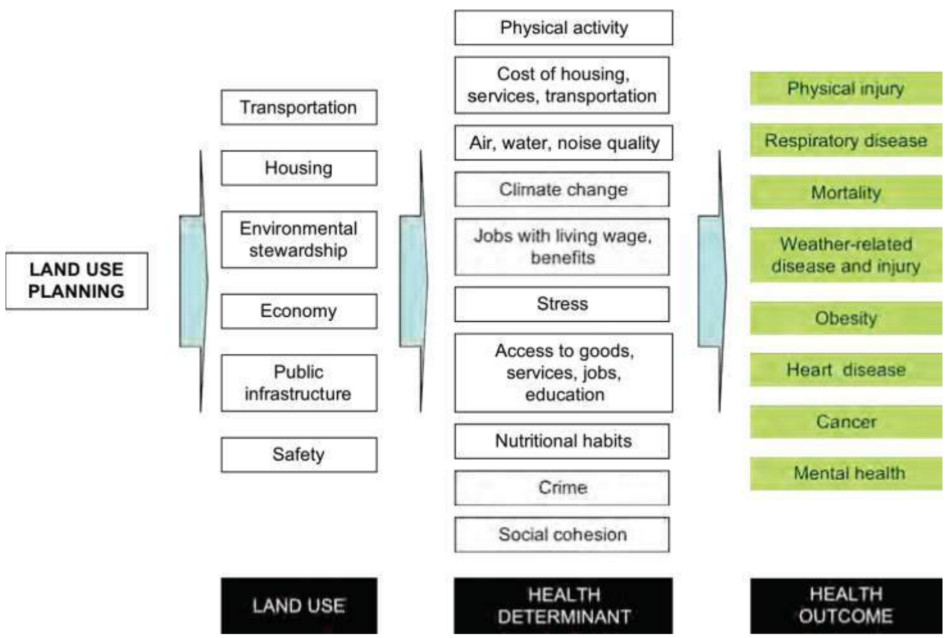
By:
Humboldt County Public Health Branch
Humboldt Partnership for Active Living
Human Impact Partners

Funded by:
The California Endowment

Introduction and Description of Methodology

Land use planning decisions are often made based on population projections, economic considerations, political realities, and community input. A substantial and growing body of evidence suggests that the way we build the world around us and the policies we implement through land use planning processes have significant impacts on public health. The goal of this report is to make the health impacts of these decisions explicit.

Planning impacts health by affecting the community determinants of health - the social, economic and environmental factors that influence well-being including for example: housing, livelihood, access to fresh produce, education, air quality, access to parks, and transportation. Economic inequality, residential segregation, substandard housing, lack of supermarkets, poor schools, insufficient public transit, and disruptions to family and social networks all have been shown to affect health negatively.



For example:

- Proximity to and mix of retail, quality destinations, and transportation mode choices are the most influential factors in people's decisions to walk.[1]
- Housing affordability is related to homelessness, overcrowding, displacement and residential segregation, all of which have important health and mental health consequences.[2 3 4]
- Access and proximity to places for physical activity, including parks, are significant predictors of physical activity levels.[5 6]
- Accessible neighborhood grocery stores reduce diet-related diseases and the distance to a full service grocery store is related to body mass index.[7 8]

<u>Land Use Planning and Health in Humboldt County</u>
In 1998, Humboldt County commenced upon a General Plan Update (GPU) to guide building and growth in Humboldt County over the next 20 years. In 2007, with the support of the Board of Supervisors, the Public Health Branch began working with the Community Development Services

Planning Division (CDS) in an effort to make sure that the General Plan would bring about the best health outcomes for current and future residents. With the encouragement of CDS and a grant from The California Endowment, the Humboldt County Public Health Branch commissioned a Health Impact Assessment (HIA) to look at how the various land use and development scenarios under consideration for the GPU would affect health.

Health Impact Assessment (HIA) is a set of tools, methods and procedures that examines a development project, a general plan, or a policy on the basis of its potential health impacts. HIA aims to make decisions accountable for their effects on health, where health is defined broadly as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. HIA brings together evidence for decision-makers to understand how their decisions on programs, projects, plans, or policies affect health, positively or negatively. HIA also offers recommendations to enhance the positive health impacts of policy-making and development projects and to eliminate, reduce, or mitigate negative impacts.

Participating organizations:

- Humboldt County Department of Health and Human Services, Public Health Branch, including Environmental Health
- Humboldt Partnership for Active Living (HumPAL)
- Community Development Services Planning Division
- Human Impact Partners
- Community based organizations (see Appendix A for participants)

Plan Alternatives analyzed in the HIA

The Humboldt County GPU HIA evaluated how a variety of land use indicators would change as a result of the three Plan Alternatives (A, B, and C) being considered in the GPU. These alternatives are described in detail below.

The exact number of housing units provided for in each Plan Alternative is still under discussion. The HIA used estimates (detailed below) based on information from the Community Development Services Planning Division for the number of housing units in each Plan Alternative. Based on US Census 2000 figures for the County, the HIA also assumed that, on average, 2.4 persons would live in each housing unit. For example, if 6,000 new housing units are being proposed, then it was assumed that 14,400 (6,000 X 2.4) more people would be able to live in the County.

Plan Alternative A[9]: This plan provides for "focused growth." Plan Alternative A encourages all new units to be built in existing areas that are already supported by public sewage and utilities, i.e., encouraging higher residential density and infill development. Infill development is the use of vacant land, or restoration or rehabilitation of existing structures or infrastructure in already urbanized areas, where water, sewer, and other public services are in place. Infill development maintains the continuity of the original community fabric.

Plan Alternative A provides for 6,000 additional units over the course of 25 years. Of those, 6,000 are urban and, therefore the urban population would increase by 14,400. In this Plan Alternative, non-urban development will require conditional approval. This Alternative would require additional work in implementation since it would need to deal with existing property rights.

Plan Alternative B: This plan is a compromise between an all-infill development plan and a plan that does not highly regulate the location of new development. Plan Alternative B primarily provides for building in urban centers where there is a good network of utilities, sewage, and transit, but allows for some ex-urban development as well with modest expansion of existing water service areas, focusing on areas adjoining the city centers.

Plan Alternative B provides for 12,000 additional units over the course of 25 years and would therefore provide housing for approximately 28,800 people. Of those, 6,000 (50%) are urban and the urban population would increase by 14,400. The remaining 6000 units (50%) are non-urban and the non-urban population would also increase by 14,400.

Plan Alternative C: This plan allows the most unrestricted growth, or an "expanded development pattern". Plan Alternative C allows the highest number of existing parcels to be developed for housing; it also expands water service areas beyond present boundaries to expand opportunities for housing in outlying parts of communities.

Plan Alternative C provides for 18,000 additional units over the course of the 25 years and would therefore provide housing for approximately 43,200 people. Of those, 6,000 (33%) are urban and the urban population would increase by 14,400. The remaining 12,000 units (67%) are non-urban and the non-urban population would also increase by 28,800.

Methods:
Humboldt County Public Health Branch, in an ongoing effort to insure that land use decisions are made through the lens of public health and well being, used San Francisco Department of Public Health's (SFDPH's) Healthy Development Measurement Tool (HDMT; www.thehdmt.org) as a starting point for this Health Impact Assessment. The HDMT is a new approach for evaluating land use planning and development with regard to the achievement of human health needs. The HDMT was created through a collaboration spearheaded by SFDPH with development stakeholders and public agencies. The HDMT uses public health to explicitly connect the needs of health and human development to physical and environmental conditions, and provides a systematic assessment approach to consider environmental stewardship, transportation, housing, public infrastructure, public safety, and the economy. The HDMT identifies indicators of – or ways of measuring the effects of – land use planning, an evidence base of how these indicators impact a community's health, and policies to encourage healthy land use decisions.

Humboldt County's Public Health Branch and Human Impact Partners revised the HDMT, which was developed in an urban setting, to create a rural HDMT that more accurately reflects the reality of Humboldt County. This Rural HDMT will have over 60 health and land use related indicators and the Public Health Branch will be making it available on their website.

The next step in the GPU HIA involved engaging residents, mostly from community-based organizations, in a series of focus groups about the General Plan Update and health. Based on input from the focus groups, the Humboldt County Public Health Branch and HumPAL, with guidance from Human Impact Partners, collaboratively chose 35 of the HDMT's 65 indicators to be studied in this HIA. Indicators chosen were those that have the most impact on health and are most likely to be influenced by policies likely to be part of the General Plan.

Indicators were divided into 6 categories: Housing, Transportation, Public Infrastructure, Economy, Public Safety, and Environmental Stewardship. Each of these topics is discussed in the HIA report. For each category of indicator, a four to five page summary is available as well as a longer in-depth analysis.

Definition of Urban, Non-urban, and Rural Character

Most of the analyses performed in the HIA rely on a comparison between "urban" and "non-urban" areas of Humboldt County. The US Census defines "urban" as all territory, population, and housing units in urbanized areas and in places of more than 2,500 persons outside of urbanized areas. Rural is basically all territory, population, and housing units not classified as urban. According to the US Census 2000, there are 126,518 people in Humboldt County. By their definitions, 88,127 of those people live in urban areas (70 percent), and 38,391 live in rural areas (30 percent).

However, estimations required assumptions based on access to urban resources that are typically in residentially dense areas, such as access to public water systems, sewer systems and proximity to necessary goods and services. Thus urban and non-urban estimates used here are different from the US Census. The definition of urban used in this report includes areas where the residential density is above 1,000 people per square mile. The shaded regions in the table below are the urban areas for this HIA analysis. Every urban area is included in the table below; not every non-urban area is.

Figure 1. Residential density / US Census population

Area	*People per square mile**	*US Census 2000 population (and their categories for urban/rural)*
Bayview CDP (outside Eureka)	3203 - average	2,359 (urban)
Cutten CDP (outside Eureka)	2249 - low	2,933 (urban)
Humboldt Hill CDP (outside Eureka)	778 - low	3,246 (urban)
Hydesville CDP (south of Fortuna)	164 - very low	1,209 (rural)
McKinleyville CDP	651 - low	13,599 (12,552 urban, 1,047 rural)
Myrtletown CDP (outside Eureka)	2097 - low	4,459 (urban)
Pine Hills CDP (outside Eureka)	305 - low	3,108 (1731 urban, 1377 rural)
Redway CDP (southeast, off 101)	951 - low	1,188 (rural)
Westhaven-Moonstone CDP (N of McKinleyville near Trinidad)	129 - very low	1,044 (rural)
Willow Creek CDP (near Blue Lake)	8.5 - very low	1,743 (rural)
Arcata	1841 - low	16651 (urban)
Eureka	2707 - average	26128 (urban)
Ferndale	1355 - low	1382 (rural)
Fortuna	2317 - low	10497 (urban)
Garberville	14 - very low	12194- (3763 urban, 8431 rural)
North Coastal CCD Remainder (between McKinleyville & Trinidad, inland)	39 - very low	20415- (12,963 urban, 7,452 rural)
Trinity-Klamath CCD Remainder	6 - very low	5437- (all rural)
Total County		126,518

*Source for densities: http://www.city-data.com/

The assignment of areas to urban and non-urban classes is imperfect. For example, the assignment classifies McKinleyville as a non-urban area and this does not account for the fact that it does have an urban core. Analyzing the County at the level of detail required to account for these discrepancies would be prohibitively time consuming. Overall, this classification system described above is a reasonable approximation of existing conditions.

Since some data was only available at the zip code level and/or more detailed analysis would be prohibitively time consuming, zip codes were assigned as either urban and non-urban. For this analysis, the following zip codes were considered to be urban: 95501, 95503, 95521, 95534, 95536, 95540. Again, this classification system is imperfect, but it is a reasonable approximation of existing conditions. This zip code based classification system does not completely match with the population density based classification system described above.

Using the standard of residential density of 1,000 people per square mile as living in an "urban environment" for Humboldt County 51% (64,409) is urban (shaded boxes) and 49% (62,109) is non-urban (total population minus urban).

In this HIA, the phrase "rural character" is used to mean a landscape in which the features of the natural environment and agriculture predominate.

Healthy Housing

Encompassing shelter, home, and neighborhood, housing affects health in diverse ways—positively and negatively. Healthy housing is affordable, physically safe, sufficiently spacious, stable, and located in a setting that provides access to jobs, goods, services, transportation and nature, supporting meaningful social participation. Access to affordable and well-maintained housing that provides shelter against weather is a basic health necessity. Changes in housing stock, location, and affordability can either facilitate or hinder the achievement of adequate housing needs in a city. When housing is scarce, people with the least financial resources are often deprived of adequate and/or affordable housing. According to a Humboldt County community survey, 57.6% of respondents thought that the County should be putting more effort into improving the availability of affordable housing.[10]

Examples of how housing can affect health include the following:

- Residential displacements during childhood can result in depression, academic delay, school suspensions, difficult transitions between schools, and loss of health-protective social networks.[11] [12] [13]
- Lack of affordable housing leads to segregation of poor and minority communities to areas of concentrated racial inhabitation.[14] Segregated neighborhoods have fewer institutional assets such as schools, libraries, and public transit, and more environmentally burdensome infrastructure such as highways, power plants, factories, and waste sites.[15] [16]
- Spending on housing decreases money available for other basic living needs such as food, medication, and clothing.[17]
- Homelessness takes a tremendous toll on one's health. In a study done in New York City, age-adjusted death rates were four times higher in the homeless population than the general U.S. population.[18]
- Sprawling residential development leads to overweight and obesity[19] and increasing rates of diabetes, heart disease, and high blood pressure.[20] [21]
- "Complete neighborhoods" - which are defined here as mixed-use neighborhoods that include commercial services, grocery stores, open space, and public transit within a five minute walking distance, a diversity of housing types (in terms of housing cost, size, and ownership/rental) to meet the needs of its residents, the presence of sidewalks, and connectivity of the street network – are associated with numerous health benefits. Some of the benefits related to complete neighborhoods include healthy bodyweight,[22] [23] higher consumption of fruits and vegetables,[24] [25] increased physical activity,[26] less dependence on cars,[27] and increased social capital.[28] [29] [30]

Updating the Housing Element of the Humboldt County General Plan is potentially a great opportunity for improving health and wellbeing, growth of community ties, and social cohesion. The Healthy Housing section of this HIA evaluates the following housing indicators as they relate to Plan Alternatives A, B and C:

HH.1.a	**Proportion of housing production to housing need by income category**
HH.1.b	**Proportion of households paying greater than 30% & 50% of their income on their homes**
HH.2.a	**Homeless population**

Existing Conditions

Housing production versus housing need. Existing demand for housing in Humboldt County is highest among low-income people. Only 43% of the projected new housing needs for the period between 2001 and 2006 were met by housing construction for people with very low incomes, and 74% of the needs were met for people with low incomes.[31]

Proportion of income spent on housing. Nearly 40% of all households in the county spend 25% or more of gross income on housing.[32] Varying by region, between 15 and 60 percent of renter households spend over 50% of income on housing, and between 6 and 24 percent of owner-occupied households spend over 50% of income on housing.[33]

Homeless population. Estimates of total homeless persons in Humboldt County throughout the course of one year range from 4,000 to 6,000.[34] [35] It has been estimated that at any point in time, there are between 800 and 1,100 homeless persons in the County,[36] and the number is generally higher during summer months than during winter months.[37]

Summary of Findings

All of the Plan Alternatives share the goal of creating a sufficient quantity of housing to supply the demand of populations moving to Humboldt County by 2025. However, it is essential to clarify that Plan Alternatives A, B and C are designed to meet the housing demand of *future populations only*. Unmet demand of existing populations will not necessarily be met by any of the three proposed plans. While Plan Alternative A is anticipated to provide housing for the projected population growth in the County, it is not expected to meet the demand of existing County residents. Due to their higher quantities of proposed housing units, Plan Alternatives B and C have the potential to meet existing unmet demand; however, their ability to do so depends upon the *affordability* of the housing that is developed. Thus, in addition to a quantitative evaluation comparing housing supply and demand, this assessment analyzes each Plan Alternative's impact on housing costs and proximity to affordable goods and services for current and future residents.

In light of existing and future housing demand in Humboldt County, **the development of multifamily housing in existing urbanized areas and the development of a higher quantity of affordable housing units than would be likely under Plan Alternative A would be best from a health perspective.**

Within the scope outlined by Plan Alternatives A through C, this analysis concludes the following:

Plan Alternative A

Health benefits would accrue because of the following changes in housing indicators:

- If new infill housing developments include multifamily housing and/or a higher number of housing units per unit area, new housing is likely be more affordable due to lower infrastructure costs associated with infill development. Lower housing costs would allow income to be spent on other basic living needs such as food, medication, and clothing.
- More affordable housing could lead to improvements in housing conditions for low-income people and a reduction in the homeless population.
- An increase in residential density could lead to complete neighborhoods, which are associated with increased exercise, decreased weight, increased social cohesion, and less dependence on cars.

Health would **remain the same** due to no change in the following indicators:

- The rural character of the county, which is valued by many residents, would virtually remain the same.

<u>Plan Alternative B:</u>

Health benefits would accrue because of the following changes in housing indicators:

- If new infill developments include multifamily housing, 50% of the new housing is likely to be more affordable due to lower infrastructure costs associated with infill development. Although it is the same number of units, this is half the *proportion* of new affordable housing expected under Plan Alternative A. Lower housing costs would allow more income to be spent on other basic living needs such as food, medication, and clothing.
- The proportion (50%) of new housing that is more affordable could lead to a reduction in the homeless population and improvements in housing conditions for low-income people. Access to affordable and well-maintained housing that provides shelter against weather is a basic health necessity.
- Fifty percent of new housing developments may be within existing urbanized areas characterized by complete neighborhoods, which are associated with increased exercise, decreased weight, increased social cohesion, and less dependence on cars.

Health would **remain the same** due to no change in the following indicators:

- The rural character of the county would not be affected in a major way.

Potential health hazards could increase due to changes in the following indicators:

- Fifty percent of the new housing would most likely not be affordable to many people, due to higher infrastructure costs associated with expanding development into non-urban areas. Higher housing costs would lead to a reduction of available funds for other basic living needs such as food, medication, and clothing.
- Fifty percent of new housing developments may be within low-density suburban neighborhoods, which are unlikely to be complete. Relative to people living in more complete neighborhoods, residents in these areas may have increased weight, decreased social cohesion, and more dependence on cars.

<u>Plan Alternative C:</u>

Potential health hazards could increase due to changes in the following indicators:

- Due to higher infrastructure costs and a low likelihood of developers choosing to build multifamily housing outside of urbanized areas, the lowest proportion of new housing would be affordable under Plan Alternative C. Higher housing costs would lead to a reduction of available funds for other basic living needs such as food, medication, and clothing.
- Of the three Plan Alternatives, the lowest proportion of new residents would move into urbanized areas characterized by complete neighborhoods. As a consequence, under Plan Alternative C a greater proportion of new residents would be likely to experience decreased exercise, weight-gain, decreased social cohesion, and more dependence on cars.
- Due to sprawling development, the county's rural character would be most diminished by Plan Alternative C. Maintaining rural character is a priority for many Humboldt County residents.

Potential Health-Promoting Mitigations

1) Develop policies to encourage affordable housing:
    a. Reduce home construction costs through material selection and design to reduce the price for the homebuyer;

   b. Un-bundle automobile parking from housing units in urban areas to give tenants and owners the opportunity to save money by using fewer parking spaces;
   c. Offer developer incentives for residential densities between 2.5 and 10 units per acre;
   d. Offer municipal support for first time and low-income homebuyers;
   e. Offer density bonuses to developers conditional on the provision of below market rate (BMR) housing;
   f. Allow single resident occupancy (SRO) units;
   g. Require a percentage of below market rate (BMR) housing;
   h. Establish inclusionary zoning policies for all housing development, including development beyond areas currently served by existing water and sewer infrastructure;
   i. Establish a Community Land Trust (or participate in the already established Humboldt Bay Housing Development Corporation); and
   j. Establish a Housing Trust Fund to commit public sources of revenue to affordable housing.

2) Reduce government constraints to dense residential development:
   a. Reduce local zoning regulations such as parking space requirements; and
   b. Reduce tax constraints, such as those that discourage upgrading of existing dwellings and conversion of single to multi-family units.
3) Establish programs to assist the homeless population:
   a. Offer pre-release permanent housing planning for people discharged from public institutions such as the foster care system, jail, prison, mental health programs, hospital, or drug and alcohol programs;
   b. Increase emergency, interim, transitional, and permanent housing options and programs; and
   c. Improve social services offered to the homeless population by the county, such as mental health, domestic abuse, and substance abuse resources.

Sustainable and Safe Transportation

Individual transportation choices can have a major impact on health. For example:

- The more one drives (Vehicle Miles Traveled, or VMT), the higher risk of obesity, motor vehicle collision, musculoskeletal pain[38], and stress[39], and the less one is physically active[40], and participates with family, friends and in civic life;
- Limited access to goods and services due to poor land use planning results in decreased ability to access health care[41 42], poor nutritional habits, and increased transportation expenses;
- Vehicle volume and speed predicts pedestrian injury and fatality;[43 44]
- Proximity to public transportation predicts use of public transportation. Use of public transportation results in higher levels of physical activity and lower greenhouse gas emissions from automobiles. These emissions are the largest source of mobile air pollution in California. Air quality has an impact on respiratory and cardiovascular disease;
- Urban areas where people use cars less show higher rates of walking and lower rates of obesity and hypertension.[45] Access to safe bike and pedestrian facilities (e.g., sidewalks and wide shoulders on non-urban roads) encourages physical activity.

Individual choices, however, are not made in a vacuum. The policies that municipalities adopt with regard to transportation and circulation limit the options available for individuals to make healthy choices. Humboldt County has the opportunity, in updating the General Plan, to set out standards for transportation that will protect the health of its citizens by expanding and prioritizing options that will discourage driving, encourage physical activity and social cohesion, and provide better access to health care services and healthy retail choices. The Safe and Sustainable Transportation section of this HIA evaluates the following transportation indicators as they relate to Plan Alternatives A, B and C:

ST.1.b	**Average vehicle miles traveled by Humboldt residents per day**
ST.1.e	**Average minutes traveled to work by zip code**
ST.2.a	**Proportion of commute trips made by public transit**
ST.2.b	**Proportion of households with 1/4-mile access to local bus**
ST.2.c	**Proportion of average income spent on transportation expense**
ST.3.a	**Ratio of miles of bike lanes/ pedestrian facilities to road miles**
ST.3.b	**Proportion of commute trips and trips to school made by walking or biking**
ST.3.c	**Number and rate of bicycle/pedestrian injury collisions**
ST.3.e	**Proportion of population living on residential streets with <35 mph speed limits.**
ST.3.f	**Percent of population who have access to pedestrian facilities.**

Existing Conditions

Vehicle Miles Traveled. In 2006, residents of Humboldt County travel 27 vehicle miles per day (VMT) per capita compared to 24 daily miles for Californians as a whole.[46] In 2001 in California, per capita VMT was 2.7 times higher in rural areas as compared with urban areas.[47]

Travel time to work. Residents of both urban and non-urban areas in the County have travel times to work (17.3 minutes on average) that are lower than the national and statewide average (27 minutes on average statewide). However, areas of Humboldt County that have low residential densities have a 26% higher average length of commute time to work than those in higher residential densities.

Public Transit Use. Only 1% of the population of the county overall use public transportation to commute to work.[48]

Income spent on transportation. The average Californian spends about $7,144 annually on private vehicle expenditure. Expenditures for private vehicles are not known for the County.

Bike lanes. Only 3% of the County roadways have Class I or II bike lanes, (lanes that are set off from highways specifically for bicycling or at least have enough room and signage for safe biking). When surveyed in 2003, 69% of county residents felt that the County should provide walking and biking paths closer to existing communities and 62% stated that closer access to outdoor recreation including bicycling was a major reason why they live in Humboldt.

Pedestrian injuries. There were 163 automobile crashes involving pedestrians in Humboldt County from 1999-2002; 112 of them – or almost 70% - were in either Eureka or Arcata.[49] 20 of these collisions, or 12% of all of the collisions in the County, were at the intersections of Route 101 in Eureka (4th and 5th Streets).

Multimodal transit hubs: There are few locations in the County that facilitate transferring from one mode of transportation to another, such as a car and/or bicycle parking near bus stops.

Summary of Findings:
In light of inevitable population growth in Humboldt County and the transportation challenges that growth implies, **this analysis concludes that health would be improved most by accommodating future population in areas where residents can most easily access jobs, goods, services, social and cultural events by forms of transportation other than cars, i.e., in the urban areas where there is an existing infrastructure for these root determinants of health. Plan Alternative A best exemplifies this and is the best option for reducing the ill health effects of excess reliance on cars.**

Within the scope outlined by Plan Alternatives A through C, this analysis concludes the following:

Plan Alternative A
Health benefits would accrue because of the following changes in transportation indicators:

- The average travel time to work would *decrease*, leaving more time with family and friends, as well as time to exercise, eat with more intention, be engaged in the community, and relax. Across all working adults in the County, this Alternative would reduce travel time to work by approximately 55,000 hours a year from current levels. This option also decreases per capita Vehicle Miles Traveled. This would also lead to the smallest increase in the volume of greenhouse gases produced by the County and therefore the smallest increase in the County's contribution to climate change and its associated health impacts.
- There would be an *increase* in use of public transportation simply by locating people within existing public transportation routes; the number of people within ¼ mile of a bus stop would increase from current 51% to 59%. People who use public transit spend a median of 19 minutes daily walking to and from transit; 29% achieve at least 30 minutes of physical activity a day solely by walking to and from transit.[50]

- Expenses for transportation would *decrease*, given that more population would live in proximity to schools, services, cultural offerings, jobs and retail outlets, and thus be more likely to walk, bike or take public transportation. This particularly impacts low income residents.
- There would be a slight *increase* in the percentage of people who walk to work, from the current 5.6% to 6.0%. This would have a potential impact on the number of people getting recommended levels of exercise, which is protective for cardiovascular disease, cancer, and osteoporosis.
- Pedestrian injury due to collisions with motor vehicles may *decrease*, given research that shows that when pedestrian/bike volume increase enough, it causes drivers to either slow down or take other routes.[51] Without reaching this critical point, however, there could be an *increased* risk of pedestrian injury due to the increase in vehicle volume in urban areas. Overall, there would be a *lower risk of pedestrian fatality* as speeds in urban areas are lower; the literature tells us that motor vehicle collisions with pedestrians are more often fatal in rural areas and areas with higher speeds.
- *Increase* in access to pedestrian facilities for residents of Humboldt County, given that all of the population growth will be located in urban areas where sidewalks and pedestrian facilities already exist.

<u>Plan Alternative B:</u>
Health would **remain the same due** to no change in the following indicators:

- The proportion of people taking public transportation would *remain the same* since the proportion of people living near bus stops likely remain 51%.
- Expenses for transportation would on average *stay the same or increase*, given a moderate increase in people who live in settings encouraging automobile use.
- The number of people walking to work would *remain the same*.
- The proportion of residents living on roads with lower speed limits would not change, thus injury and fatality due to motor vehicle collisions would not change.
- The proportion of residents with access to pedestrian facilities would not change. Thus there would be little change in the number of people who walk.

And potential **health hazards would increase** due to changes in the following indicators:

- The time it takes to travel to work would increase. Across all working adults in the County, this Alternative would increase travel time by approximately 55,000 hours a year from current levels. People would have about the same amount of time for exercise, family, friends, relaxation, and better nutrition.
- Vehicle Miles Traveled would increase by 16% - approximately 200 million extra miles per year traveled in the County - leading to higher rates of obesity, more cardiovascular disease, less physical activity, less time spent in civic activities or with family, and higher rates of stress. Greenhouse gas emissions and climate change contributions by the County would increase as a result.
- *Slightly lower ratio* of bike/pedestrian facilities to road miles due to some *increase* in number of road miles with development.
- Pedestrian injury and fatality would *not change significantly*, but there may be a slight increase due to a population increase. More people, no matter where they are, imply more cars, more driving, and more accidents.
- More people living in non-urban areas means more automobile travel overall and increased traffic in urban areas.

Plan Alternative C:

Potential health hazards could increase due to changes in the following indicators:

- VMT would *increase* by 32% - approximately 400 million extra miles per year traveled in the County - with potential increase in obesity, cardiovascular disease, and stress and decrease in physical activity and social cohesion. Greenhouse gas emissions and climate change contributions by the County would increase the most under this Plan Alternative.
- Travel time to work would *increase*, leaving slightly less time for exercise, family, friends, relaxation, and better nutrition. Across all working adults in the County, this Alternative would increase travel time by approximately 110,000 hours a year from current levels.
- Public transit use is likely to *decrease* as the proportion of the population within ¼ mile of a bus stop will decrease from 51% to 46%.
- Average expenses for transportation would likely *increase*, since there will be more dependence on cars. Families would thus have less money to spend on health insurance/health care, healthy food, education, and other healthful priorities.
- The proportion of bike/pedestrian facilities to road miles would *decrease* due to an *increase* in miles of road.
- There would be a *decrease* in the percentage of people who walk to work, thus less physical activity and increased risk of obesity, cancer, heart disease, and osteoporosis.
- Pedestrian injury would potentially *increase* due to the increased traffic from non-urban areas traveling in to cities for goods and services. There may also be an *increase* in pedestrian fatality as there will be more people driving in non-urban areas at higher speeds.
- The proportion of people living on roads with higher speeds would *increase*.
- The proportion of Humboldt's population that has access to pedestrian facilities would *decrease* due to population growth in non-urban areas where pedestrian facilities are uncommon.

Potential Health-Promoting Mitigations

1) Develop policies to increase public transit use:
    a. Encourage employer-based incentive programs for use of public transit and improve awareness of such programs;
    b. Increase bus and paratransit routes;
    c. Increase frequency and connections and hours of operation;
    d. Improve coordination between public transit agencies;
    e. Increase service to non-urban areas;
    f. Increase public education about public transit options;
    g. Increase proportion of funding for public transit and bike/ped relative to single occupant vehicle travel;
    h. Promote transit routes to employment locations;
    i. Consider a variety of transit vehicle types to serve different types of needs;
    j. Evaluate locations of bus stops;
    k. Develop standards for transit shelter amenities (seating, schedules, etc) tailored to local conditions/resources.
2) Develop policies to encourage walking and biking:
    a. Redirect money that goes to automobile travel to support alternative forms of transportation;
    b. Reduce speed limits on arterials, collectors, and local roads in non-urban areas;
    c. Establish a seat on HCAOG representing human-powered transport;

d. Raise priority of non-motorized modes of transport in land use planning. For example, develop building design standards and revise zoning codes to emphasize pedestrian/bike safety, especially on key pedestrian, bike and transit corridors. Zoning codes to consider include those that look at: mixed use zoning, human activity presence, the building/sidewalk interface, parking design, and lighting.
e. Develop streetscape standards that emphasize pedestrian and bike safety (lighting, trees, greenery, traffic calming measures, etc.);
f. Collect data about pedestrian facilities throughout Humboldt County, much like information is tracked about the amount and condition of road surfaces; make this data public and use this data to guide development of pedestrian facilities;
g. Promote and publish safe pedestrian and bike routes;
h. Fund a bicycle and pedestrian safety staff position for the County, in HCAOG for example;
i. Complete, build out and connect bike and pedestrian networks;
j. Institute traffic calming measures, including clearly marked bike and pedestrian routes, bike boulevards, bulb outs, median islands on two or more lane streets, in urban areas to decrease speeds and firmly separate pedestrians/bikers from motor vehicles;
k. Include paved shoulders on all roads in non-urban areas that can be used by bicyclists and pedestrians;
l. Improve signalization of crossing and routes;
m. Raise priority for funding for trails and active recreation infrastructure and facilities;
n. Teach bicycle and pedestrian safety in schools and workplaces and educate residents about the benefits of walking and biking.

3) Establish multimodal transit hubs with co-located businesses, childcare, senior services and housing with priority for transportation disadvantaged.
4) Encourage retail, business, and industry to grow within urban boundaries, perhaps establishing Central Business Districts with incentives for businesses to locate in them.
5) Encourage larger employers to adopt Transportation Demand Management programs such as encouraging flex time and incentives for carpooling.
6) Extend the usefulness of privately-funded shuttles (casinos, social service providers, etc.) to make additional loops/stops to supplement and coordinate fixed-route transit.
7) Create parking restrictions to support taking public transit:
    a. Establish workplace and retail fees for parking;
    b. Unbundle cost of parking from housing units;
    c. Reduce parking requirements for new developments;
    d. Limit availability of parking except proximal to transit hubs.
8) Create school-based incentives:
    a. Designate safe walking and biking routes to school;
    b. Require that schools establish and support walking groups to school ("walking school buses");
    c. Develop policies to reduce car trips to school;
    d. Establish a task force for school citing (including school closures) and safe routes decisions including public works, city, county, CALTRANS, law enforcement, school staff, public health, community groups and others;
    e. Promote student attendance at their local neighborhood school.
9) Develop transit-oriented streetscape and building design standards for key transit nodes and corridors, partially funded via development impact fees.

10) Improve locally-based programs and mechanisms to help people take transit and self-organize for ridesharing, walking school buses, bike buddies, paratransit etc.

Public Infrastructure

Public Infrastructure includes resources and amenities that residents can use – things like childcare, schools, parks, medical facilities, grocery stores, banks, sidewalks, roads, and sewer systems. The location of these resources and their proximity to where people live help determine whether people use them, how often, and how they access them (e.g., by walking or driving).

The General Plan will decide where future housing will be developed in the County. Depending on the Plan Alternative selected, housing may be available in areas that already have public infrastructure – that are already complete neighborhoods – or in areas where little or no infrastructure exists. This decision impacts health in several ways. When a neighborhood is 'complete', that is it contains most of the public infrastructure people need in their daily lives, people tend to:

- drive less and walk or bike more;
- exercise more;
- have fewer car accidents;
- have decreased social isolation;
- be less stressed.

These health benefits are described further in the introduction to the transportation section.

The Public Infrastructure section of this HIA evaluates the following housing indicators as they relate to Plan Alternatives A, B and C:

PI.1.d **Proportion of zipcodes without childcare facilities**
PI.2.a **Accessibility of full-service grocery store/supermarket or store carrying produce**
PI.2.b **Proportion of households within ½ mile of a public elementary school**
PI.2.d **Fast food establishments within ½ mile of high schools and middle schools**
PI.3.a **Proportion of population within ¼ mile of open public parks**
PI.4.d **Percentage of population within 2 miles of a medical center**
PI.5.a **Percentage of seniors within ½ mile of senior center**
PI.6.a **Residential density**

<u>Existing Conditions</u>

Proximity to elementary schools, public parks, senior centers and medical centers: The following table details existing conditions in Humboldt County.

Area	% of households within ½ mile of one of the 48 public elementary schools	% of population within ¼ mile of one of the 86 public parks	% of seniors within ½ mile of one of the 20 senior centers	% of population within 2 miles of one of the 20 medical facilities
Humboldt County	35.3%	21.0%	21.4%	72.2%
Areas with urban zip codes	41.4%	28.9%	24.7%	82.6%
Areas with non-urban zip codes	24.1%	6.6%	14.9%	53.5%

Eureka and Arcata	43.6%	33.8%	24.5%	83.2%
McKinleyville	21.4%	9.9%	21.5%	85.4%

Childcare facilities. One in five labor force participants in Humboldt County is a parent living in a household in which all parents work.[52] There are approximately 274 formal child care facilities in Humboldt County, including:
• 159 licensed family child care homes
• 26 licensed child care centers
• 21 Head Start and Early Head Start Programs
• 30 child development programs funded by the California Department of Education
• 38 license-exempt before- and after-school programs.[53]

Of the 40 Humboldt zip codes, 18 (45%) had no licensed childcare facilities listed and 24 (60%) had no licensed family child care homes listed. Rural areas of Humboldt County include fewer childcare facilities than urban areas. In the 2005 Child Care Needs Assessment, only 25% of licensed childcare providers are located in "outlying rural areas". This report stated that 21 of 29 zip codes (72%) had no licensed family child care homes.[54]

Fast food establishments near schools. The following table details the number of fast food establishments (defined as restaurants that prepare and serve food quickly) near middle and high schools in Humboldt County.

City	Number of fast food restaurants within ½ mile of high schools and middle schools
Arcata	6
Eureka	4
Fortuna	4
Hoopa	0
McKinleyville	6

Grocery Stores. Most grocery stores are concentrated in the western region of the County, near Highway 101. Cities that are more densely populated, such as Eureka, Arcata, McKinleyville, and Fortuna, have more grocery stores than non-urban towns such as Trinidad and Ferndale.

Residential Density. The average density of permitted new development in Humboldt County for the period 1985-2000 was 1 unit per 10 acres.[55]

Summary of Findings:
Given the necessity of future development in Humboldt County, the impact that development will have on health and the ability to plan for that development, **accommodating future population in areas that currently have the necessary infrastructure would be best from a health perspective. Plan Alternative A best exemplifies this and is the best option for reducing the ill health effects of residents living far from important goods and services.**

Within the scope outlined by Plan Alternatives A through C, this analysis concludes the following:

Plan Alternative A

Health benefits would accrue because of the following changes in infrastructure indicators:

- The proportion of households within 0.5 miles of a public elementary school would *increase* to 36.0%, allowing more children to engage in physical activity by walking to school and leading to less school-related driving.
- The proportion of the population within 0.25 miles of a park would *increase* to 21.8%, allowing more people to engage in physical activity at those parks and allowing more people to enjoy other health benefits from being near them (e.g., mental health).
- The proportion of seniors (62 or older) within 0.5 miles of a senior center would *increase* to 22.0%, allowing more seniors to engage in health beneficial activities at those centers and decreasing isolation of seniors.
- The proportion of the population within 2 miles of a medical center would *increase* to 73.4% allowing more people to get medical care, including preventative care, more easily.
- The proportion of residents within ½ a mile of a grocery store would increase, allowing for improved nutrition.
- The greatest proportion of County residents would live in dense, complete neighborhoods which are associated with the health benefit of access to goods and services, as well as other benefits such as increased physical activity, reduced levels of overweight and obesity, and better social cohesion.

Health would **remain the same due** to no change in the following indicators:

- By concentrating both families with children and childcare providers in the same areas, Plan Alternative A would best meet the demand for childcare by working parents. The potential cost of living decrease under this Alternative could also decrease the need for childcare if more parents choose to stay at home with their children rather than feel the necessity to work outside the house for financial reasons. However, Plan Alternative A is expected to result in the highest proportion of zip-codes without childcare facilities. The proportion of the County's population living within non-urban zip-codes may not have access to childcare under Plan Alternative A, which is detrimental to health because it may be difficult for parents to work and earn a sufficient income.
- The number of fast food establishments near high schools would likely *remain about the same* since this alternative includes the development of the least number of new units and would therefore attract the fewest new fast food establishments. The diet of students would likely remain the same.

<u>Plan Alternative B:</u>

Health benefits would accrue because of the following changes in infrastructure indicators:

- Families with children in urban areas would most likely be in close proximity to childcare providers, while families in non-urban communities could have less access to childcare. The overall demand for childcare may not be met as much as it would under Plan Alternative A. However, Plan Alternative B is expected to result in a lower proportion of zip-codes without childcare facilities than Plan Alternative A. Under this Plan Alternative, non-urban populations may have greater access to new childcare facilities in their areas, which is important for the health of working families.

Health would **remain the same due** to no change in the following indicators:

- The proportion of residents within ½ a mile of a grocery store would remain about the same and nutrition would not likely be affected.
- About the same proportion of County residents would live in dense, complete neighborhoods which are associated with the health benefit of access to goods and services, as well as increased physical activity.

And potential **health hazards would increase** due to changes in the following indicators:

- The proportion of households within 0.5 miles of a public elementary school would *decrease slightly* to 34.9%. Fewer children would engage in physical activity by walking to school and school-related driving would increase slightly.
- The proportion of the population within 0.25 miles of a park would *decrease* to 20.4%, allowing fewer people to engage in physical activity at those parks and allowing fewer people to enjoy other health benefits from being near them (e.g., mental health).
- The proportion of seniors within 0.5 miles of a senior center would *decrease slightly* to 21.0%, allowing slightly fewer seniors to engage in health beneficial activities at those centers and slightly increase isolation of seniors.
- The proportion of the population within 2 miles of a medical center would *decrease slightly* to 71.7% allowing slightly fewer people to get medical care, including preventative care, easily.
- The number of fast food establishments near high schools would likely *increase* since this alternative includes the development of the more new units and would therefore attract the more new fast food establishments. The diet of students could become worse.

<u>Plan Alternative C:</u>

Health benefits would accrue because of the following changes in infrastructure indicators:

A) Families who do live in urban areas would most likely be in close proximity to childcare providers and public transportation. The overall demand for childcare might not be met by Plan Alternative C as much as it would under Plan Alternatives B or A. On the other hand, Plan Alternative C is expected to result in the lowest proportion of zip-codes without childcare facilities. Non-urban populations would potentially experience the health benefit of having childcare facilities nearby. Access to childcare would enable these non-urban parents to maintain jobs, and it would enable children to gain from development opportunities such as socializing with other children.

Potential health hazards could increase due to changes in the following indicators:

- The proportion of households within 0.5 miles of a public elementary school would *decrease* to 34.0%, allowing fewer children to engage in physical activity by walking to school and leading to more school-related driving.
- The proportion of the population within 0.25 miles of a park would *decrease* to 19.2%, allowing fewer people to engage in physical activity at those parks and allowing fewer people to enjoy other health benefits from being near them (e.g., mental health).
- The proportion of seniors within 0.5 miles of a senior center would *decrease* to 20.6%, allowing fewer seniors to engage in health beneficial activities at those centers and increasing isolation of seniors.
- The proportion of the population within 2 miles of a medical center would *decrease* to 70.0%, making it more difficult for more people to get medical care, including preventative care.
- The number of fast food establishments near high schools would likely *increase most* since this alternative includes the development of the most new units and would therefore attract the most new fast food establishments, including some in non-urban areas. The diet of students could become worse.
- The proportion of residents within ½ a mile of a grocery store would decrease and nutrition would not likely be negatively affected.
- The greatest proportion of new housing built between now and 2025 would be within incomplete neighborhoods with limited access to good and services.

Potential Health-Promoting Mitigations

1) Ensure all new communities that are developed have a public elementary school; include developer fees for new schools.
2) Increase access to parks by:
    a. Ensuring schoolyards are available in off-hours for community use;
    b. Building new parks in new developments;
    c. Ensuring funding for parks is maintained;
    d. Ensuring that forests, parks and wetlands in the County are not being converted to other uses.
3) Increase access to senior centers by:
    a. increasing awareness about existing senior centers;
    b. building more senior centers;
    c. increasing funding for senior centers;
    d. creating other services for seniors;
    e. increasing transportation services for seniors.
4) Increase access to medical facilities by:
    a. increase transportation available to bring people to medical facilities;
    b. increase awareness of existing transportation options.
5) Increase access to childcare by:
    a. Continuing to make federal and state subsidies for after-school programs and childcare available;
    b. Providing incentives for new childcare facilities by easing the process of obtaining and maintaining a childcare license;
    c. Offering low-interest loans or grants to childcare operators for the establishment and operation of childcare facilities;
    d. Supporting increased investment in employer-sponsored childcare assistance programs;
    e. Improving public transportation so that families without vehicles can transport children to childcare;
    f. Ensuring that all future communities have licensed childcare facilities;
    g. Including childcare centers and family childcare homes in zoning plans in all communities;
    h. Allowing childcare centers in all zones besides Open Space and zones that are inappropriate for health and safety reasons;
    i. Encouraging placement of childcare facilities within office parks, industrial developments, and commercial areas;
    j. Supporting placement of childcare facilities near commute routes, public transit and multi-modal transportation hubs;
    k. Encouraging childcare facilities within multi-family housing projects.
6) Implement and enforce zoning restrictions against the placement of fast food establishments within ½ mile of a school.
7) Provide incentives for grocery stores selling produce to be located in all residential neighborhoods, regardless of resident income levels.
8) Implement policies that encourage development of complete neighborhood in non-urban areas.

Healthy Economy

The Humboldt County General Plan clearly recognizes the need for future policies to support economic development practices that "promote and sustain economic prosperity." This economic prosperity can be achieved by ensuring that the economy provide:

- A minimum standard of living - a living wage;[56]
- Job security;
- High employment rates;
- High numbers of jobs that provide health insurance.

Income is one of the strongest and most consistent predictors of health and disease in public health research literature. The strong relationship between income and health is not limited to a single illness or disease. The adoption of a living wage is associated with:

- A decrease in premature death from all causes for working adults;
- Improved educational outcomes and a reduced risk of early childbirth among the offspring of low-wage workers;[57]
- Better health, improved nutrition, and lower mortality;[58]

Unemployment, on the other hand, is associated with premature mortality[59], cardiovascular disease, hypertension, depression, and suicide.[60]

Jobs that do not include health insurance contribute to poor health outcomes. Families with at least one full-time, full-year worker are more than twice as likely to have health insurance coverage, compared to families whose wage earners work as part-time employees (less than 35 hours per week), as contingent labor (e.g., on a seasonal or temporary basis, as employees of contractors, self-employed), or in which there is no wage earner.[61] People without health insurance forego timely health care, suffer more severe illness, and are more likely to die a premature death than their insured counterparts[62]. Annually nationwide, 18,000 premature deaths are attributable to lack of health coverage.[63]

The Healthy Economy section of this HIA evaluates industries according to the following indicators for workers in a healthy economy:

HE.1.a **Proportion of jobs paying a livable wage**
HE.2.a **Proportion of jobs that provide health insurance**
HE.2.c **Number of jobs available with appropriate educational requirements**

This information is compared to baseline trends in the County for:

- **Living wage for family size of one adult and one child;**
- **Unemployment rate;**
- **Percent of population uninsured;**
- **Current education attainment of population 25 years and older;**
- **Current employment.**

The main source of employment information for this Health Impact Assessment came from the *California LaborMarketInfo*[64], an employment database provided by the State of California. Included in this analysis are occupations identified at the Humboldt County General Plan Update and Health focus groups and with the Humboldt County Public Health Branch, but only those where there was sufficient information for Humboldt County, i.e., this analysis does not represent all occupations in each industry, but serves as a sample. Occupations were categorized based on the description as provided by *California LaborMarketInfo*.

Goals, policies, and implementation measures defined in the Humboldt County General Plan Update Chapter 11: Economic Development Element, which can be accessed on the Humboldt County website[65], reinforce the goal of creating a "healthy economy", here defined as maintaining a healthy, employed workforce with living wages and health insurance in relation to the analysis of the current economic conditions based on industry. Positive impacts of current goals, policies, investments and partnerships as stated in the Humboldt County General Plan Update in conjunction with current findings of this assessment are:

- Maintaining a diverse, stable, and growing local economy (ED-G1, ED-P19);
- Expanding internet access (ED-G2);
- Supporting education and training of the workforce (ED-G4, ED-P11, ED-P17, ED-P18, ED-IM4);
- Protecting timber lands (ED-G8);
- Revitalizing Brownfields (ED-G9, ED-P6, ED-P7);
- Encouraging partnerships between educational and training institution, employment centers and job searchers (ED-G10);
- Economic Development Assistance Programs for current and future workforce (ED-G11).

Existing Conditions

Living Wage Occupations. A wide range of positions exists in each industry (including managerial, for example) and these positions come with different pay and benefits. The conclusions made below are only a sample provided by the *California LaborMarketInfo* database and are not meant to summarize all living wages by occupations in the entire industry.

Occupations in Humboldt County that can provide a living wage (i.e., an hourly mean wage that can support a family size of one adult and one child: $15.27 per hour) include:

- Timber;
- Construction;
- Road construction and maintenance;
- Restoration of lands;
- High technology industries.

Industries that often do not provide a living wage include:

- Agriculture, Ranching, Fishing;
- Tourism including restaurants, hotel, outdoor recreation;
- Retail;
- Government;
- Gaming.

Industries that sometimes provide a living wage include:

- Green industry;
- Healthcare.

Hourly mean wages for those employed in *education* could not be suitably estimated due to the seasonal work period.

Significant Employment Providers. The population employed in the industries mentioned above varies, but employment sectors providing the most jobs include:

- educational institutions, health and social services (26.6%)
- retail trade (12.5%).

Those in retail trade often earn wages below the living wage according to the *California LaborMarketInfo* database.

Educational Attainment/Training. Of the population in the County 25 years and older, approximately 74% have finished junior high but do not have more than an Associate's Degree. This level of education qualifies them for several industries with living wages:

- Timber;
- Construction (excluding managerial);
- Healthcare;
- Some education occupations.

Many of these industries do require additional on the job training ranging from 30 days to one year.

Occupations not often compensating employees with a living wage based on this level of educational attainment are (all excluding managerial and supervisor positions):

- Agriculture, Ranching, Fishing;
- Restaurants;
- Hotel;
- Outdoor tourism;
- Retail;
- Government;
- Gaming.

Projected Employment Growth (2004-2014). California LaborMarketInfo forecasts an increase in employment need in industries from 2004-2014. The growth industries often providing living wages include:

- High technology (20-40% growth);
- Registered nurses and some other health care professions (22.5%);
- Some construction occupations (19.1%).

These occupations educational/training perquisites range from an Associate's or Bachelor's Degree to on the job training.

Occupations with projected growth that infrequently supply living wages include:

- Gaming dealers and service workers (33% growth);
- Retail salespersons (21.9%);
- Recreation attendants in the outdoor tourism industry (18.8%);
- Preschool teachers (15.6%);
- Hotel clerks (13.6%).

Many of the occupations require a minimum of on the job training or vocational education.

Health Insurance Benefits. Information on health insurance benefits provided categorized by industry is limited and therefore not used in this analysis.

<u>Summary of Findings</u>

From a public health perspective, preserving and promoting growing industries that pay living wages, provide health insurance and meet existing levels of education would be best. Jobs that meet these needs include timber, construction of housing, roads and other structures, some jobs within healthcare and education. Industries that do not frequently meet these needs include retail, agriculture and tourism. Each Plan Alternative has strengths and weaknesses with regard to the jobs that would be created or preserved.

Below is a limited analysis of the Plan Alternatives based on descriptions in the Humboldt General Plan Update. There will be exceptions in these alternatives based on various industry and economic circumstances and trends.

<u>Plan Alternative A</u>

- With the protection of prime employment and industrial reuse, this land use alternative preserves and promotes some industries that provide employees with living wages and appropriate education requirements, such as timber.
- Housing construction jobs, which often can pay living wages, may increase least in this Alternative, since the fewest number of housing units would be built. However other constructions jobs, such as construction of walking trails, may increase.
- Some industries that infrequently provide jobs with living wages would also remain relatively stable (e.g., tourism and agriculture) or grow slightly given the population growth (e.g., retail). Other industries that also infrequently provide living wages, such as big box retail, would be less likely given the limited development opportunities.
- There is also a possibility that the cost of living may decrease in this Alternative since, for example, people may be less dependent on owning a car, average electricity consumption could decrease and housing prices may be reduced.

<u>Plan Alternative B</u>

- This land use scenario could be slightly detrimental to some industries that can provide employees with living wages and have appropriate education requirements, such as timber.
- Construction jobs, which also can pay living wages, may increase more than in Plan Alternative A.
- Some industries that infrequently provide jobs with living wages would also remain relatively stable (e.g., tourism) or grow given the higher population growth in this Plan Alternative (e.g., retail). Others industries that do not frequently provide jobs with living wages would decrease (e.g., agriculture). Plan Alternative B is slightly more hospitable to other industries that also do not always provide living wages, such as big box retail.

<u>Plan Alternative C</u>

- This land use alternative would be detrimental to some industries that can often provide employees with living wages and have appropriate education requirements, such as timber.
- Construction jobs, which also can pay living wages, would increase most in this Plan Alternative.
- Some industries that infrequently provide jobs with living wages would also remain relatively stable (e.g., tourism) or grow given the higher population growth in this Plan Alternative (e.g., retail). Other industries that infrequently provide for living wages would decrease (e.g.,

agriculture). This Plan Alternative is most likely to promote other industries that also do not always provide living wages, such as big box retail.

- There is also a possibility that the cost of living may increase in this Alternative since, for example, people may be more dependent on owning a car, average electricity consumption could increase and housing prices may increase.

Potential Health-Promoting Mitigations

1) Develop policies to attract and retain industries which:
   a. Can provide a living wage;
   b. Provide health insurance benefits;
   c. Meet existing levels of workforce education.
2) Develop policies to solidify collaborations that can provide employees the opportunity for advancement, possibly resulting in earning a living wage, including those with:
   a. Educational institutions;
   b. Labor training centers;
   c. Other labor organizations.
3) Ensure that a trained and qualified workforce is available to meet the needs of projected growing industries that can often provide living wages.
4) Assure availability of substance abuse treatment services to decrease the number of people disqualified for continued employment based on positive drug tests, absenteeism or poor performance.

Public Safety, Social Cohesion and Health

Humboldt County decisions on public safety and social cohesion will have an impact on health. For example:

- First responder (fire, paramedics, EMTs) response times can have an impact on mortality and morbidity both due to fire hazard and medical emergency;[66 67 68]
- The state of California expects its residents to be able to self-sufficient for the first 72 hours after an emergency, and those trained in emergency preparedness are more likely to be, thus to avoid injury and care for injuries. Those trained in first aid are 2.4 times more likely to use their first aid skills in an emergency;[69 70]
- Humboldt County residents have much higher arrest rates for driving under the influence (DUI) and for alcohol violations than in California as a whole.[71] Fatal crashes and traffic fatalities in rural areas are 3.5 times more prevalent than expected on the basis of the percentage of total population, and the risk that the driver behavior of DUI is attributed to a fatal crash is 10% higher in rural areas than urban.[72]
- Isolation, or lack of social connection, is associated with depression, anxiety, suicide, slower recovery from illness, as well as other health outcomes.[73]

The General Plan Update has many opportunities to impact these indicators. The policies that municipalities adopt with regard to safety and location of new population can make a grave difference in regard to proximity to hospitals and first responders such as fire stations, how often people will have to drive on winding or potentially dangerous roads, emergency preparedness training and drunk driving, and very simply, how close people live to each other. The Public Safety, Social Cohesion and Health section of this HIA evaluates the following indicators as they relate to Plan Alternatives A, B and C:

SC.1.c	**Rates of driving under the influence (DUI)**
SC.2.a	**First responder response times - Fire response times**
SC.2.b	**Emergency preparedness sites/ training for citizens**
SC.4.a	**Isolation index**

<u>Existing Conditions</u>

First Responder Response Times. Currently, rural fire response times are approximately 11 minutes, and urban response times are 7 minutes.[74]

Emergency Preparedness of the Citizenry. In 2006-2007, Humboldt County's chapter of the American Red Cross trained approximately 9,000 people in Health & Safety trainings and 13,000 people attended disaster preparedness trainings or workshops.[75] 2,000 county employees have received training, including 200 Public Health Branch employees. All incorporated municipal employees are required to be trained, and schools must have an emergency operations plan.[76]

Rates of DUI. Humboldt County has one of the highest rates of deaths due to alcohol and drug use in the State of California.[77] Adult arrest rates for DUI in 2001 were 15.2 per 1,000 compared to 8.3 per 1,000 in the state of California. In 2000, the rate of fatalities and injuries from motor vehicle accidents in Humboldt County was 153.5 per 100,000 licensed drivers compared to 98.1 per 100,000 in California.[78]

Isolation. There is no one measure for isolation that has been used in Humboldt County, so this HIA used an "index", or a conglomeration of multiple measures: psychological distress, suicide, mental health treatment, substance abuse treatment, crime and civic engagement. In 2005, 10.2% of Humboldt County residents, or 1 out of every 10, stated they had spent between 10 – 20 days in the last month in poor mental health and 20.3% felt that they needed help for an emotional/mental problem[79] From 2001-2004, Humboldt County's rough suicide rate was 22.3 per 100,000, over three times Los Angeles's rate of 7.1 per 100,000. The most recent statistic for California is 9.4 per 100,000.[80] 11.2% had seen a mental health professional.[81] Humboldt County has higher rates of admission for drug and alcohol treatment than California, and also has over double the rate of death due to alcohol and drugs.[82] Crime rates are higher in Humboldt (46.3 per 1000 people in 2001) than in California overall (39.4 per 1000 people in 2001).

Some measures of civic engagement find Humboldt County faring better than the California as a whole. The County has between 5-11 percent higher voter registration rates than California since 1996. In 2000, 73% of those registered cast a ballot, slightly higher than California's rate of 71%. Many people feel that residents of the County are active in their communities, know their neighbors and enjoy this aspect of living in the County.

Proximity to schools and community centers are important aspects of isolation and are addressed in the Public Infrastructure section.

<u>**Summary of Findings**</u>**:**
There are avoidable and unavoidable safety issues that any municipality faces. Humboldt County has the opportunity for prophylaxis in designing its General Plan. **Accommodate future population in areas where residents will have better access to emergency services, have less chance of fatality if in a motor vehicle accident, will have a higher rate of enforcement of DUI laws, and will have greater social connections would enhance health in the County. The land use maps of Plan Alternative A will best protect Humboldt County's residents in terms of public safety and social cohesion.**

Within the scope outlined by Plan Alternatives A through C, this analysis concludes the following:

<u>Plan Alternative A</u>
Health benefits would accrue because of the following changes in Public Safety and Social Cohesion indicators:

- Response times from first responders would, on average, be slightly lower. For certain emergency medical situations such as cardiovascular events, quicker response times would signify better health outcomes.
- Emergency preparedness currently has focused on the coastal areas, which is where infill is slated to take place. If current outreach and training remains the same, emergency preparedness would improve as more people would live in the targeted areas. Thus, mortality as well as the affects of injuries such as musculoskeletal injuries, broken bones, and abrasions (the most common injuries in natural disasters) would decrease due to an increase in residents knowing how to take care of themselves and others.
- Isolation would likely decrease. Health benefits due to greater social connection include decreased rates of depression and suicide, more social support leading to greater access to resources, better recovery from illness, and greater ability to advocate for positive change.

Health benefits are mixed due to changes in the following indicator:

- If all population growth is accommodated in urban areas, fatality rates from driving under the influence of alcohol would likely decrease while accident and injury from DUI accidents would likely increase. Urban and rural rates of drinking are similar in the existing literature about DUI, but prevalence statistics show higher rates of arrest for driving while intoxicated and fatality as well as use of substance abuse treatment in Humboldt County. While it is unclear if a causal relationship between alcohol intake and living in a rural area is implicated, injury and fatality from DUI would likely decrease due to lower speed limits and less dangerous conditions (such as curved roads, cliffs, poorly lit roads).

<u>Plan Alternative B:</u>

Health benefits would remain the same due to no change in the following indicators:

- First responder response times would likely remain similar.
- Fatalities and injuries from DUI would likely remain similar.
- The proportion of residents who are socially isolated would likely remain the same, given that Plan Alternative B allows for growth in both urban and non-urban areas that reflects the current proportion of residents in the county. Thus, suicide, depression, anxiety, and illness recovery times would be similar to current conditions.

And **potential health hazards would increase** due to changes in the following indicators:

- Unless the Red Cross and other agencies charged with training citizens in emergency preparedness increase programming, the proportion of citizens ready for a natural disaster would decrease.

<u>Plan Alternative C:</u>

Potential health hazards would increase due to changes in the following indicators:

- First responder response times would increase slightly, and more people would be served by the lower-capacity fire departments in rural areas..
- The proportion of residents trained in case of a natural disaster would decrease, leaving more people in Humboldt County unprepared and vulnerable to death, injury, and disease in the aftermath of a disaster.
- Injury and death due to traffic fatality from DUI would likely increase.
- Isolation would increase, given that more of the population growth would be accommodated in rural areas. Potentially that could lead to higher rates of depression and suicide; less social support; less access to health resources, networks, and information; and higher rates of substance abuse.

Potential Health-Promoting Mitigations

1) Incentivize employers to encourage volunteering and voting.
2) Require construction or renovation of community centers with funding for staff and programs with large rural or urban development projects.
3) As part of a community benefits package, require developers to fund programs to engage the community, such as community concerts, parades, festivals.
4) Support programming to build retiree/student partnerships or other mentoring relationships.
5) Expand outreach for Citizen Advisory Committees on various types of municipal projects.
6) Measure isolation and social cohesion in Humboldt County using a validated tool such as the Saguaro Index[83] or the Petris Scale[84] in order to have an indicator to measure.

7) Support community building activities such as parades and events that showcase local artisans.
8) Support clustered development in regions where water supply is adequate for fighting fires.
9) Establish a uniform measurement system county-wide to track response times.
10) Encourage currently trained EMTs to gain paramedic training.
11) The DRAFT Safety Element of the GPU has very little to say about improving emergency preparedness among Humboldt County's citizenry, beyond implementing the Emergency Operations Plan, which also does not go into detail. Increase the importance of emergency preparedness by highlighting it more in the General Plan.
12) Have schools communicate their Emergency Operations Plans to parents.
13) Expand funding for trainings and publicity about emergency preparedness.
14) Set benchmarks on how many citizens are trained in each area. Designate a public agency responsible.
15) Support the Humboldt Red Cross in outreach efforts to bring people into their CERT training (Community Emergency Response Team).
16) Set up a Rural Emergency Preparedness outreach team to specifically address the readiness and concerns of rural residents in case of emergency.
17) Implement evidence-based interventions and policies against alcohol-impaired driving:
    a) Implement 0.08% blood alcohol concentration (BAC) laws. These are state laws that lower the illegal BAC for drivers from 0.10% to 0.08%. These have been shown to reduce alcohol-related fatalities by a median of 7 percent;
    b) Implement minimum legal drinking age laws and lower BAC laws specific to young or inexperienced drivers (zero tolerance laws);
    c) Increase the use of sobriety checkpoints;
    d) Fund mass media campaigns to educate the population about the dangers of drunk driving;
    e) Increase school-based education programs to educate students about the dangers of drunk driving and of riding with a drinking driver;
    f) Train alcohol servers on intervening with people who have been drinking and intend to drive;
    g) Decrease alcohol outlets and their hours of operation.

Environmental Stewardship & Health

According to an EPA report from 2000[85]:

> Direct environmental impacts of current development patterns include habitat loss and fragmentation, and degradation of water resources and water quality. Building on undeveloped land destroys and fragments habitat and thus displaces or eliminates wildlife communities. The construction of impervious surfaces such as roads and rooftops leads to degradation of water quality by increasing runoff volume, altering regular stream flow and watershed hydrology, reducing groundwater recharge, and increasing stream sedimentation and water acidity. A one-acre parking lot produces a runoff volume almost 16 times as large as the runoff volume produced by an undeveloped meadow. Development claimed more than half of the wetlands in the lower 48 states between the late 1700s and the mid-1980s.

In the Humboldt General Plan Update survey, 86.4% of respondents said that the surrounding natural environment was extremely important to the quality of life in Humboldt County and 85.1% said that quality of the natural environment was a major factor in why they decided to live in the county.[86] In this section of the Health Impact Assessment, development impacts on health through changes to the environment are considered. Development anywhere tends to degrade the environment, but the aim is to control the degree of degradation through better land use policy. Examples of how land use affects environment and health include:

- Further declines in agricultural lands, timber production, forestland fragmentation, and property improvements for development reduce the viability of the local farming and forest industry, diminish economic productivity and result in job losses. Income and unemployment impact health and well-being greatly (see the Healthy Economy section). Timber lands also contain culturally significant resources, wildlife habitats, sensitive watersheds (i.e, critical water supply areas), and protect the land from erosion, all of which also contribute to health.
- Consumption of locally produced foods can: reduce consumption of fossil fuels and reduce potential for pollution and for global warming[87]; increase consumption of fruits and vegetables; reduce consumption of processed foods; and have economic benefits including local farmers receiving more of the money spent on food[88] and keeping money in the community.[89]
- Parks and open space areas promote physical activity[90] and social interaction. Living in proximity to green space is associated with better self-rated health and higher scores on general health questionnaires.[91] Access to parks and open spaces also has a positive impact on stress, depression, and mental functioning.
- Watersheds (regions of land within which water flows down into rivers, lakes, or ocean; drainage basins) have been harmed by development. The increase in impervious areas (most notably, roads and parking lots) leads to reduction of water supplies and to increased flooding. Stormwater runoff, which is often polluted from household landscaping or agricultural pesticides, herbicides and fertilizers and from heavy metals from industry, has increased. Access to clean drinking water is vital for health.
- Electricity generation contributes to greenhouse gas emissions and indirectly to climate change which threatens health through more extreme weather events, increased air pollution, limitations on food production, increased water-borne and food-borne illnesses, and increased infectious disease vectors. The benefits of decreased energy consumption also include economic benefits through lower utility bills.

The environment offers resources and carries out valuable services for us. For example, it purifies water and air and gives us space for physical activity. When these resources and services are not available or the environmental systems go awry, technologies are developed, and financial and health costs are paid. For example, water purifiers must be purchased, asthma rates increase, and memberships at gyms must be bought. Protecting the environment takes advantage of this 'natural capital' and will improve health and lower the cost of living.

The Environmental Stewardship section of this HIA evaluates the following environmental indicators as they relate to Plan Alternatives A, B and C:

ES.1.b	**Residential electricity use (kWH) per capita**
ES.2.a	**Acres of public open space per 1,000 population in Urban areas**
ES.3.a	**Proportion of County land area retained for active farming uses**
ES.3.b	**Proportion of County land area retained for timber production**
ES.3.c	**Percent of food consumption from local sources**
ES.5.c	**Percent of households using municipal water system**
ES.5.a	**Total impervious area in County**

Existing Conditions

Agricultural and timber lands. In 2002, there were 633,931 acres of farm land, 28% of Humboldt acreage. According to the California Department of Forestry and Fire Protection, in 1996 the County had 1,487,000 acres of forest land (65% of total acreage), 20% less than the amount in 1967.[92]

Parks and open space. There are 7.5 square miles of public open space per 1000 persons in Humboldt County. Seventeen percent of land in Humboldt is publicly owned. Of the 2,287,000 acres of land in the county, 262,000 are national forests and 15,000 are other public lands.[93] Urban areas of the County also have a good number of parks. In Eureka, there are 4.5 acres of park per 1000 residents; Arcata has 6.2 acres per 1000 residents; and Fortuna has 6.5 acres of park per 1000 residents.

Public water supply. In Humboldt County there are 21 community Public Water Systems (PWS) with greater than 200 service connections and 25 PWS with fewer than 200 service connections. The lager PWSs tend to be used in more urban areas with denser populations. The numbers of coliform and turbidity failure are far lower in the larger PWS in the County.[94]

Impervious area. Data on current Total Impervious Area (TIA) in Humboldt County is only available around Arcata. All but one of the watersheds in Arcata is more developed than the amount recommended for stability (10%).[95] Some, like the Campbell Creek and Sunset Creek watersheds are significantly more developed (over 30%).

Electricity use per capita in the County, ~7300 kWh/year, is similar to use in California and about half the use in the US.[96] Electricity use in the County increased about 1.3% per year between 1990 and 2000, while population growth was about 0.6% per year. Due to decreased use in industry (mainly timber), energy use in the County decreased significantly (~24%) between 2000 and 2003. According to the Humboldt County Energy Element Appendices: Technical Report, currently, the County produces locally 73% of electricity and 11% of natural gas consumed.[97]

Local food. According to one source, around 85% of Humboldt's food is brought in by trucks.[98] In the US, on average, an item of food travels 1500 miles between the farm and the plate.[99] Opportunities for access to local produce include: 13 farmers markets, 6 local Community Supported Agricultural Farms programs, local grocery stores that highlight locally grown food, and a Farm-to-School program for education.

Summary of Findings:
In light of the predicted population growth in the County and the potential harm to the environment that could accompany that growth, **the best health outcomes would be achieved by accommodating future population in the urban areas that are currently developed and by protecting productive lands and other open space from development. Plan Alternative A best exemplifies this and is the best option for promoting health through environmental protection.**

Within the scope outlined by Plan Alternatives A through C, this analysis concludes the following:

Plan Alternative A
Health benefits would accrue because of the following changes in environmental indicators:
- The proportion of households that have access to large municipal water systems would increase and thereby more people would have access to safer drinking water.
- Per capita electricity consumption would decrease since urban housing tends to be smaller. This will help minimize pollution and global warming and their associated health effects and leave more money available for other necessities, such as food.

Health would **remain the same due** to no change in the following indicators:
- Productive agricultural and timber land would be preserved and thereby jobs, culturally significant resources, habitats of threatened species, sensitive watersheds, or critical water supply areas would be maintained. The amount of locally produced food would also not be impacted and therefore local consumption may be at least maintained.
- Total Impervious Area (TIA) would increase least since urban development will not require new road and parking construction and has the potential to build multi-family units with smaller roof areas. However, urban watersheds could be negatively affected and policies to account for this are needed. The health benefits of less TIA include less flooding, less water pollution, and preservation of water resources.

And potential **health hazards would increase** due to changes in the following indicators:
- The acres of park per 1000 residents in urban areas would decrease unless policies are adopted to increase the number or size of parks as more people move into these areas. Parks contribute to health by providing opportunities for physical activity and social interactions and because views of natural spaces improve mental health.

Plan Alternative B:
Health would **remain the same due** to no change in the following indicators:
- The proportion of households that have access to large municipal water systems would remain about the same as would the number of people who have access to safer drinking water.
- Per capita electricity consumption would remain about the same since new housing will be evenly distributed in urban and non-urban areas. This will not change the amount of pollution being generated and will contribute to global warming, both of which have negative health consequences. Additionally, people will spend about the same amount of

money on electricity and will not have more available for other necessities.

And potential **health hazards would increase** due to changes in the following indicators:

- Some productive agricultural and timber land could be lost and thereby jobs, culturally significant resources, habitats of threatened species, sensitive watersheds, or critical water supply areas may be lost. The amount of locally produced food could also decrease and therefore local consumption may be reduced.
- As above, the acres of park per 1000 residents in urban areas would decrease unless policies are adopted to increase the number or size of parks as more people move into these areas.
- Total Impervious Area would increase due to the non-urban development which will require new road and parking construction. Urban watersheds could be negatively affected, as in the other Plan Alternatives and policies to account for this are needed. Flooding and water pollution will increase, and water resources will be lost.

Plan Alternative C:

And potential **health hazards would increase** due to changes in the following indicators:

- The greatest amount of productive agricultural and timber land would be lost and thereby jobs, culturally significant resources, habitats of threatened species, sensitive watersheds, or critical water supply areas will be negatively affected. The amount of locally produced food would also decrease and therefore local consumption may be reduced.
- As above, the acres of park per 1000 residents in urban areas would decrease unless policies are adopted to increase the number or size of parks as more people move into these areas.
- The proportion of households that have access to large municipal water systems would likely decrease as would the number of people who have access to safer drinking water.
- Total Impervious Area would increase due to the non-urban development, which will require new road and parking construction. Urban watersheds will also be negatively affected, as in the other Plan Alternatives and policies to account for this are needed. Flooding and water pollution will increase, and water resources will be lost.
- Per capita electricity consumption would likely increase since more new housing will be built in non-urban areas. This will increase the amount of pollution being generated and will increase global warming, both of which have negative health consequences. Additionally, people will spend more money on electricity and will not have less available for other necessities.

Potential Health-Promoting Mitigations

1) Selectively preserve agricultural land and timber land if scenarios B or C are chosen.
2) Restrict housing placement to the periphery of agriculturally zoned land to maintain contiguous acreage for future farming use.
3) Maintain existing and build new urban parks by:
    a. Enacting a Humboldt County discount for national, state, and county parks;
    b. Ensuring funding for parks is maintained;
    c. Ensuring that forests, parks and wetlands in the County are not being converted to other uses;
    d. Building parks in urban areas to increase acreage of parks available;
    e. Increasing funding and protection for national, state, and county parks.
4) Reduce impact on TIA by:
    a. Building more densely and building fewer roads and parking lots;

   b. Implementing policies that decrease parking requirements for retail establishments in non-urban areas, decrease parking for office buildings, and encourage parking garages instead of large parking lots;
   c. Encourage development in areas near existing roads;
   d. Incentivizing the use of more porous materials for new roads and parking lots;
   e. Incorporating the Ahwahnee Water Principles into the General Plan: "City and County officials, the watershed council, LAFCO, special districts and other stakeholders sharing watersheds should collaborate to take advantage of the benefits and synergies of water resource planning at the watershed level;"
   f. Set limits on TIA for each watershed;
   g. Encouraging roofing partially or completely covered with vegetation and soil that can absorb water.
5) Decrease per capita electricity consumption by:
   a. Increasing energy efficiency of housing;
   b. Encouraging construction of multi-unit buildings and smaller houses;
   c. Encouraging construction of buildings that follow environmental standards such as those proposed by Leadership in Energy and Environmental Design (LEED);
   d. Regulating electricity use by industry and businesses (e.g., turning lights off in office buildings at night);
   e. Promoting solar and other locally produced energy production and consumption;
   f. Reducing the County's carbon footprint by following the recommendations of groups like the International Council for Local Environmental Initiatives (ICLEI);
   g. Implementing outdoor lighting efficiency standards to decrease public and private use of electricity.
6) Encourage consumption of locally produced food by:
   a. Increasing incentives to produce food locally and consume locally produced food;
   b. Increasing programs and incentives for locally grown food businesses (e.g., see: http://guide.buylocalca.org/ and http://www.caff.org/programs/eco_index.shtml)
   c. Encouraging County institutions (e.g., hospitals) to use locally grown foods;
   d. Supporting of food incubator businesses in the County.

Conclusions

In the process of updating its General Plan, Humboldt County is currently evaluating 3 Plan Alternatives. In this Health Impact Assessment, these alternatives were analyzed from a health perspective using 35 indicators prioritized by stakeholders in focus groups, by Humboldt Partnership for Active Living, and by the Humboldt County Public Health Branch. In looking at data on existing conditions for each indicator and analyzing how each Plan Alternative would likely change each indicator quantitatively and/or qualitatively, conclusions were reached about the likely health impacts of each Plan Alternative.

Briefly, Plan Alternative A provides for "focused growth." It encourages all new units to be built in existing areas that are already supported by public sewage and utilities, i.e., encouraging higher residential density and infill development. Alternative A provides for 6,000 additional units over the course of 25 years. Plan Alternative B is a compromise between an all-infill development plan and a plan that does not highly regulate the location of new development. It primarily provides for building in urban centers where there is a good network of utilities, sewage, and transit, but allows for some ex-urban development as well with modest expansion of existing water service areas, focusing on areas adjoining the city centers. Alternative B provides for 12,000 additional units over the course of 25 years. Plan Alternative C allows the most unrestricted growth, or an "expanded development pattern". Plan Alternative C allows the highest number of existing parcels to be developed for housing; it also expands water service areas beyond present boundaries to expand opportunities for housing in outlying parts of communities. Alternative C provides for 18,000 additional units over the course of the 25 years.

Many of the predicted changes in indicators, such as the proportion of the population living near parks, are only predicted to change by less than two percent. While this may seem like an insignificant amount, few other decisions about land use in the County could make changes of this magnitude. Given the current trends in health, everything possible must be done to change the built environment in ways to promote health.

One of the goals of HIA is to judge a plan for its potential health effects on a population, and the distribution of those effects within the population. In Humboldt, seniors, children, Native Americans, and those living close to the poverty line are vulnerable populations that currently often have more significant health issues. The decisions made in this general plan will affect those populations and those effects should be considered when choosing between the Plan Alternatives. In most cases, the policies associated with Plan Alternative A reduce this disparity most. For example, the poor, seniors and children have less access to private motor vehicle travel. By placing future development in urban areas, Plan Alternative A would make non-motorized forms of transit a more viable alternative for accessing parks, medical center, senior centers and grocery stores.

Many issues are and should be considered in the choice of Plan Alternatives for the General Plan Update; health is just one of them. If a Plan Alternative is chosen that has negative health impacts, additional health promoting mitigations can and should be implemented to offset these negative impacts. Many of these mitigations are suggested in both the summary documents and the full report.

Given the importance of health and current trends such as the increasing rates of type 2 diabetes and heart disease in the County, health should be a primary consideration in the choice of Plan Alternatives. As the table below shows:

- **Plan Alternative A will likely have the most positive overall health impacts and require the fewest health related mitigations**
- **Plan Alternative C will likely have the most negative overall health impacts and require the greatest number of health related mitigations; and**
- **Plan Alternative B would change health outcomes least.**

However, Plan Alternative A also may impact health negatively and other options not under consideration may be still better. For example, the need for affordable housing may not be met under Plan Alternative A. A plan involving the construction of more than 6000 units of housing in the currently urban areas would likely retain or increase most of the positive health impacts described for Plan Alternative A and would mitigate some of the potentially negative health impacts it has.

The table below summarizes conclusions for each indicator analyzed. In the table, a "+" sign indicates that the indicator would change in a positive way for that Plan Alternative, and, therefore, that health outcomes related to that indicator would improve as well. A "~" sign indicates that the indicator would not be affected significantly by the choice of alternatives. A "-" sign indicates that both the indicator and health would be negatively affected by that Plan Alternative. Lastly, a "TBD" (To Be Determined) indicates that not enough information is currently available to evaluate how the indicator and health would changed.

Indicator	Description	Plan Alternative A Impact	Plan Alternative B Impact	Plan Alternative C Impact
SUSTAINABLE AND SAFE TRANSPORTATION				
ST.1.b	Average vehicle miles traveled by Humboldt residents per day	+	-	-
ST.1.e	Average minutes traveled to work by zip code	+	~	-
ST.2.a	Proportion of commute trips made by public transit	+	~	-
ST.2.b	Proportion of households with 1/4-mile access to local bus	+	~	-
ST.2.c	Proportion of average income spent on transportation expense	+	~	-
ST.3.a	Ratio of miles of bike lanes/ pedestrian facilities to road miles	+	-	-
ST.3.b	Proportion of commute trips and trips to school made by walking or biking	+	~	-
ST.3.c	Number and rate of bicycle/pedestrian injury collisions	TBD	TBD	-
ST.3.e	Proportion of population living on residential streets with <35 mph speed	+	~	-

	limits			
ST.3.f	Percent of population who have access to pedestrian facilities	+	~	-
HEALTHY HOUSING				
HH.1.a	Proportion of housing production to housing need by income category	+	~	-
HH.1.b	Proportion of households paying greater than 30% & 50% of their income on their homes	+	~	-
HH.2.a	Homeless Population	+	~	-
PUBLIC INFRASTRUCTURE				
PI.1.d	Proportion of zipcodes without childcare facilities	-	~	+
PI.2.a	Proportion of residents within ½ mile of a grocery store	+	~	-
PI.2.b	Proportion of households within ½ mile of a public elementary school	+	~	-
PI.2.d	Fast food establishments within ½ mile of high schools and middle schools	~	-	-
PI.3.a	Proportion of population within ¼ mile of open public parks	+	~	-
PI.4.d	Percentage of population within 2 miles of a medical center	+	~	-
PI.5.a	Percentage of seniors within ½ mile of senior center	+	~	-
PI.6.a	Residential density	+	~	-
PUBLIC SAFETY AND SOCIAL COHESION				
SC.1.c	Rates of driving under the influence (DUI)	TBD	TBD	TBD
SC.2.a	First responder response times - Fire response times	+	~	-
SC.2.b	Emergency preparedness sites/ training for citizens	+	~	-
SC.4.a	Isolation index	+	~	-
HEALTHY ECONOMY				
HE.1.a	Proportion of jobs paying a living wage	TBD	TBD	TBD
HE.2.a	Proportion of jobs that provide health insurance	TBD	TBD	TBD
HE.2.c	Number of jobs available with appropriate educational requirements	TBD	TBD	TBD
ENVIRONMENTAL STEWARDSHIP				
ES.1.b	Residential electricity use (kWH) per capita	+	~	-
ES.2.a	Acres of public open space per 1,000 population in Urban areas	-	-	-
ES.3.a	Proportion of County land area retained for active farming uses	~	-	-
ES.3.b	Proportion of County land area retained for timber production	~	-	-

ES.3.c	Percent of food consumption from local sources	~	-	-
ES.5.a	Total impervious area in County	~	-	-
ES.5.c	Percent of households using municipal water system	+	~	-

Appendix A: Data Contributors and Focus Group Participants

The following people contributed data to this HIA:

- Tom Matson, Director of Public Works, Humboldt County
- Hugh Scanlon, California Department of Forestry
- Sheila Steinberg PhD, California Center for Rural Policy at Humboldt State University
- Susan Ornelas
- Melanie Williams, HumPAL (Humboldt Partnership for Active Living)
- Jen Rice, Natural Resources Services, Redwood Community Action Agency
- Deborah Giraud, UC Davis Agricultural Extension Service
- Kirk Girard, Alyson Hunter, Cybelle Immett, Martha Spencer, Michael Richardson, Humboldt Community Development Services
- Erica Terrance, Northcoast Environmental Center
- Cathy Bifeier, California Water Resources Board (North Coast Watershed Assessment Program)
- Mark Andre, City of Arcata
- Steve Steinberg, PhD, Department of Environmental and Natural Resource Sciences, Humboldt State University
- Steven Hackett, PhD, Humboldt State University
- Pat Higgens
- Jacqueline Debets, Humboldt County economic Development
- Rob Amerman and Jan Turner, Housing and Homeless Coalition
- Wendy Rowan, First Five Commission
- Julie Sessa, Area 1 Agency on Aging
- Judy Anderson, Local Childcare Planning Council
- Rick Martin, Air Quality Management District
- Luis Bruhnke, North Coast Emergency Medical Services
- Sue Aszman, USDA NRCS Arcata Soil Survey Office
- Kevin O'Neil, California Department of Forestry
- Staff, PG&E
- Connie Stewart, Assemblymember Patty Berg's office
- Spencer Clifton, Humboldt County Association of Governments
- Penny Figas, Director, Humboldt Del Norte County Medical Society
- Maureen Chase, Eureka City Schools
- Staff, Public Health Branch

The following people participated in focus groups:
Arcata Focus Group

- Ken Miller, Salmon Forever
- Mark Lovelace, Healthy Humboldt
- Peggy Martinez, Humboldt Council of the Blind
- Norma McAdams, Hoopa Valley
- Wendy Ring, Mobile Medical Office
- Timothy Daniels, Bigfoot Bicycle Club
- Rick Martin, North Coast Air Quality Management District
- Bill Spencer
- Deborah Giraud, U.C. Cooperative Extension
- Chris Rall, Greenwheels

- Susan Ornelas, Jacoby Creek Land Trust
- Joyce Houston, Public Health
- Andrea Armin
- Chris Jones, Tri County Independent Living
- Ann Lindsay, Public Health Officer
- Lona Bates, City of Arcata
- Carol McFarland, Foster Avenue Neighbors
- Ingrid Kosek, Friends of the Annie and Mary Rail Trail
- Linda Doerflinger, HumPAL, NAMI
- Robert Boher, Yurok Tribe
- David Mohrman
- Kim Hagans, United Way Switchboard
- Jason Davis, North Coast Air Quality Management District
- Marilyn Foote, Redwoods Rural Health Center
- Michael Atkins, Ridgewood Village
- Ann King Smith, Ex. Arcata Planning Commissioner, North Coast Regional Land Trust
- Michael Richardson, Community Development Services, County of Humboldt

Eureka Focus Group

- Victoria Onstine, Area 1 Agency on Aging
- Paula Yoon
- Susan Penn
- Jay Sooter, Small Business
- Larry Evans, Alliance for Sustainable Jobs and the Environment
- Wendy Rowan, First 5 Humboldt
- Lawrence Wieland, Redwood Family Practice
- Aaron Antrim, Green Wheels
- Ali O. Lee, Lighthouse of the North Coast
- Tressie Word, Winzler and Kelly

Fortuna Focus Group

- Nicole Gans, DHHS PHB Health Education
- Judi Anderson, Local Childcare Planning Council
- Kathleen Adkins, Lighthouse of the North Coast
- Patti Rose, Cedar St. Sr. Apts., So. Hum.Community Healthcare
- Sylvia Jutila, American Cancer Society
- Sharon Latour, Presbyterian Church, Garberville
- Dorina Espinoza, Public Health Branch
- Clif Clendenen, Clendenen's Cider Works
- Estelle Fennell

Appendix B: Map Creation and Data Analysis for Humboldt County

The system used for mapping and various analyses was ArcGIS 9.2 software by ESRI (2007). This software integrated the data for mapping and analysis. The color schemes for the maps were selected by consulting ColorBrewer (http://www.colorbrewer.org), an online tool for selecting color schemes.

The maps (population/household/age data) were classified using Jenks Natural Breaks. In this classification method, the data are assigned to classes based upon their position along the data distribution relative to all other data values. The classification is determined by the best arrangement of values into classes by comparing the sum of squared differences of values from the means of their classes.

The projection and coordinate system used for the maps
NAD_1927_StatePlane_California_I_FIPS_0401
Lambert_Conformal_Conic
False_Easting: 2000000.000000
False_Northing: 0.000000
Central_Meridian: -122.000000
Standard_Parallel_1: 40.000000
Standard_Parallel_2: 41.666667
Latitude_Of_Origin: 39.333333

The source of the population, household and age data was the 2000 Census. The data and map file boundaries were retrieved through Geolytics Research Package – using the Census Summary File 1 (SF1), also known as the long form, and Summary File 3 (SF3).

The method to determine the proximity measures (proportion of the population/households/seniors) is the 'centroid within' method. Each census block group was converted to a centroid or a point which represents the geographic center of each census block. The block groups which have their geographic center within the study area (in this case the appropriate sized buffer) are counted as being the distance the buffer represents. This method represents a good comprise of extraction techniques and polygons with a majority of its area within the study area will be included. Calculating centroids is not a precise measurement and there is a margin of error.

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Healthy Housing Indicators

HH.1.a Proportion of housing production to housing need by income category

Health-Based Rationale

When housing production does not meet housing demand, people with the least financial resources are often deprived of adequate and/or affordable housing. One human health impact of inadequate housing stems from people spending high proportions of their incomes on rent or a mortgage; this corresponds to fewer resources for food, heating, transportation, health care, and child care.

Many low-income residents cannot afford housing that includes basic features necessary for health. For example, one out of every seven low-income families in the US lives in physically inadequate housing, defined as having severe physical deficiencies such as lacking hot water, electricity, a toilet, or both a bathtub and a shower.[1] Substandard housing with deficiencies such as these may be associated with exposure to waste and sewage, physical hazards, mold spores, poorly maintained paint, cockroach antigens, old carpeting, inadequate heating and ventilation, exposed heating sources and wiring, and broken windows. In turn, these exposures can lead to health conditions including respiratory diseases,[2] [3] lead poisoning,[4] and injuries.[5]

A third potential impact of inadequate housing supply is the need for people to leave their community in order to find affordable housing. Moving away can result in the loss of jobs, traveling long distances for work, difficult school transitions, and the loss of health-protective social networks. For children, moving can be particularly difficult. Research has shown that increased mobility in childhood is associated with academic delay, school suspensions,[6] and depression later in life.[7]

Existing conditions

Housing Demand: In order to house the population growth projected by the Department of Finance between now and 2025, approximately 5,021 housing units are needed in Humboldt

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[1] US Census Bureau. 1993 American Housing Survey. Available at http://www.census.gov/prod/2006pubs/h150-05.pdf.

[2] Eggleston PA, Butz A, Rand C, Crutin-Brosnan J, Kanchanaraska S, Swartz L, Breysse P, Buckley T, Diette G, Merriman B, Krishnan JA. 2005. Home environmental intervention in inner-city asthma: A randomized controlled trial. Annals of Allergy, Asthma and Immunology 95(6):496-497.

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County.[8]

Area Median Income: The County's household AMI was $33,281 in 2004.[9]

Housing Production: Between 2001 and 2006, there were a total of 2,070 building permits issued for new residences in unincorporated areas.[10] As of October 31, 2007, the number of residential units permitted in 2007 was 248.[11]

Table HH.1. Housing Production Compared to Housing Need[12]

Humboldt County Unincorporated Areas, 2001-2006

Income Level	Projected Housing Need (Housing Units)	Housing Construction (Housing Units)	% of Need Met	Production Needed to Meet Goals
Very Low (50% AMI**)	498	216	43%	282
Low (80% AMI**)	324	239	74%	85
Moderate (120% AMI**)	420	538	128%	Surplus: 118
Above Moderate (Market rate)	552	1,077	195%	Surplus: 525
Total	1,794	2,070	115%	Surplus: 276

*Production is new units; rehabbed and conserved units are not counted.
** AMI = Area Median Income

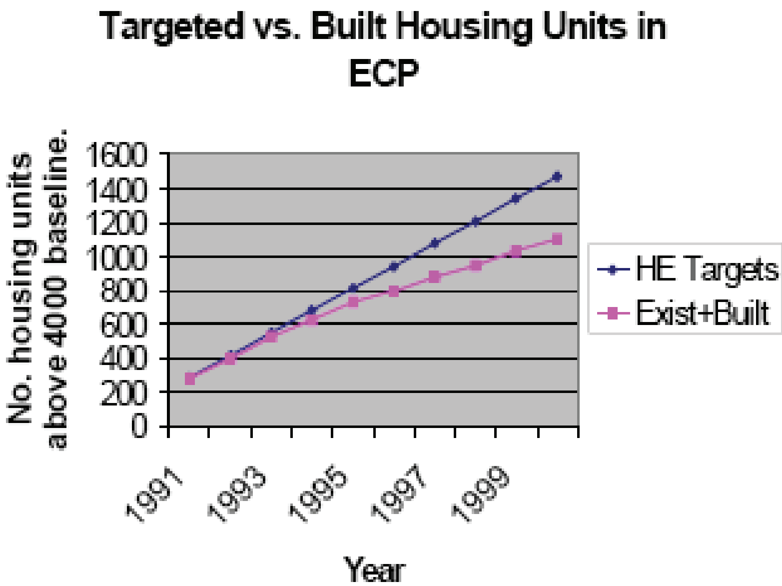
People with the least financial resources are least likely to have their housing needs met. As shown in Table HH.1 above, only 43% of the projected new housing needs for the period between 2001 and 2006 were met by housing construction for people with very low incomes, and 74% of the new housing needs projected for this period were met by housing construction for people with low incomes.

According to Eureka's Abbreviated Consolidated Plan, written in 2004, Eureka contains the largest numbers of affordable housing units.[13] However, for the past decade, the number of new houses built in Eureka has been consistently and increasingly short of the number of housing units needed as identified in the community planning documents and the housing

[8] General Plan Update & Updated Population and Housing Projections, October 2007 (powerpoint presentation).
[9] http://quickfacts.census.gov/qfd/states/06/06023.html.
[10] 2006 Annual Progress Report on Implementation of the Housing Element, General Plan Report requirement pursuant to Section 65400 of the Government Code.
[11] General Plan Update & Updated Population and Housing Projections, October 2007 (powerpoint presentation).
[12] 2006 Annual Progress Report on Implementation of the Housing Element, General Plan Report requirement pursuant to Section 65400 of the Government Code.
[13] Waxman, Deborah T. Creating Affordable Housing in Humboldt County (Master's Thesis).

element. This trend is demonstrated in the following figure:

Figure HH.1. Targeted versus Built Housing Units in Eureka [14]



Analysis

<u>Assumptions</u>

- Housing demand of incoming populations within the next 25 years will generally adhere to the State's projected growth rate for the County, which calls for 5,021 new housing units.[15]
- Infill development will corresponds to denser development, thereby increasing the number of housing units per unit area of land.
- Housing within existing sewer and water infrastructure areas would more likely be within mixed-use neighborhoods (also known as "complete neighborhoods," which include commercial services, grocery stores, open space, and public transit within a five minute walking distance, a diversity of housing types [in terms of housing cost, size, and ownership/rental] to meet the needs of its residents, the presence of sidewalks, and connectivity of the street network) than housing outside of existing infrastructure boundaries.

<u>Logic</u>

- Low-income people disproportionately face a housing shortage in Humboldt County.

[14] Department of Community Development Services, Humboldt County General Plan update (Draft). February 2004. Housing Needs, Availability and Affordability in the Eureka and McKinleyville Community Planning Areas of the Unincorporated Areas of Humboldt County.
[15] Smith, Michael D., and Steinberg, Steven J., January 2005. Room to Grow? An assessment of the Potential for Unincorporated Humboldt County to Accommodate Future Projected Population Growth.

- The production of new dwelling units in Humboldt County will meet housing demands for incoming low-income people only if these new developments are affordable.
- Denser infill housing development may be more affordable than housing associated with sprawling development. Urban housing costs tend to be lower due to multi-family housing and higher residential density.[16] Provided the existing urban infrastructure can accommodate new housing, another cost that can be avoided with infill development is that of sewer and water infrastructure.[17] Studies show that water and sewer costs are about 40% higher in spread-out development than in compact development.[18]
- In addition to being more affordable, higher-density development within existing urbanized areas would preferentially meet housing needs of all income and mobility levels, due to the higher likelihood of these areas being "complete neighborhoods."

<u>Quantitative Analysis</u>

Table HH.2, presented below, shows median home prices and populations for four urban and five non-urban Humboldt County cities.

<table>
<tr><th colspan="6">Table HH.2. Median House Prices and Populations for Select Urban and Rural Cities in Humboldt County</th></tr>
<tr><th>Urban Cities[1]</th><th>2005 Median House Price (Dollars)[2]</th><th>2000 population[3]</th><th>Non-Urban Towns[1]</th><th>2005 Median House Price (Dollars)[2]</th><th>2000 population[3]</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Arcata</td><td>317,783</td><td>16,651</td><td>Hydesville</td><td>377,689</td><td>1,209</td></tr>
<tr><td>Eureka (95501)</td><td>270,279</td><td rowspan="2">26,128</td><td>McKinleyville</td><td>317,783</td><td>13,599</td></tr>
<tr><td>Eureka (95503)</td><td>299,530</td><td>Redway</td><td>333,929</td><td>1,188</td></tr>
<tr><td>Ferndale</td><td>420,278</td><td>1,382</td><td>Willow Creek</td><td>227,924</td><td>1,743</td></tr>
<tr><td>Fortuna</td><td>296,596</td><td>10,497</td><td>Garberville</td><td>412,088</td><td>12,194</td></tr>
<tr><td colspan="6">1 = Cities with residential densities of 1,000 people per square mile and above are designated as urban, and cities with residential densities below 1,000 people per square mile are designated as rural.</td></tr>
<tr><td colspan="6">2 = Phone correspondence, Humboldt Association of Realtors.</td></tr>
<tr><td colspan="6">3= US Census 2000.</td></tr>
</table>

The following information is based on the data included in Table HH.2:

- Urban average house cost (average of median house costs by city, weighted by population[19 20]) = $300,589;

[16] Haughey, Richard M. The Case for Multifamily Housing, Second Edition. Washington, D.C.: ULI–the Urban Land Institute, 2003.

[17] Snyder, Ken and Bird, Lori, December 1998. Paying the Costs of Sprawl: Using Fair-Share Costing to Control Sprawl.

[18] Local Government Commission. Livable Communities and Water: Key facts about growth and California's water supplies.

[19] Phone Correspondence, Humboldt Association of Realtors.

- Non-urban average house cost (average of median house costs by city, weighted by population) = $354,029;
- Difference in housing cost between non-urban (higher cost) and urban (lower cost) = $53,440.

Based on this, the average cost of new housing would be:
- $300,589 for Plan Alternative A, since 100% of housing would be urban;
- $327,309 for Plan Alternative B since 50% of housing would be urban and 50% of housing would be non-urban;
- $332,854 for Plan Alternative C, since 33% of housing would be urban and 66% of housing would be non-urban.

Qualitative Analysis
In a community survey, 57.6% of respondents thought that the county should be putting "more effort" or "much more effort" into improving the availability of affordable housing in the county.[21]

Disparities
This will primarily affect populations such as the low-income population, single-parent families, and low-paid workers. Also, according to a focus group participant, county students experience a housing shortage.[22]

Conclusions
Each of the three Plan Alternatives would meet the total *future* demand of housing units. In order to estimate how much housing need met by each scenario, the following discussion examines the affordability of housing under each one:

A) Plan Alternative A provides 6,000 additional housing units over the course of 25 years, 100% of which are urban. This scenario proposes to meet the county's future housing demand solely through infill development in areas served by existing water and sewer lines. Based on estimations of housing costs under this Plan Alternative (see quantitative analysis above), which were calculated using median house prices for select cities in the county and definitions of urban vs. non-urban cities (described in the introduction to the summary), this Plan Alternative would result in the **most affordable housing** (proportionally) of the three scenarios. Essential resources such as public transportation, grocery stores, childcare, and senior services would be in close proximity to new housing developments, thereby decreasing transportation costs.

B) Plan Alternative B proposes 12,000 additional units over the course of 25 years, including 6,000 urban (50%) and 6,000 non-urban (50%). New housing would be distributed evenly between areas with and without existing water and sewer

[20] US Census 2000.
[21] Humboldt County General Plan Update Survey, 2003. Humboldt County Planning Department. [Available at http://co.humboldt.ca.us/planning/gp/survey/results.htm].
[22] Personal Communication, December 10, 2007.

infrastructure. Based on estimations of housing costs under this scenario, which were calculated using median house prices for select cities in the county and definitions of urban vs. non-urban cities (described in the introduction to the summary), this scenario would result in 50% of the new housing that would be built within existing water and sewer infrastructure being more affordable and practical for low-income people with currently unmet housing demand, whereas 50% of the new housing units built outside of this infrastructure would be less affordable. In summary, Plan Alternative B would likely produce **both affordable and unaffordable housing**.

C) Plan Alternative C proposes 18,000 additional units over the course of 25 years, including 6,000 urban (33%) and 12,000 non-urban (66%). This scenario meets the county's housing demand primarily through extending infrastructure into lands adjacent to existing urbanized areas, with some infill of existing water and sewer service areas. Based on estimations of housing costs under this scenario, this option is associated with the **least affordable housing** (proportionally). The 66% of new housing to be developed outside of urbanized areas would probably not be within complete neighborhoods, and may lack essential resources.

<u>Caveats</u>
Housing proposed by Plan Alternative A is intended to meet future housing needs based on incoming population within the next 25 years. However, housing proposed by Plan Alternative A would not supply housing to meet existing unmet housing needs.

Plan Alternatives B and C have the potential to reduce the cost of housing due to their proposed production of housing over and above the projected housing demand. In line with this theory, urban infill development of a greater quantity of housing units than what is proposed by Plan Alternative A would also have the potential to reduce the cost of housing.

Recommended Health-Promoting Mitigations:

- Inclusionary Zoning: In order to increase the stock of affordable housing units, inclusionary zoning offers developers incentives to build low and moderate cost housing that would otherwise be unavailable in the marketplace. Inclusionary housing programs in the State of California have created over 34,000 affordable homes and apartments over the past 30 years. According to the California Coalition for Rural Housing, inclusionary housing has the potential to create at least 15,000 units of affordable housing annually in California, nearly doubling the current rate of affordable housing production in the state.[23] Arcata has adopted a policy of Inclusionary Zoning, and as of October 2007, Humboldt County is considering doing the same.
- Reduction of construction costs: Reduction of construction costs through material selection and building and parking layout can reduce the price of the house for the homebuyer.
- Un-bundle automobile parking from housing unit in urban areas: The cost of parking for residential units is often passed on to the occupants indirectly through the rent or

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[23] California Coalition for Rural Housing and Non-Profit Housing Association of Northern California, 2003. Inclusionary Housing in California: 30 Years of Innovation.

purchase price. A strategy for reducing the cost of housing is to sell parking spaces separately. This gives tenants and owners the opportunity to save money by using fewer parking spaces.

- Municipal support for first time and low-income homebuyers: Financial support for first time and low-income homebuyers can help to house people who otherwise could not afford the housing they need.
- Density bonuses: A density bonus is the entitlement to build additional residential units above the maximum number of units permitted pursuant to the existing General Plan, applicable specific plan and/or zoning designation.[24] In order to increase affordable housing opportunities, density bonuses can be offered to developers conditional on the provision of below market rate (BMR) housing.
- Allow Single Resident Occupancy Structures (SROs): This is multi-unit housing for very-low-income persons that typically consists of a single room and shared bath and also may include a shared common kitchen and common activity area.[25] Usually SRO's are developed by converting hotels, and they are often allowed under the same permits as hotels.[26]
- Require a percentage of BMR housing: Mandatory BMR housing reflecting the income distribution of the population can increase affordable housing opportunities.
- Establish a Community Land Trust (or participate in the already established Humboldt Bay Housing Development Corporation).
- Housing Trust Fund: Housing trust funds are funds established by cities, counties and states that dedicate sources of revenue to support affordable housing. They are usually created by legislation or ordinance.[27] By committing public sources of revenue to affordable housing, a bigger proportion of a given population receives the opportunity to own housing.

[24] City of San Mateo, Below Market Rate (Inclusionary) Program [Available at www.cityofsanmateo.org/downloads/planning/bmr_inclusionary_program.pdf].

[25] New York State Office for the Aging. Your Guide to Senior Housing. http://seniorhousing.state.ny.us/definitions/index.htm.

[26] 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003, Amended November 30, 2004).

[27] PolicyLink, 2007. Housing Trust Funds – What is it?

HH.1.b Proportion of households paying greater than 30% & 50% of their income on their homes

Health-Based Rationale

Housing is considered affordable when a monthly mortgage or rent payment is no more than 30 percent of income.[28] Higher proportions than 30% are considered overpayment. Thus, defining affordable housing requires the consideration of both one's income and one's housing costs. California housing element law defines four income categories based on the percentage of an area's median income (AMI):

- Very low-income 0 - 50% of AMI
- Low-income 50 - 80% of AMI
- Moderate-income 80 - 120% of AMI
- Above moderate-income 120+% of AMI

Existing Conditions

Percent of households spending 25% or more of income on housing: The following table shows the percentage of various types of Humboldt County households spending 25% or more of their gross income on housing: [29]

Table HH.3. Percentage of Humboldt County households spending 25% or more of gross income on housing.

Type of Household	Percentage of households
All households	37%
Owner-occupied households	34%
Renter households	48%
Low-income renters ($10,000-$19,000 annual income)	85%
Low-income home owners	56%

Percent of renters spending 50% or more of income on housing: The following table shows the proportion of **renter** households in various regions of Humboldt County whose gross rent is greater than 50% of renter's last year income:[30]

[28] Department of Community Development Services, Humboldt County General Plan update (Draft). February 2004. Housing Needs, Availability and Affordability in the Eureka and McKinleyville Community Planning Areas of the Unincorporated Areas of Humboldt County.
[29] 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003).
[30] US Census 2000.

Table HH.4 Percent of Renter Households with rent > 50% of last year's income		
Location	Percent of Renter Households	Region
Fieldbrook and McKinleyville	26%	Northern
Arcata and Manila	38%	Northern
Blue Lake	18%	Northern
Hoopa and Weitchpec	18%	Northern
Orick	16%	Northern
Moonstone Beach, Trinidad and Westhaven	34%	Northern
Eureka	24%	Central
Kneeland	20%	Central
Ferndale	13%	Southern
Alton, Fernbridge, Fortuna, Rohnerville	22%	Southern
Alderpoint	38%	Southern
Briceland and Garberville	15%	Southern
Honeydew	60%	Southern

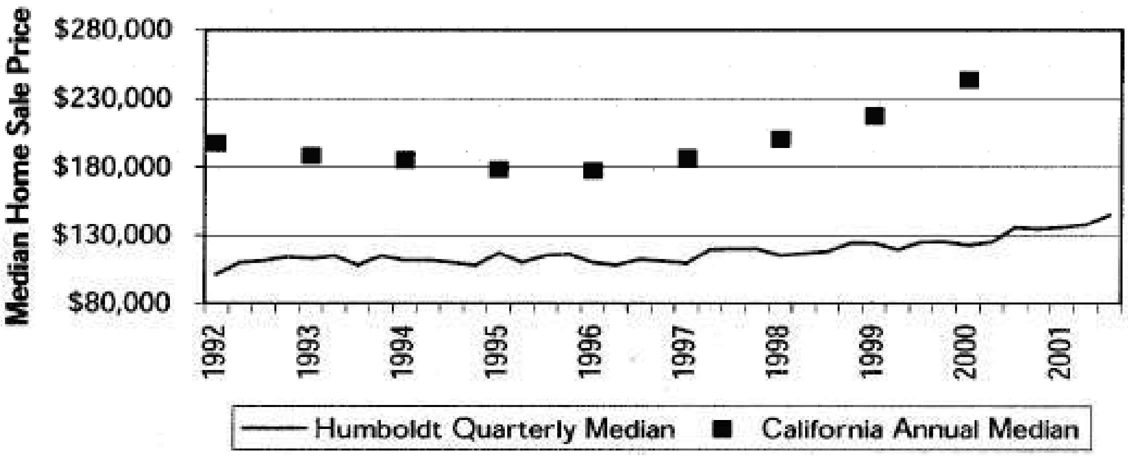
Percent of owners spending 50% or more of income on housing: The following table shows the proportion of **owner-occupied housing** whose monthly costs are >50% of owner's last year income:

Table HH.5 Percent of Owner-Occupied Households with housing costs > 50% of last year's income		
Location	Percent of Owner-Occupied Households	Region
Fieldbrook and McKinleyville	11%	Northern
Arcata and Manila	6%	Northern
Blue Lake	14%	Northern
Hoopa and Weitchpec	11%	Northern
Eureka	10%	Central
Ferndale	16%	Southern
Alton, Fernbridge, Fortuna, Rohnerville	11%	Southern
Briceland and Garberville	24%	Southern

Housing Costs: The median home price in Humboldt County in November 2007 was $299,000.[31] Home prices have significantly increased over the last decade, as shown below.

[31] Humboldt Association of Realtors, 2005, Humboldt County Housing Affordability Index. [Available at http://harealtors.com/properties.php].

Figure HH.2. Median Home Sales Prices in Humboldt County 1992-2001[32]



Analysis

Assumptions

- Land costs and the infrastruture costs of water and sewer access are borne by the homebuyer, while roads and police/fire protection are borne by the taxpayer.
- Inclusionary zoning and other policies and programs to create affordable housing of are assumed to be effective within existing water and sewer infrastructure areas only. Arcata has an inclusionary housing policy requiring at least 15% of publicly or privately developed housing to be affordable to low-and moderate-income persons and families, and of these units, at least 40% must be affordable to very low-income households. For agency-developed housing, at least 30% must be affordable to low- and moderate-income persons and families.[33] The County is considering inclusionary zoning and other methods for creating affordable housing as well.

Logic

- While the cost of land in urban areas tends to be higher, denser urban development is likely to include smaller housing units, smaller lots, and/or multi-family housing, which all contribute to greater affordability for a wide range of income levels.[34] [35]
- Water and sewer infrastructure costs are typically higher in rural areas than in urban areas.[36] Studies show that water and sewer costs are about 40% higher in spread-out development than in compact development.[37]

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32 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003).

33 City of Arcata, Redevelopment Implementation Plan 2006-2010, Section 4, Affordable Housing Plan & Estimated Expenditures: 2006-2011. [Available at http://calruralhousing.org/housing-toolbox/inclusionary-housing-policy-search/policies/arcata].

34 Haughey, Richard M. The Case for Multifamily Housing, Second Edition. Washington, D.C.: ULI–the Urban Land Institute, 2003.

35 Transportation Research Board, National Research Council, 1998. TCRP Report 39: The Costs of Sprawl – Revisited.

36 Transportation Research Board, National Research Council, 1998. TCRP Report 39: The Costs of Sprawl – Revisited.

37 Local Government Commission. Livable Communities and Water: Key facts about growth and California's water supplies.

- Based on these factors, infill development is likely to correspond to more affordable housing than sprawling development. Accordingly, monthly costs of owning or renting a home within infill development would comprise a lesser percentage of monthly income than owning or renting a home within sprawling development.

Quantitative Analysis

In Humboldt County, the cost of land in urban areas is higher than the cost of non-urban land.[38] A comparison of urban Eureka with non-urban McKinleyville, for example, yields a difference of $20,000 per unit area of land:

Table HH.6. Average cost of land per acre in Eureka vs. McKinleyville[39]	
City	Average cost of land per acre
Eureka (urban)	$115,000
McKinleyville (non-urban)	$95,000

Table HH.7 depicts new home costs in Eureka versus McKinleyville as analyzed in the 2004 Housing Needs Assessment. These two communities provide a comparison of urban versus non-urban house prices in Humboldt County. Land is more expensive in Eureka, which is the more residentially dense community, whereas infrastructure costs are higher in McKinleyville, which is the less residentially dense community. Note that the costs of land depicted here assume different lot-sizes for each community, which are one-third acre for Eureka and one-fifth acre for McKinleyville. Housing costs were estimated based on the assumption that the size of houses would be the same in either community. These assumptions may not be correct. For example, homes constructed in denser areas may in actuality occupy smaller lots and be smaller than those located in less dense areas.

Table HH.7. Typical New Home Costs in Eureka and McKinleyville[40]		
	Eureka (Cutten)	**McKinleyville**
Raw land cost	$38,000 (corresponds to 0.33-acre)	$19,000 (corresponds to 0.2-acre)
Infrastructure costs	$50,000	$56,000
1,200 sq.ft. home construction costs @ $95/sq. ft.	$114,000	$114,000
Subtotal	$202,000	$189,000
Taxes, Insurance, Financing (estimated @ 10%)	$20,200	$18,900
New Home Cost (Developer)	$222,200	$207,900
New Home Cost (Buyer) @ 10%	$244,420	$228,690

[38] Department of Community Development Services, Humboldt County General Plan update (Draft). February 2004. Housing Needs, Availability and Affordability in the Eureka and McKinleyville Community Planning Areas of the Unincorporated Areas of Humboldt County.

[39] Department of Community Development Services, Humboldt County General Plan update (Draft). February 2004. Housing Needs, Availability and Affordability in the Eureka and McKinleyville Community Planning Areas of the Unincorporated Areas of Humboldt County.

[40] Department of Community Development Services, Humboldt County General Plan update (Draft). February 2004. Housing Needs, Availability and Affordability in the Eureka and McKinleyville Community Planning Areas of the Unincorporated Areas of Humboldt County.

profit margin		

Qualitative Analysis
In a community survey, 57.6% of respondents thought that the county should be putting "more effort" or "much more effort" into improving the availability of affordable housing in the county.[41]

Disparities
Low and very-low income people are most affected by the differences inherent in the three Plan Alternatives. These groups are more likely to pay high percentages of monthly income on housing.

Conclusions

A) Plan Alternative A provides 6,000 additional housing units over the course of 25 years, 100% of which are urban. This scenario proposes to meet the county's housing demand solely through infill development in areas served by existing water and sewer lines. Building in areas with pre-existing infrastructure could facilitate development of affordable housing. Because lot sizes would be smaller than in historical development patterns, one of the key components of housing cost, the price of land, would be significantly reduced.[42] Based on these factors, this scenario would produce the largest quantity of affordable housing, and consequently, lead to a **reduction in the proportion of households paying greater than 30% and 50% of their income on their homes**.

B) Plan Alternative B proposes 12,000 additional units over the course of 25 years, including 6,000 urban (50%) and 6,000 non-urban (50%). New housing would be distributed evenly between areas with and without existing water and sewer infrastructure. Development in areas outside of those currently serviced by sewer and water would likely increase the infrastructure costs, possibly contributing to increased housing costs for homebuyers.[43] For the developments outside of infrastructure areas, the lot sizes may be larger[44] leading to higher land costs.[45] Based on these factors, this scenario would increase affordable housing by a lesser amount than Scenario A would.

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[41] Humboldt County General Plan Update Survey, 2003. Humboldt County Planning Department. [Available at http://co.humboldt.ca.us/planning/gp/survey/results.htm].
[42] Room to Grow?: An Assessment of the Potential for Unincorporated Humboldt County to Accommodate Future Projected Population Growth, Dr Michael Smith and Dr Steven Steinberg, Humboldt State University, January 2005.
[43] Local Government Commission. Livable Communities and Water: Key facts about growth and California's water supplies.
[44] Lindsay, Ann, Health Officer, Humboldt County Department of Health and Human Services. Personal Communication, December 10, 2007.
[45] Room to Grow?: An Assessment of the Potential for Unincorporated Humboldt County to Accommodate Future Projected Population Growth, Dr Michael Smith and Dr Steven Steinberg, Humboldt State University, January 2005.

On the other hand, new development projects in previously undeveloped land has the potential to present the County with new opportunities to utilize inclusionary zoning in these areas. A mixture of market-rate and low-income housing, as mandated by an inclusionary zoning policy, could increase the affordability of housing in the County.

In summary, **the proportion of households paying greater than 30% and 50% of their incomes on their homes may or may not be reduced by Plan Alternative B.**

C) Plan Alternative C proposes 18,000 additional units over the course of 25 years, including 6,000 urban (33%) and 12,000 non-urban (66%). This scenario meets the county's housing demand primarily through extending infrastructure into lands adjacent to existing urbanized areas, with some infill of existing water and sewer service areas. This option allows for the largest number of housing units, but as with the other scenarios, this does not necessarily correspond to affordable housing. Historically, housing development in previously undeveloped areas has been large-lot single-family homes, priced at the high end.[46] Contributors to high cost may include increased land costs associated with greater lot sizes[47] and infrastructure costs.[48] Based on this analysis, this scenario would produce the lowest quantity of affordable housing, this scenario may lead to an **increase in the proportion of households paying greater than 30% and 50% of their income on their homes**.

Caveats

Incomes reported may not reflect illegally obtained income, which may be a significant factor in underestimating affordability of housing in some areas.[49]

It is possible that some of the public might react negatively to multi-unit housing and increasing density. Further community education and early involvement of neighbors in the area to be developed in planning and mitigation of community concerns in a mutually acceptable manner could mitigate this.

Recommended Health-Promoting Mitigations:

- Developer incentives for residential densities between 2.5 and 10 units per acre
- Implementation of inclusionary zoning, requiring development to include a mix of housing types at a wide price range, as well as other programs and policies for increasing the amount of affordable housing (e.g., maximizing use of State and Federal funding resources and exploring non-traditional funding resources)

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[46] Lindsay, Ann, Health Officer, Humboldt County Department of Health and Human Services. Personal Communication, December 10, 2007.

[47] Room to Grow?: An Assessment of the Potential for Unincorporated Humboldt County to Accommodate Future Projected Population Growth, Dr Michael Smith and Dr Steven Steinberg, Humboldt State University, January 2005.

[48] Local Government Commission. Livable Communities and Water: Key facts about growth and California's water supplies.

[49] Lindsay, Ann, Health Officer, Humboldt County Department of Health and Human Services. Personal Communication, December 10, 2007.

- Encourage the development of rental units.
- Public outreach campaign about the need for multi-unit housing to fulfill all housing including low-income housing needs. This could be coupled with the promotion of environmentally preferable Plan Alternative.
- As discussed in the 2004 Update to the 2003 Housing Element of the Humboldt County General Plan, in order to facilitate denser residential development, certain local government constraints could be reduced, such as:
  - Local zoning regulation constraints – For instance, according to the Housing Element Update, zoning regulations specify that each home with two or more bedrooms is required to have four parking spaces, unless the property is served by a 40-foot wide road. Another requirement restricts minimum parcel sizes to 5,000 square feet. While these regulations are generally necessary to protect public health, safety and welfare, they also make it more expensive to develop housing. Due to the critical need to provide more affordable housing, the County could reduce the regulatory burden on lower-cost housing by modifying a number of zoning constraints, such as these.[50]
  - Local budget constraints – Local agencies are the sole providers of all the public services and improvements that support new housing. Adequate local funding must be available to support new housing development.
  - Tax Constraints – Currently, reassessment laws tend to discourage major rehabilitation and upgrading of existing dwellings and conversion of single to multi-family units.[51]

[50] 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003).
[51] 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003).

HH.2.a Homeless Population

Health-Based Rationale

Homelessness is a condition that describes people who lack a fixed, regular, and adequate nighttime residence. The term may also include people whose primary nighttime residence is in a homeless shelter, in an institution that provides a temporary residence for individuals intended to be institutionalized, or in a public or private place not designed for use as a regular sleeping accommodation for human beings.[52]

Homelessness is usually a consequence of a combination of structural and individual factors. On an individual level, homelessness is frequently the result of a crisis in one's life, such as leaving the parental home after arguments; marital or relationship breakdown; death of a spouse; leaving prison; a sharp deterioration of mental health; increased drug or alcohol misuse; unemployment or another financial crisis; or eviction. In addition, there are many factors that put individuals at a greater risk of homelessness when a crisis occurs. Some common background characteristics of people who become homeless include physical or sexual abuse in childhood or adolescence; a background of institutional care; lack of social support network; debts, especially due to rent and mortgage; anti-social behavior; substance abuse; and poor mental or physical health.[53]

Structural factors, relating to how we organize our society and distribute wealth and power, also play a role in homelessness. According to Ireland's Homeless Agency, "The failure of infrastructure to support those most vulnerable in our society has resulted in high levels of poverty, rising unemployment, social exclusion, the lack of affordable accommodation and increasingly negative effects of de-institutionalization ultimately creating pathways into homelessness."[54]

Homeless people have many of the same health problems as people with homes, but at rates three to six times greater than housed people.[55] Age-adjusted death rates were four times higher in the homeless than the general U.S. population in a study done in New York City.[56] In homeless shelters, high levels of contact, poor nutrition, poor access to health care, and substance abuse contributes to an increased risk for respiratory infections and outbreaks of tuberculosis and other aerosol transmitted infections infectious diseases.[57] [58] Among homeless children, 78% have suffered from depression, behavior problems, or severe academic delay.[59] Approximately one-third of homeless people have mental illnesses, and

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[52] United States Code, Title 42, Chapter 119, Subchapter I, § 11302. United States Code: General definition of a homeless individual.
[53] The Homeless Agency. http://www.homelessagency.ie/about_homelessness/causes.html.
[54] The Homeless Agency. http://www.homelessagency.ie/about_homelessness/causes.html.
[55] National Health Care for the Homeless Council, 2007. Basics of Homelessness. http://www.nhchc.org/Publications/basics_of_homelessness.html
[56] Barrow SM, Herman DB, Cordova P, Stuening EL. 1999. Mortality among homeless shelter residents in New York City. American Journal of Public Health 1999:529-534.
[57] Francis J. Curry National Tuberculosis Center, Institutional Consultation Services, and California Department of Health Services. TB in Homeless Shelters: Reducing the Risk through Ventilation, Filters, and UV. 2000. [available at www.nationaltbcenter.edu].
[58] Raoult, D. et al. Sept. 2001. Infections in the homeless. The Lancet Infectious Diseases. 1(2):77-84.
[59] Zima BT, Wells KB, Freeman HE. 1994. Emotional and behavioral problems and severe academic delays

approximately one-half have a current or past drug or alcohol addiction.[60] Many homeless people are in desperate need of health care services, but because they are often uninsured and lack access to preventative health care, they go without care until minor problems become urgent medical emergencies.[61]

Homelessness can also be emotionally damaging. In addition to representing poverty due to a lack of financial resources, homelessness can also cause people to lose privacy, security, and control over their lives. The longer the time period that a person is homeless, the more difficult it is for them to recover.[62]

Existing conditions

Total Number of Homeless: Estimates of total homeless persons in Humboldt County throughout the course of one year range from 4,000 to 6,000.[63] [64] It has been estimated that at any point in time, there are between 800 and 1,100 homeless persons in the County,[65] and the number is generally higher during summer months than during winter months.[66] According to the Housing and Homeless Coalition, the number of homeless in the County has gone down in the last three years, while the number of homeless children has stayed the same.[67]

The following tables present results of a point-in-time survey conducted on January 25, 2005.

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among sheltered homeless children in Los Angeles County. American Journal of Public Health. 84:260-264.

[60] National Health Care for the Homeless Council, 2007. Basics of Homelessness. http://www.nhchc.org/Publications/basics_of_homelessness.html.

[61] National Health Care for the Homeless Council, 2007. Basics of Homelessness. http://www.nhchc.org/Publications/basics_of_homelessness.html.

[62] City of Arcata, March 7, 2007. Homeless Services Plan: 2007-2016.

[63] Waxman, Deborah T. Creating Affordable Housing in Humboldt County (Master's Thesis).

[64] 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003) Amended November 30, 2004).

[65] 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003 Amended November 30, 2004).

[66] City of Arcata, March 7, 2007. Homeless Services Plan: 2007-2016.

[67] Personal Communication, December 10, 2007.

Table HH.8. Summary of Homeless Population by Household Type Reported[68]				
	Sheltered - Emergency Shelter	Sheltered - Transitional Housing	Unsheltered	Total
Individual Households*	152	99	854	1,105
Family Households with Children	15	36	251	302
Total Households	167	135	1,105	1,407
Persons in Individual Households*	152	99	854	1,105
Persons in Family Households with Children	37	78	627	742
Total Homeless Persons in Households	189	177	1,481	1,847

***HUD assumes one person per individual household.**

Table HH.9. Summary of Homeless Persons by Subpopulation Reported[69]			
Subpopulation	Sheltered	Unsheltered	Total
Chronically Homeless	107	395	502
Severely Mentally Ill	223	0	223
Chronic Substance Abuse	267	0	267
Veterans	73	0	73
Persons with HIV or AIDS	6	0	6
Victims of Domestic Violence	113	0	113
Unaccompanied Youth less than 18 yrs.	75	0	75

Location, Gender, Age, and Voluntar Homeless statistics: Another survey of the Humboldt County homeless population, conducted in January 2005, documented the following information:[70]

Table HH.10 Location of Homeless Respondents	
Location	Percent
Eureka	16.6%
Arcata	6.8%
Southern Humboldt	6.8%
Other Locations	69.8%

Table HH.11 Gender of Homeless Respondents	
Gender	Percent
Male	82%
Female	18%

68 U.S. Department of Housing and Urban Development (HUD), August 13, 2007. HUD's 2006 Continuum of Care Homeless Assistance Programs Homeless Populations and Subpopulations. [Available at http://www.hud.gov/offices/cpd/homeless/local/ca/caCoC.cfm?CoC=522].
69 U.S. Department of Housing and Urban Development (HUD), August 13, 2007. HUD's 2006 Continuum of Care Homeless Assistance Programs Homeless Populations and Subpopulations. [Available at http://www.hud.gov/offices/cpd/homeless/local/ca/caCoC.cfm?CoC=522].
70 City of Arcata, March 7, 2007. Homeless Services Plan: 2007-2016.

Table HH.12 Respondents who are Voluntarily Homeless	
Voluntary homeless	Percent
Do not choose to remain homeless	57%
Choose to remain homeless	8%
No response	32%

Table HH.13 Age of Homeless Respondents[71]	
Age	Percent
Under 20 years	5%
20-29 years	27%
30-39 years	24%
40-49 years	23%
50-59 years	17%
60-69 years	3%
70 or more years	0%

Homelessness in Eureka and Arcata: Eureka hosts the majority of the homeless population, with an estimated 888 people.[72] [73] Eureka is also home to the largest numbers of affordable housing units, residents in poverty, and homeless services in the County. The City of Eureka provides approximately 423 beds in various shelters and transitional housing facilities, and an additional 86 during the winter. Many homeless people sleep in automobiles, outdoors, or in motels.[74]

There are between 50 and 75 homeless individuals in Arcata throughout the year, and the number rises to approximately 200 in the summer. In Arcata, an estimated 900 to 1,000 individuals experience some form of homelessness each year.[75]

Much smaller homeless populations are estimated to live in other incorporated cities in Humboldt County, which provide minimal or no homeless services. In unincorporated areas of Humboldt County, transients and homeless individuals often camp or stay with friends.[76]

Additional Location information: Almost three quarters of the County's homeless population camp in locations ranging from forests, wildlife sanctuaries, and city parks, to bushes along railroad tracks, under bridges, and on private property. Approximately 17% stay in shelters, 4% stay in motels, and 3% stay with friends.[77]

Nomadic population: In addition to the homeless population, there is also a nomadic population in Humboldt County with its own set of housing needs. According to the 2003 update of the county's Housing Element of the General Plan, "nomadic households belong

[71] Humboldt Housing and Home Coalition, January 23, 2007, Survey of Humboldt County Homeless People.
[72] City of Arcata, March 7, 2007. Homeless Services Plan: 2007-2016.
[73] Waxman, Deborah T. Creating Affordable Housing in Humboldt County (Master's Thesis).
[74] Waxman, Deborah T. Creating Affordable Housing in Humboldt County (Master's Thesis).
[75] City of Arcata, March 7, 2007. Homeless Services Plan: 2007-2016.
[76] Waxman, Deborah T. Creating Affordable Housing in Humboldt County (Master's Thesis).
[77] City of Arcata, March 7, 2007. Homeless Services Plan: 2007-2016.

to a generally unnoticed demographic segment of our population that resides throughout the year in various campgrounds, parks, and other sites both public and private. The nomadic population distinguishes itself from other forms of housing styles by staying on the move. The nomadic population also has a spectrum of socio-economic income groups from high to moderate, to low and very low income groups". The 2003 Housing Element Update reports that in Humboldt County, "56 nomadic households might avail themselves of a special occupancy park specifically designed for lower income persons, and there are others who would use it on a more permanent basis who do not consider themselves nomadic." This evaluation estimates that there are presently 89 special occupancy spaces needed to accommodate the housing needs of nomadic persons.[78]

Analysis:

Assumptions

- At least 57% of the homeless population in the County does not choose to be homeless. These citizens would reside in permanent housing if it was accessible to them.

Logic

- One key strategy for reducing homelessness is the creation of affordable housing. While emergency shelters and transitional housing provide vital access to services for families in crisis, they often fail to address the long-term needs of homeless people. Getting people into housing and then providing the support and services they need to maintain housing leads to long-term stability and increased self-sufficiency.[79] [80] Because of its greater affordability,[81] [82] development of higher density housing is more likely to be accessible to the portion of the homeless population with significant incomes and a certain level of stability. Resources such as jobs, social service programs, food access, transportation, and social connection with others, are typically centered in denser areas. All three scenarios provide the same amount of housing in higher-density areas of the county, so they may all lead to more affordable housing than the housing currently available.
- Additional housing options for the homeless, such as those listed below (with the exception of the "special occupancy park"), are more likely to be concentrated within dense areas. Because all three Plan Alternatives propose the same amount of infill development, the following housing options could be incorporated by local governments into any of the three scenarios:
    - Homeless Shelters: Temporary residences for homeless people.
    - Transitional Housing: Programs that assist people who are ready to move

[78] 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003, Amended November 30, 2004).
[79] City of Arcata, March 7, 2007. Homeless Services Plan: 2007-2016.
[80] Housing First. http://www.beyondshelter.org/aaa_initiatives/ending_homelessness.shtml.
[81] Haughey, Richard M. The Case for Multifamily Housing, Second Edition. Washington, D.C.: ULI–the Urban Land Institute, 2003.
[82] Transportation Research Board, National Research Council, 1998. TCRP Report 39: The Costs of Sprawl – Revisited.

beyond emergency shelter into a more independent living situation. Transitional programs allow individuals and families to further develop the stability, confidence, and coping skills they need to sustain permanent housing. Some transitional program participants live in apartment-style quarters, while others may live in group settings where several families or individuals share a household.[83]

- Homeless Support Centers: Resource centers with services to assist homeless people to cope with the problems they face in learning how to sustain their lives. They may also provide housing.[84]
- Multifamily Housing: Higher density housing, which is sometimes affordable to very low-income persons, may provide housing to members of the homeless population with significant incomes and who are stable enough to be on their own.[85]
- Single Resident Occupancy Structures (SROs): This is multi-unit housing for very-low-income persons that typically consists of a single room and shared bath and also may include a shared common kitchen and common activity area.[86] Usually SRO's are developed by converting hotels, and they are often allowed under the same permits as hotels.[87]
- Special Occupancy Park: A park specifically designed for the nomadic population, who otherwise sleep in various campgrounds, parks, and other sites both public and private.[88]

- However, a community that is concentrated in the area where social services are located may present better opportunities for the homeless population. In a sprawling community, social services may be less concentrated, and not as convenient in terms of access to other urban resources such as transportation, etc.

Disparities

People suffering from alcoholism and other substance abuse may be unable to access treatment programs.

Conclusions

Each of the three Plan Alternatives proposes the development of 6,000 housing units within urban centers. Multi-family housing units, homeless shelters, transitional housing, homeless support centers, SROs, and special occupancy parks would be possible within each scenario. **This analysis concludes that each of the three Plan Alternatives are equivalent in**

[83] Los Angeles Homeless Services Authority. http://www.lahsa.org/archive/programs/transitionalhousing.htm,

[84] 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003, Amended November 30, 2004).

[85] 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003, Amended November 30, 2004).

[86] New York State Office for the Aging. Your Guide to Senior Housing. http://seniorhousing.state.ny.us/definitions/index.htm.

[87] 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003, Amended November 30, 2004).

[88] 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003, Amended November 30, 2004).

terms of housing Humboldt County's homeless population, which depends on many factors including the availability of affordable housing, social services and programs, and other resources.

Nevertheless, the following factors may potentially make Plan Alternative A the most favorable choice:

- Expenses associated with building infrastructure outside of an existing urbanized area (i.e. related to Plan Alternatives B and C) will theoretically be paid for by county tax funds. Diverting tax funds towards water and sewer infrastructure development could potentially take them away from social services that are important resources for the homeless population. Whether the increase in the tax base that results from the increase in population in Plan Alternatives B and C offset this is an open question.
- There are more resources in urban areas for people with low incomes, such as transportation, access to jobs, treatment programs, health care, and other services. Under Plan Alternative A, these social services and programs would be concentrated into urban centers, while the sprawling development proposed by the other scenarios may result in these resources becoming more spread out and thus less accessible by the homeless population.

Caveats

- Only the portion of the homeless population that earns income and/or pursues opportunities for housing will attain housing. Percentage of homeless population who chooses to be homeless (between 8% and 43%) may not be affected by any of the Plan Alternatives. Park space for "nomadic" population and access to wilderness camping for homeless may not be affected by any of the scenarios.

Recommended Health-Promoting Mitigations

- Pre-release permanent housing planning for people discharged from public institutions such as the foster care system, jail, prison, mental health programs, hospital, or drug and alcohol programs.
- Increase emergency, interim, transitional, and permanent housing options and programs.
- Improve social services offered to the homeless population by the county, such as mental health, domestic abuse, and substance abuse resources.

Safe and Sustainable Transportation Indicators

ST.1.b Average vehicle miles traveled by Humboldt residents per day

Health-Based Rationale

Vehicle miles traveled are directly proportional to air pollution and greenhouse gas emissions.[1] Air pollutants, including ozone and particulate matter, are causal factors for cardiovascular mortality and respiratory disease and illness.[2] Greenhouse gases are contributing to climate change, which may increase heat-related illness and death, health effects related to extreme weather events, health effects related to air pollution, water-borne and food-borne diseases and vector-borne and rodent-borne disease.[3] [4]

Areas with high levels of vehicle miles traveled per capita tend to have higher accident and injury rates. More time in a car means higher exposure to the perils of driving, including accidents.[5]

Amount of vehicle miles traveled has a direct relation to amount of physical activity. A study done in Atlanta, Georgia looked at people living in walkable vs. car-dependent neighborhoods, and found that those living in car-dependent neighborhoods drove an average of 43 miles per day (vs. 26 in walkable neighborhoods), and walked much less (only 3% walked vs. 34% in the walkable areas).[6] Automobile use for all trips in different countries ranges from a low of 36% in Sweden to a high of 84% in the United States. Walking and bicycling levels are inversely correlated with automobile use: in lower auto-use countries such as Sweden, modal share of trips by walking or biking was above 40%, and in high auto-use countries, percentage of walking and biking was below 20%. In the US, walking or biking only accounted for about 10% of all trips.[7]

VMT correlates with obesity. In the Atlanta study, the car-friendly communities had almost double the rate of obesity as the pedestrian-friendly communities (22% vs. 12%). Also, commute time correlates with both obesity and physical inactivity. In a study of California counties assessing vehicle miles traveled and obesity, counties with the highest average amount of vehicle miles traveled were significantly associated with the highest average rank of obesity.[8]

How much one drives is also affected by proximity to public transportation, to work and to goods and services as well as to neighborhood walkability and bikability, to parking availability and to traffic congestion. For example, the San Francisco Metropolitan Transit Commission found that individuals living and working within ½ a mile of public transit use transit for 42% of their work commute trips, while only 4% of those that do not live within ½ a mile use public transit and that households living in dense areas and

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[1] Ewing R, Frank L, Dreutzer R. 2006. Understanding the relationship between public health and the built environment: A report to the LEED-ND Core Committee.

[2] CARB. 2004. Recent research findings: Health effects of particulate matter and ozone air pollution, January 2004. California Air Resources Board. American Lung Association. Available at http://www.arb.ca.gov/research/health/fs/PM-03fs.pdf.

[3] Knowlton K, Lynn B, Goldberg RA, Rosenzweig C, Hogrefe C, Rosenthal JK, Kinney PL. 2007. Projecting heat-related mortality impacts under a changing climiate in the New York City region. AJPH 97:2028-34.

[4] Canadian Public Health Association. 2007. Health effects of climate change and air pollution. Available at http://www.ccah.cpha.ca/effects.htm. Accessed on January 21, 2008.

[5] Frumkin H, Frank L, Jackson R. 2004. Urban sprawl and public health. Island Press.

[6] Frank LD, Saelens BE, Powell KE, Chapman JE. 2007. Stepping towards causation: do built environments or neighborhood and travel preferences explain physical activity, driving, and obesity? Soc Sci Med. Nov;65(9):1898-914.

[7] Frank LD, Engelke P. How land use and transportation systems impact public health: A literature review of the relationship between physical activity and the built form. ACES: Active Community Environments Initiative Working Paper #1. Available at http://www.cdc.gov/nccdphp/dnpa/pdf/aces-workingpaper1.pdf.

[8] Health Place. 2006 Dec;12(4):656-64. The link between obesity and the built environment. Evidence from an ecological analysis of obesity and vehicle miles of travel in California. Lopez-Zetina J, Lee H, Friis R.

near public transit produce about half the weekday daily vehicle miles traveled as compared to people in more suburban and rural areas.[9]

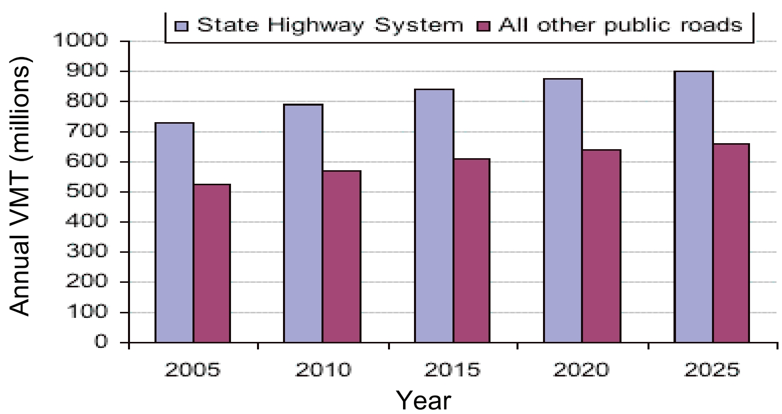
How much one drives has an impact on the amount of money a family has available for other health needs, such as nutritious food, health care costs.

Existing conditions

Average VMT and urban vs. non-urban differences in VMT: In 2006, Humboldt residents traveled 27 daily vehicle miles per capita compared to 24 daily miles for California as a whole.[10] According to the Federal Highway Administration, in 2001 in California, per capita VMT was 2.7 times higher in rural areas as compared with urban areas (58.8 daily vehicle miles traveled per capita versus 21.8).[11] In 2000, Humboldt County had about 9,600 annual *highway* vehicle miles traveled per capita.[12] This is 6% greater than the State average for that year. Humboldt County's level of vehicle miles traveled is due both to the number of personal vehicle miles traveled and the need to transport the majority of consumer goods into the county, and other materials (like municipal refuse) out of the county.[13]

Daily regional VMT on freeways, arterials and collectors is expected to increase 24.4 percent between 2005 and 2020. This represents an average annual increase of 1.9 percent on the County's state highway system.[14]

Figure ST.1: Projected Growth in Vehicle Miles Traveled in Humboldt County 2005-2025 without mitigations.[15] Alternative planning scenarios could affect this growth rate. Additionally, mitigations are suggested below.



Analysis

Logic

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[9] MTC. 2006. Characteristics of Rail and Ferry Station Area Residents in the San Francisco Bay Area: Evidence from the 2000 Bay Area Travel Survey. Volume 1. Metropolitan Transportation Authority.
[10] Caltrans, California Motor Vehicle Stock, Travel and Fuel Forecast (MVSTAFF), December, 2006.
[11] FHA. Highway Statistics 2000. Updated March, 2003. Office of Highway Policy Information, Federal Highway Administration, US Dept of Transportation at http://www.fhwa.dot.gov/ohim/hs00/ps1r.htm. Accessed on December 28, 2007.
[12] California Department of Transportation. 2004. "California Motor Vehicle Stock, Travel and Fuel Forecast," Division of Transportation System Information.
[13] Zoellick J. 2005. Humboldt County Energy Element Background Technical Report. Schatz Energy Research Center. Humboldt State University.
[14] Humboldt County 2006 Regional Transportation Plan Update. *HCAOG, Assessment of Needs*. Page II-130.
[15] Caltrans, California Motor Vehicle Stock, Travel and Fuel Forecast (MVSTAFF), November 2004.

- In areas with dense development, complete neighborhoods ('complete' means having nearby goods and services, parks, schools and jobs) and access to public transit, VMT is lower.

Quantitative Analysis
To compare vehicle miles traveled in the future for each Plan Alternative, a function that accounted for location of future population (urban vs. non-urban) and average VMT by location was used. The equations follow:

$$VMT_A = (U_C + U_I)x + NU_C 2.7x$$

$$VMT_B = (U_C + U_I)x + (NU_C + NU_I)2.7x$$

Where:

VMT = Vehicle Miles Traveled, with subscripts corresponding to their Plan Alternative
U_C = Urban population – current
U_I = Urban population – increase
NU_C = Non-urban population – current
NU_{IB} = Non-urban population – increase in SP B
NU_{IC} = Non-urban population – increase in SP C
x = current rate of vehicle miles traveled
2.7 = the multiplier to account for differences in VMT per capita by location.[16]

Percent increase in VMT if Plan Alternative B was approved over Plan Alternative A:

$$\frac{VMT_B}{VMT_A} = \frac{(U_C + U_I)x + (NU_C + NU_{IB})2.7x}{(U_C + U_I)x + NU_C 2.7x}$$

For Plan Alternative A:
$(U_C + U_I)$: 64,409 + (6,000 units in urban areas X 2.4 people per household = 14400) = 78,809
NU_C: 62,109

Given that non-urban residents drive 2.7 times more than urban residents, by increasing the percentage of urban residents, the VMT per capita will decrease. For purposes of comparison, Plan Alternative A is taken as the base case for the calculations below.

For Plan Alternative B:
$(U_C + U_I)$: 64,409 + (6,000 units in urban areas X 2.4 people per household = 14400) = 78,809
$(NU_C + NU_I)$: 62,109 + (6,000 units in non-urban areas X 2.4 people per household = 14,400) = 76,509

$$\frac{VMT_B}{VMT_A} = \frac{78{,}809x + (76{,}509)2.7x}{78{,}809x + (62{,}109)2.7x} = \frac{78{,}809 + 206{,}574}{78{,}809 + 167{,}694} = \frac{285{,}383}{246{,}503} = 1.16$$

Therefore, 16% more VMT would be expected under Plan Alternative B when compared to Plan

[16] FHA. Highway Statistics 2000. Updated March, 2003. Office of Highway Policy Information, Federal Highway Administration, US Dept of Transportation at http://www.fhwa.dot.gov/ohim/hs00/ps1r.htm. Accessed on December 28, 2007.

Alternative A. This would translate roughly into an additional 200 million miles traveled annually by Humboldt residents.

Percent increase in VMT if Plan Alternative C was approved over Plan Alternative A:

$$\frac{VMT_C}{VMT_A} = \frac{(U_C + U_I)x + (NU_C + NU_{IC})2.7x}{(U_C + U_{IC})x + NU_C 2.7x}$$

For Plan Alternative C:

$(U_C + U_I)$: 64,409 + (6,000 units in urban areas X 2.4 people per household = 14400) = 78,809

$(NU_C + NU_I)$: 62,109 + (12,000 units in non-urban areas X 2.4 people per household = 28,800) = 90,909

$$\frac{VMT_C}{VMT_A} = \frac{78{,}809x + (90{,}909)2.7x}{78{,}809x + (62{,}109)2.7x} = \frac{78{,}809 + 245{,}454}{78{,}809 + 167{,}694} = \frac{324{,}263}{246{,}503} = 1.32$$

Therefore, 32% more VMT would be expected under Plan Alternative C when compared to Plan Alternative A. This would translate roughly into an additional 400 million miles traveled annually by Humboldt residents.

Qualitative Analysis

Focus groups held specifically on the General Plan Update's impact on health revealed a general strong support for the County to focus more on walkable and bikeable communities, a better public transportation system to increase physical activity, decrease reliance on automobiles, and improve mobility for transportation disadvantaged. In these focus groups as well as an extensive Policy Charrette held by HumPAL, there was a call for better documentation of impact on VMT, i.e., that the County develop a monitoring system and continue to measure increases or decreases on this indicator.

A major policy recommendation that came out of the HumPAL Policy Charrette on Defining Healthy Design in Humboldt County was to measure and report per capita VMT, number of trips, per capita passenger miles, number of trips by bike/ped, and to count all of these modes for each traffic study. In addition, participants want these measures periodically evaluated and reported. Given this strong recommendation, it seems clear that the public supports decreasing VMT.[17] Additionally, public support is strong for reducing opportunity for sprawling communities, thus reducing the potential for more VMT.[18]

Disparities

- Low income populations tend to have fewer cars, thus less opportunity to accumulate VMT.
- Low income populations are less likely to afford housing in more non-urban areas with large lot sizes, thus they may drive less.
- If low income populations need to drive more, the percent of their income devoted to transportation will be higher given the cost of fuel.
- Many seniors may be unable or unwilling to drive, and so may use of paratransit more. Denser option would benefit them.

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[17] HumPAL. 2007. Defining Healthy Design in Humboldt County: A 'Policy Charrette'. Humboldt Partnership for Active Living.

[18] Dyett & Bhatia. 2004. Humboldt 2025 General Plan Update. Sketch Plan Alternatives. Humboldt County Department of Community Development Services. Available at http://co.humboldt.ca.us/planning/gp/pdf/SKALT5.pdf.

Conclusions

A) Plan Alternative A will lead to a decrease in per capita VMT because a higher proportion of residents will live in urban areas and those residents on average drive less. Given that, Humboldt County residents on average will drive less, offering healthful opportunities to connect with family and friends, to be physically active, and the least risk for motor vehicle accidents and chronic disease due to obesity. Alternative Plan A also offers the least amount of risk for contributing to climate change and ill health effects due to global warming.

B) With Plan Alternative B, there would be 16% more VMT than with Plan Alternative A – approximately 200 million extra miles per year traveled in the County. While this is not the largest increase, it does raise the risk of obesity, motor vehicle accidents, a decrease in rates of physical activity, and less time for social cohesion.

C) Plan Alternative C would lead to the largest increase in VMT; residents in Humboldt County would experience an average increase of 32% in the amount of VMT compared to Plan Alternative A. This would translate into an extra 400 million miles traveled by Humboldt residents a year. Accompanying this are larger increases in obesity rates, traffic accidents, lack of physical activity, a decrease in connecting with family and friends, and Plan Alternative C offers the greatest increase in Humboldt County's contribution to global warming.

Caveats

When urban areas achieve a high level of density, VMT starts to decline due to use of public transit and the inconvenience of driving and owning a car.[19]

Recommended Health-Promoting Mitigations:

- Encourage larger employers to adopt Transportation Demand Management programs.
- Increase public education about public transit options.
- Design multimodal transit hubs with co-located businesses and housing with priority for transportation disadvantaged.
- Increase public transit options: bus and paratransit routes, frequency and connections, coordination.
- Increase funding for public transit and promote routes to employment locations.
- Encourage retail, business, and industry to grow within urban boundaries, perhaps establishing Central Business Districts with incentives for businesses to locate there.

[19] Holtzclaw J. 1994. Using residential patterns and transit to decrease auto dependence and costs. Natural Resources Defense Council. Available at http://www.smartgrowth.org/library/articles.asp?art=190&res=1024.

ST.1.e Average minutes traveled to work by zip code

Health-Based Rationale

The amount of time one spends in the car has increased over the course of the last 25 years, when VMT per capita started increasing dramatically. An increasing amount of time commuting decreases the time an individual has to spend with family and effects engagement in civic or volunteer activities.[20] Thus, long commutes can distance an individual from his/her community and decrease social connectivity. Social connection has a variety of health impacts, ranging from reducing stress, having a longer lifespan, supplying access to emotional and physical resources.[21] [22]

Also, the more time in the car, the less time a person has to engage in leisure time physical activity and physical activity is associated with many health outcomes.[23] One study in the US showed that each additional hour spent in a car per day was associated with a 6% increase in the likelihood of obesity. Each additional hour walked per day was associated with a 4.8% reduction in the likelihood of obesity.[24] Time spent in a car driving is also associated with 1.6 to 2.8 times higher odds of having shoulder pain when compared to those who spend less time in a car.[25]

On a very immediate level, an increase in the amount of driving can increase the odds of neck and back pain; people who drive 9,000 – 18,000 annual miles are 75% more likely to have neck and back pain than those who travel 3,000 miles annually.[26]

In general, people in developed countries spend an average of about one hour a day in motor vehicle travel. Valuing travel time at $8/hr (half of $16/hr average wage) indicates an overall average per capita travel time cost of about $3,000 per year.[27]

Traveling to and from work is the single biggest cause of stress for many people. According to a UK survey, 44% of people believed rush hour traffic was the single most stressful part of their life.[28] In a study of nine hundred working women in Texas, respondents rated commuting as the activity that gave them the least amount of happiness.[29]

Residents of automobile dependent suburban areas such as San Bernardino County tend to experience greater per capita congestion delay than dense cities such as New York and Chicago. U.S. automobile commute travel times are lowest for residents of communities with moderate to high densities (11-16

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[20] Putnam R. 2001. Bowling alone. Simon & Schuster. New York, NY.

[21] Berkman LF, Syme SL. 1979. Social networks, host resistance and mortality: a nine-year follow up study of Alameda County residents. American Journal of Epidemiology 109:186-204.

[22] Poortinga W. 2006. Social relations or social capital? Individual and community health effects of bonding social capital. Social Science and medicine 63:255-270

[23] Lopez-Zetina J, Lee H, Friis R. 2006. The link between obesity and the built environment. Evidence from an ecological analysis of obesity and vehicle miles of travel in California. Health Place. Dec;12(4):656-64.

[24] Frank L, Andresen MA, Schmid TL. 2004. Obesity relationships with community design, physical activity, and time spent in cars. American Journal of Preventive Medicine 27(2):87-96.

[25] Skov T, Borg V, Orhede E. 1996. Psychosocial and physical risk factors for musculoskeletal disorders of the neck, shoulders, and lower back in salespeople. Occup Environ Med 53(5):351-356

[26] Skov T, Borg V, Orhede E. 1996. Psychosocial and physcial risk factors for musculoskeletal disorders of the neck, shoulders, and lower back in salespeople. Occupational and Evnironmental Medicine 53(5):351-6.

[27] Litman T. Updated March 2007. Transportation Costs & Benefits: Resources for Measuring Transportation Costs and Benefits. Victoria Transport Policy Institute. Available at http://www.vtpi.org/tdm/tdm66.htm.

[28] BBC. 2000. Commuting is 'biggest stress'. Available at http://news.bbc.co.uk/1/hi/health/999961.stm.

[29] Kahneman D, Krueger A, Schkade D, Schwarz N, Stone A. 2004. A survey method for characterizing daily life experience: The day reconstruction method (DRM). Science, v306 p1776.

residents per acre), while transit commute times decrease with density. While the densities are different for Humboldt County, we found it to be generally true that the more dense areas had lower commute times. Empirical evidence indicates that higher-density development does not necessarily increase congestion, and Smart Growth strategies that improve accessibility and transportation mode diversity can further reduce per capita congestion delay.[30]

Existing conditions

Commute times: The majority of residents of both urban and non-urban areas in Humboldt County have travel times to work that are lower than the national and statewide average (17.8 minutes vs. 27 minutes[31]). Average commute time in the US is 26.4 minutes[32].

The table below details travel time to work by region in the County. The average travel time to work overall in the County is 17.8 minutes according to the 2000 Census. The weighted average travel time to work for non-urban areas is 19.1 minutes, while it is 15.4 minutes for urban areas. Areas that have low residential densities have a 26% higher average length of commute to work (measured in time) than those in higher residential densities.

Table ST.1. Travel Time To Work from the 2000 Census

Place	Ave. Travel Time (Min.)
Humboldt County	17.8
Arcata	15.1
Blue Lake	18.6
Eureka	14.9
Ferndale	19.9
Fortuna	18.3
Rio Dell	19.1
Trinidad	22.8
Cutten	14.1
Humboldt Hill	17.0
Hydesville	22.3
McKinleyville	19.0

[30] Victoria Transport Policy Institute. 2007. Congestion Reduction Strategies: Identifying and Evaluating Strategies To Reduce Traffic Congestion. Available at http://www.vtpi.org/tdm/tdm96.htm. Accessed on January 10, 2008.
[31] CalTrans. 2003. 2000-2001 California Statewide Travel Survey: Weekday Travel Report. California Department of Transportation in conjunction with the US Dept. of Transportation, Federal Highway Administration. Available at http://www.dot.ca.gov/hq/tsip/tab/documents/travelsurveys/Final2001_StwTravelSurveyWkdayRpt.pdf Accessed on December 13, 2007
[32] Bureau of Transportation Statistics, U.S. Department of Transportation. From home to work, the average commute is 26.4 minutes. OmniStats. October 2003. Available at: http://www.bts.gov/publications/omnistats/volume_03_issue_04/html/entire.html. Accessed January 10, 2008.

Myrtletown	12.7
Pine Hills	18.1
Redway – Garberville	19.9
Westhaven-Moonstone	23.3
Willow Creek	20.6
Blue Lake Rancheria	26.7
Hoopa Valley	14.6
Table Bluff Reservation	22.4
Yurok Reservation	31.3

Analysis

Assumptions

- More workplaces are located in urban centers.
- Goods and services are concentrated in urban centers.
- Plan Alternative A would not require additional roadway construction or bicycle lanes.
- There would be no specific increase in public transit funding, routes or frequency.

Quantitative Analysis

The current county-wide average travel time to work using the definitions of urban and non-urban described in the introduction are:

$$\frac{64{,}409\ (15.4) + 62{,}109\ (19.4)}{\text{Entire population}} = \frac{991{,}899 + 1{,}204{,}915}{(126{,}518)} = 17.3 \text{ minutes}$$

Under Plan Alternative A:

$$\frac{\text{New urban population } (78{,}809)\ (15.4) + \text{non-urban } (62{,}109)(19.4)}{\text{Entire population } (140{,}918)} = \frac{1{,}213{,}659 + 1{,}204{,}915}{140{,}918} = \frac{2{,}418{,}574}{140{,}918}$$

The new travel time to work under Plan Alternative A would be 17.2 minutes. Across all working adults in the County, this would reduce travel time by approximately 55,000 hours a year from current levels.

Under Plan Alternative B:

$$\frac{\text{New urban population } (78{,}809)\ (15.4) + \text{non-urban } (76{,}509)(19.4)}{\text{Entire population } (155{,}318)} = \frac{1{,}213{,}659 + 1{,}484{,}275}{155{,}318} = \frac{2{,}697{,}934}{155{,}318}$$

The new travel time to work under Plan Alternative B would be 17.4 minutes. Across all working adults in the County, this would increase travel time by approximately 55,000 hours a year from current levels.

Under Plan Alternative C:

$$\frac{\text{New urban population } (78{,}809)\ (15.4) + \text{non-urban } (90{,}909)(19.4)}{\text{Entire population } (169{,}718)} = \frac{1{,}213{,}659 + 1{,}763{,}635}{169{,}718} = \frac{2{,}977{,}294}{169{,}718}$$

The new travel time to work under Plan Alternative C would be 17.5 minutes. Across all working adults in the County, this would increase travel time by approximately 110,000 hours a year from current levels.

Health Disparities

- For Native American communities living on reservations further away from urban areas, time travel to and from work (off-reservation) may be disproportionately higher than other populations.
- Low income residents living in non-urban areas but working in urban areas (due to availability of jobs) can be disproportionately impacted by the distance to work.
- Farm workers living in-between urban and non-urban areas who must commute to work have fewer options for transportation. Time to work may be disproportionately longer for them.
- Seniors or those with disabilities may have less access to transportation (longer distance to travel to public transportation, no access to/inability to drive a car) and therefore may have to travel for longer periods of time to work.

Conclusions

A) Under Plan Alternative A, the average travel time to work would *decrease*. Across all residents of the County, commute travel would be reduced by approximately 110,000 hours in a year. Health effects of decreased travel time include more time with family and friends, higher rates of exercise, increased engagement in one's community, decreased stress and decreased risk for musculoskeletal pain associated with long trips in the car.

B) Plan Alternative B will *increase* the average travel time to work *slightly*. Across all residents of the County, commute travel would be increased by approximately 110,000 hours in a year. Longer travel times are associated with higher rates of obesity, stress, and musculoskeletal pain, and decreased community connection and rates of physical activity.

C) Plan Alternative C would offer the *largest increase* in travel time to work. Across all residents of the County, commute travel would be increased by approximately 220,000 hours in a year. Without mitigations from municipal and business leaders, residents would face longer distances to popular destinations that are accessible only by driving. Thus, health effects such as lack of physical activity, stress from driving, shoulder and back pain, and lack of connection to others are likely to result.

Recommended Health–Promoting Mitigations:

- Implement policies to encourage walking and biking, such as construction of pedestrian facilities (e.g., sidewalks).
- Increase incentives for carpooling.
- Increase frequency and accessibility of public transit.

Other mitigations to decrease time traveled to work would not likely to promote health. These include increasing development of roads and increasing industrial development aware from urban centers.

ST.2.a Proportion of commute trips made by public transit

Health-Based Rationale

In California, about 20 percent of those working in office buildings near rail stations regularly commute by transit, nearly three times transit's modal share among those working away from rail stations. Mode choice models reveal that office workers are most likely to rail-commute if frequent feeder bus services are available, employers help cover the cost of taking transit, and parking is in short supply.[33] While Humboldt County does not have a public rail system, if buses were more available and residents lived and worked close to bus stops, it follows that residents would potentially use a public transit system.

Americans who use public transit spend a median of 19 minutes daily walking to and from transit; 29% achieve more than or equal to 30 minutes of physical activity a day solely by walking to and from transit,[34] enabling them to reach the recommended amount of physical activity (30 minutes a day, five times a week) simply by taking public transit. Further, 16% of all recorded walking trips are part of transit trips, and these tend to be longer than average walking trips, according to an analysis of US travel survey data.[35] Thus, those taking public transit reap the health benefits of exercise and physical activity, i.e., reduced risk for cardiovascular disease and diabetes, increased strength for bone health, decreased risk of cancer, and decreased risk of depression.

Taking public transportation aids in decreasing isolation and encourages what city planning advocate Jane Jacobs referred to as casual contact from unplanned social interactions.[36] Socially isolated people die at two or three times the rate of people with a network of social relationships and sources of emotional and instrumental support.[37]

Additionally, public transit use (instead of driving) reduces noise and air emissions from cars. Environmental noise, mostly from transit, is associated with increased annoyance, stress, decreased sleep and concentration, poor school outcomes, and heart disease.[38] [39] [40] Reductions in driving can also improve air quality and thereby reduce respiratory disease.[41] Additionally, reduction of emissions, including greenhouse gasses, can help reduce global warming. The effects of global warming could have significant health impacts including issues related to heat, extreme weather events, and the spread of vectors that carry infectious disease.[42]

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[33] Cervero R. 2006. Office Development, Rail Transit, and Commuting Choices. Journal of Public Transportation 9(5):41-55.

[34] Besser LM, Dannenberg AL. 2005. Walking to public transit: Steps to help meeting physical activity recommendations. American Journal of Preventative Medicine 29(4):273-280.

[35] Weinstein A, Schimek P. 2005. How much do Americans walk? An analysis of the 2001 NHTS. Transportation Research Board Annual Meeting. Cited in Transit Oriented Development: Using Public Transportation to Create More Accessible and Livable Neighborhoods. Available at http://www.vtpi.org/tdm/tdm45.htm.

[36] Jacobs J. 1993. The death and life of American Cities. Modern Library Edition. NY: Random House.

[37] Brunner E. 1997. Stress and the biology of inequality. BMJ 314(7092):1472-6.

[38] Babisch W, Beule B, Schust M, Kersten N, Ising H. 2005. Traffic noise and risk of myocardial infarction. Epidemiology 16:33-40.

[39] Stansfeld SA, Berglund, B, Clark C, Lopez-Barrio I, Fischer P, OÌhrstroÌm E, Haines MM, Head J, Hygge S, Kamp I, Berry BF, and RANCH study team. 2005. Aircraft and road traffic noise and children's cognition and health: a cross-national study. The Lancet 365(9475): 1942-49.

[40] London Health Commission. 2003. Noise and Health: Making the Link. Available at http://www.phel.gov.uk/hiadocs/noiseandhealth.pdf.

[41] Brauer M, Hoek G, Van Vliet P, Meliefste K, Fischer PH, Wijga A, Koopman LP, Neijens HF, Gerritsen J, Kerkhof M, Heinrich J, Beliander T, Brunekreef B. 2002. Air pollution from traffic and the development of respiratory infections and asthmatic and allergic symptoms in children. American Journal of Respiratory and Critical Care Medicine 166:1092-1098.

[42] Canadian Public Health Association. 2007. Health effects of climate change and air pollution. Available at http://www.ccah.cpha.ca/effects.htm. Accessed on January 21, 2008.

Last, taking public transit is cheaper than owning a car. A household with 2 adults that use public transit saves an average of $6,251 per year compared to an equivalent household that owns 2 cars.[43] The savings associated with taking public transit can be used for other necessities including healthcare, food, housing and clothing, and thereby lead to improved health through mechanisms associated with those, which are discussed elsewhere in this report.

Existing conditions

Public Transit Use: One percent of commute trips in Humboldt County are made by public transit. Many of the car-less households in Humboldt County do not have access to public transportation.[44] Approximately 24 percent of residents in the County do not or cannot drive (96,065 licensed drivers of 126,518 total population).[45] The table below details public transit use by location in the County.

Table ST.2. Use of Public Transit to Travel to Work (2000 Census)

Place	Public Transportation (%)
Humboldt County	1.0
Arcata	2.4
Blue Lake	0
Eureka	1.9
Ferndale	0
Fortuna	0.4
Rio Dell	0
Trinidad	1.2
Cutten	0
Humboldt Hill	0.9
Hydesville	0
McKinleyville	0.8
Myrtletown	0
Pine Hills	1.7
Redway – Garberville	0

[43] Bailey L. January 2007. Public Transportation and Petroleum Savings in the US: Reducing Dependence on Oil. ICF International, Fairfax Virginia
[44] U.S. Census 2000, analyzed using Geolytics software.
[45] Natural Resources Services. 2006. Humboldt Country Transportation Disadvantaged Population Report. Redwood Community Action Agency. Available at http://www.nrsrcaa.org/path/pdfs/HumCoTDPReport5_06.pdf. Accessed on January 11, 2008.

Westhaven-Moonstone	0
Willow Creek	0
Blue Lake Rancheria	0
Hoopa Valley	0
Table Bluff Res.	0
Yurok Reservation	1.6

Although not many people take public transit, more people in urban centers do so. Where public transit is more easily accessible, residents use it more often. Further evidence of higher use of public transit in more urban or higher residential density areas comes from some US Census 2000 data:

Arcata County Congressional District		In "Arcata City"
Take car, truck, van:	75.4%	70.1%
Public transit:	1.9%	2.4%

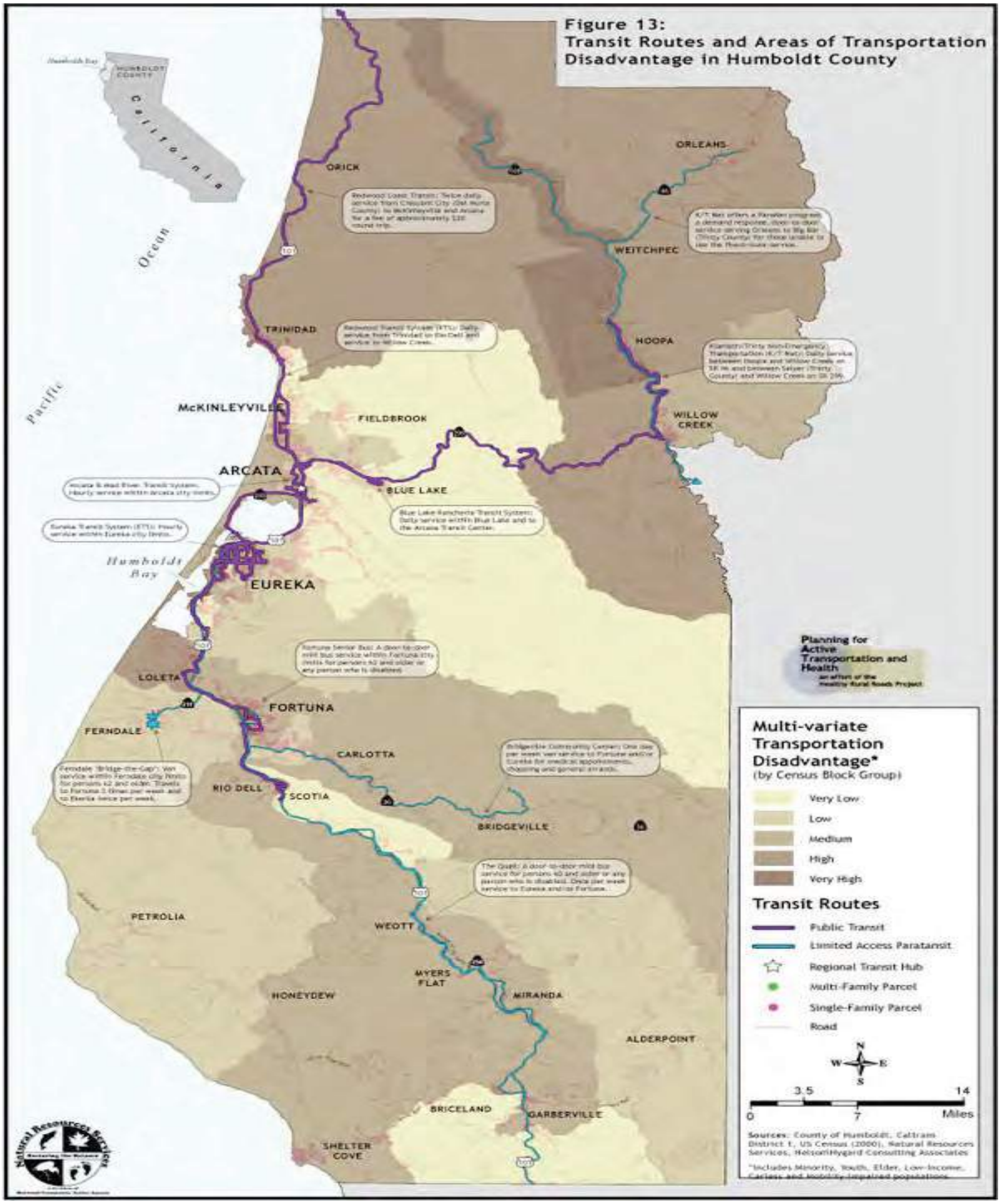
Eureka County Congressional District		In "Eureka City"
Take car, truck, van:	86.9%	83.1%
Public transit:	1.4%	1.9%

Garberville County Congressional District	
Take car, truck, van:	80.9%
Public transit:	<<.01%

Transit Routes: The Humboldt Bay region has the most transit service coverage in the County. Those living outside the Bay region, however, face significant gaps in transportation services. Paratransit and other community services provide limited help to seniors and the disabled, but youth and other members of the community are not eligible to take advantage of these services.[46] The map below shows existing transit routes.

[46] Natural Resources Services. 2006. Humboldt Country Transportation Disadvantaged Population Report. Redwood Community Action Agency. Available at http://www.nrsrcaa.org/path/pdfs/HumCoTDPReport5_06.pdf. Accessed on January 11, 2008.

Figure ST.2. Transit routes.



Analysis

Assumptions

- Use of public transit depends on many factors including:
    - proximity to transit stops;
    - frequency of transit;

  - commute distance and time;
  - parking availability and cost;
  - traffic congestion, cost of driving;
  - cost of transit;
  - employer incentives;
  - safety of transit and of driving;
  - weather; and
  - hours of operation.
- It is assumed that there will be no increase in public transit funding, routes, or frequency.

<u>Logic</u>

- Denser neighborhoods already have more proximity to transit and therefore urban dwellers are more likely to take public transit.

<u>Quantitative Analysis</u>

Since use of public transit depends on many factors, not only proximity to transit stops, a quantitative analysis is not currently possible.

<u>Qualitative Analysis</u>

Many participants in the Health and GPU focus groups were passionate about the problems the current public transportation system poses for those wanting to use it. The list of issues that make public transportation use uninviting include:

- the fragmented nature of service;
- different municipalities' systems do not coordinate with each other;
- low rate of scheduled services in non-urban areas in particular;
- uninviting and at times dangerous stations for waiting for buses;
- cost;
- distance;
- weather;
- traffic patterns and pedestrian safety;
- hours of operation;
- availability of parking;
- availability of travel stipends/incentives provided by work or to low income families; and
- public Transit commute takes longer than private vehicle commute, which is like a lack of access issue.

Written comments on the Draft Circulation Element of the GPU have noted that the County continues to focus primarily on automobile transportation. This is understandable given the low rate of public transit use; however, without municipal support both philosophically and financially, public transit will never be embraced.

The Moving Goods and People background report for the GPU states that congestion and safety along the major roadways between Eureka and Arcata is a concern. The section of SR 101 between the two cities is the most heavily traveled segment of roadway in the county, averaging 35,000 average daily trips (ADT).[47] Plan Alternative A holds the most promise for reducing congestion; both Eureka and Arcata are fairly well-served by public transportation as well as goods and services, so with proper incentive, residents could take

[47] Dyett & Bhatia. 2002. Humboldt County 2025 General Plan Update. Moving Goods and People: A Discussion Paper for Community Workshops. Available at http://co.humboldt.ca.us/planning/gp/meetings/moving_gp/moving.pdf. Accessed on December 13, 2007.

existing bus routes to avoid congestion and stress.

Disparities

1. Lower-income populations tend to reply more heavily on public transportation than higher income populations.
2. Disabled populations may be unable to drive, thus proximity to services and greater access to public transit would benefit their mobility and general health. If public transportation is handicapped accessible and sidewalks are ADA-compliant, Plan Alternative A could be better for them.
3. Seniors citizens who are no longer able to drive rely more heavily on public transportation.

Conclusions

A) Given that public transportation as well as jobs and schools are much more available in urban areas with residential density, by locating new growth in these areas Plan Alternative A would *increase* use of public transportation. People who use public transportation are more likely to get recommended amounts of physical activity and reap the health benefits of exercise and physical activity, i.e., reduced risk for cardiovascular disease and diabetes, increased strength for bone health, decreased risk of cancer, and decreased risk of depression. Using public transit also can decrease isolation, reduce noise and air emissions from cars with all the attendant benefits to respiratory health and ability to concentrate.

B) The proportion of the population in urban vs. non-urban areas would remain similar to the current situation under Alternative Plan B, so this Plan offers the *least amount of change* with regard to how many people take public transportation, and thus the least amount of change in health outcomes due to physical activity, noise and air quality, and obesity related chronic disease.

C) Plan Alternative C would encourage more of the new residents to Humboldt County to locate in non-urban areas and this is likely to *decrease use of public transit* to work and to school, resulting in increases in obesity and related chronic disease such as diabetes, increased isolation, increased noise and air pollution effecting most pertinently respiratory health, and increasing Humboldt County's contribution to climate change.

Recommended Health-Promoting Mitigations:

- Improve amount and awareness of employer-based incentives for taking transit, including programs to purchase transit from before-tax income, employer-subsidized public transportation.
- Increase public transportation services into non-urban areas (paratransit or buses).
- Improve coordination between public transit agencies.
- Pursue private-public partnerships and streamline opportunities for employers/institutions to fund transit service that benefits their populations.
- Consider a variety of vehicle types to serve different types of needs (not everything has to be an industrial feeling large bus with a few passengers).
- Develop transit-oriented streetscape and building design standards for key transit nodes and corridors, partially funded via development impact fees.
- Reduce parking requirements for new developments, thus reducing incentives to have more cars.
- Unbundle cost of parking from housing units.

ST.2.b Proportion of households with 1/4-mile access to local bus

Health-Based Rationale
Accessibility to public transport may influence Humboldt County residents to drive more. People who can easily access public transit, those who live near it for example, are more likely to use it. The Metropolitan Transportation Authority studied the transportation habits of people who live close to and farther away from public transit stations in the San Francisco Bay Area. They found that the following to be true:

- People who live within a ½ mile of a rail or ferry station are 4 times more likely to use transit than people living farther than a ½ mile.
- People who live within a ½ mile of a rail/ferry stop are twice as likely to walk and three times as likely to bike as residents living more than a ½ mile.
- People who live and work within ½ mile of rail/ferry stop use transit for 42% of their work commute trips. Those that live and work farther than ½ mile use public transit for 4% of their trips.
- Even those urban residents who were farther than one mile from rail/ferry stops are still twice as likely as suburban residents and four times as likely as rural residents to use transit.
- People living close to rail/ferry transit are twice as likely to walk for short trips.[48]

While this data comes from an urban study and examines proximity to rail or transit, the analyses are strong enough to assume that proximity to public transit of any sort would increase the likelihood of its use.

Research has found that proximity to public transit helps to determine travel choice.49 For any normal trips, only 10% of Americans will walk a distance of one-half mile. A recent study in King County, WA demonstrated that for every quarter mile increase in distance to transit, the likelihood of using transit fell 16%. Transit use promotes environmental health by reducing air pollution and greenhouse gas emissions from automobiles. People living in car-less households, or who are otherwise transportation disadvantaged, may rely on public transit or simply do without services, employment, education and social opportunities.

Existing conditions
Proximity to Bus Stops: Data from the US Census 2000 regarding several areas of Humboldt County illustrates that urban areas are far better equipped with bus access than non-urban arears.

Eureka: There are 11803 residential parcels and 37939 individuals. 10353 residential parcels are within ¼ mile of a public bus stop, thus 88% of the residents in Eureka are within ¼ mile of a bus stop.

Arcata: 4128 residential parcels are within ¼ mile of a public bus stop, representing 10873 individuals. 70% of the residents in Arcata are within ¼ mile of a bus stop (Mad River Transit Authority).
The Census does not count students in dormitories as being residents of Arcata.

Fortuna: There are 4058 residential parcels and 12471 individuals. 1152 parcels are within ¼ mile of a public bus stop, thus 28% of the residents of Fortuna are within ¼ mile of a bus stop (Humboldt Transit Authority).

South Bay: There are 2183 residential parcels accounting for 6575 individuals. 137 parcels are within ¼ mile of a public transit stop, thus 6% of the residents of the South Bay are within ¼ mile of a bus stop

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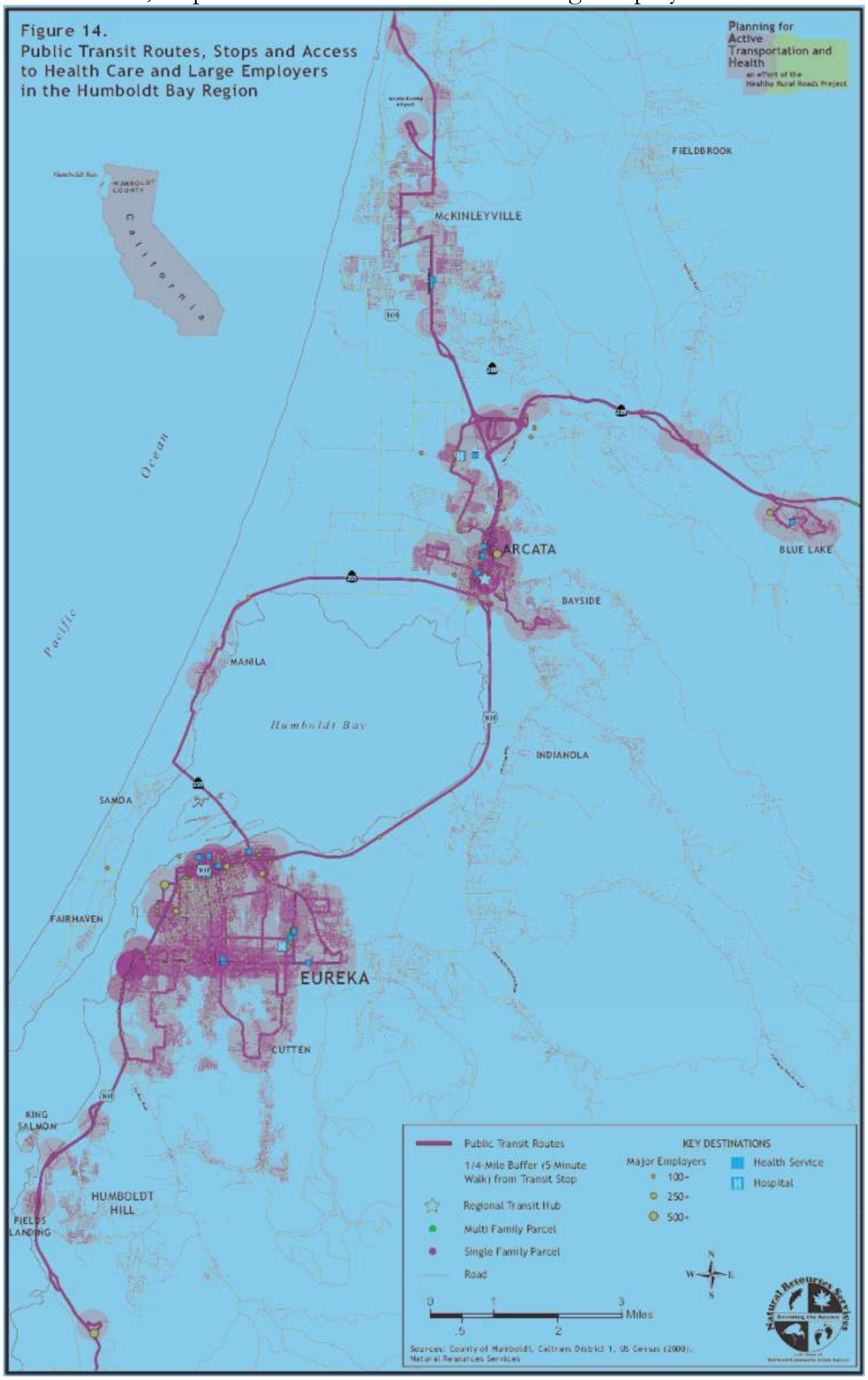
[48] MTC. 2006. Characteristics of Rail and Ferry Station Area Residents in the San Francisco Bay Area: Evidence from the 2000 Bay Area Travel Survey. Volume 1. Metropolitan Transportation Authority.
[49] Ewing R, Frank L, Kreutzer R. Understanding the Relationship between Public Health and the Built Environment: A Report to the LEED-ND Core Committee. 2006.

(Humboldt Transit Authority).

Hoopa: There are 259 residential parcels accounting for 2633 individuals. 28 parcels are within ¼ mile of a public bus stop. 11% of the residents of Hoopa are within ¼ mile of a bus stop (KT-Net). However, the KT-Net bus does not always strictly adhere to picking up and letting off passengers only at the listed bus stops. Pedestrians walking along Highway 96 are sometimes able to flag down the bus.
Note: The 1/4 mile access numbers refer to weekday schedules. There is reduced bus service on Saturday and virtually no service on Sunday.

The current population with ¼ miles access to public transit was mapped by in the Planning for Active Transportation and Health project in the Transportation-Disadvantaged Populations report of 2006. The figure below is taken from that report.

Figure ST.3. Transit routes, stops and access to healthcare and large employers.[50]



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[50] RCAA. 2006. Humboldt County Transportation-Disadvantaged Populations Report. Redwood Community Action Agency, Natural Resources Services. Available at http://www.nrsrcaa.org/path/TDPReport.htm. Accessed on November 28, 2007.

Analysis

Assumptions

- Bus service will not be expanded.
- People in urban areas currently are within ¼ mile of a bus stop (see maps)

Logic

- Denser areas currently have more bus stops and nearby bus routes, therefore, denser areas will be served better in the future.

Quantitative Analysis

Currently, 51% of the population, or 64,409 of the 126,518 people, live in urban areas near bus stops.

Under Plan Alternative A, 14,400 people would come to the urban areas of Humboldt. Therefore 59% ((64,409+14,400)/(126,518+14,400)) of the future population would be near bus stops. Therefore Plan Alternative A *increases* the proportion of people who have ¼ mile access to public transportation.

Under Plan Alternative B, 14,400 people would come to the urban areas of Humboldt and another 14,400 would come to the non-urban areas. Therefore 51% ((64,409+14,400)/(126,518+28,800)) of the future population would be near bus stops. Therefore Plan Alternative B *does not change* the proportion of people who have ¼ mile access to public transportation.

Under Plan Alternative C, 14,400 people would come to the urban areas of Humboldt and another 28,800 would come to the non-urban areas. Therefore 46% ((64,409+14,400)/(126,518+43,200)) of the future population would be near bus stops. Therefore Plan Alternative C *decreases* the proportion of people who have ¼ mile access to public transportation.

Qualitative Analysis

Simple access to public transit is not the only determinant to its use. In qualitative discussions with focus group members, the importance of frequency of public transit, the public outreach about schedules and availability of public transit, coordination of scheduling between the various transit authorities, outreach and information about services entered the discussion as additional reasons as to why people do not use the bus system.

Participants in the Health and GPU focus groups felt:

- Better coordination between public transit agencies was needed, especially for access to medical services and for seniors.
- There are rural health clinics in both Redway and the hospital in Garberville. Transport should be coordinated between these sites.
- The size of vehicles should be appropriate to population being served.
- Noise levels decrease because there are less cars on the road with better public transportation.
- Casinos provide ready transportation and could be mobilized to be a resource for the general community.
- Lack of transportation options can lead to social isolation.
- Lack of access to transportation (either private vehicle or living on a transit route) leads to lack of access to employment, financial resources, health facilities, increased stress and reduced access to other needs
- There are no good options for taking public transit from Southern Humboldt to Eureka.

During HumPAL's Policy Charrette, an exercise about values in public transportation brought forth the following comments:

- Public transportation that is not scary is needed.
- A thorough and reliable public transportation would be valued.
- A "functional" public transportation is needed.
- Public transportation and facilities must be designed and programmed to encourage alternative transportation.
- Public transportation services must be coordinated.

Disparities

Those affected disproportionately by distance to bus stops (and thus use of public transit) are those who do not own cars: seniors, disabled, children, and low income residents of Humboldt County.

Conclusions

A) **Plan Alternative A *increases* the amount of people who would have ¼ mile access to bus routes from 51% to 59%.** People who live near public transportation tend to use it at an increased level, with health benefits accruing such as increased physical activity and increased social cohesion.

B) **Plan Alternative B will result in an almost equal proportion of people with access to public transit bus routes as currently have them**, although the increase in population implies that overall more people will have access. Accordingly, more people will also drive private vehicles.

C) **Plan Alternative C would result in a decrease in the amount of people who have ¼ mile access to bus routes in Humboldt County from the current 51% to only 46% of the population**. Health hazards from driving private vehicles, such as increased risk of injury from traffic accidents and lack of exercise, will thus accrue for the majority of the population.

Recommended Health-Promoting Mitigations:

- Increase investment in public transit to extend bus service to new areas.
- Improve frequency of service, especially in urban areas.
- Study bus stop spacing and locations in order to make sure bus stops are in the right places and within walking distance of population.
- Develop standards for transit shelter amenities (seating, schedules, etc) tailored to local conditions/resources.
- Extend the usefulness of privately-funded shuttles (casinos, social service providers, etc.) to make additional loops/stops to supplement and coordinate fixed-route transit.
- Better coordinate existing fixed-route transit services (schedules, hubs, marketing, fares).
- Limit availability of parking except by transit hubs.
- Encourage employee and public subsidies for public transit.
- Improve hours of operation of existing public transit to ensure that it is most useful for commute trips to work and school.

ST.2.c Proportion of average income spent on transportation expense

Health-Based Rationale

A high proportion of income put toward transportation can mean that a family has less money to spend on healthful choices. In low-income households particularly, high transportation expenditures reduce the amount households have to spend on housing, food, health care, insurance, education and other needs. Prohibitive transportation costs can interfere with employment prospects, economic self-sufficiency and access to health-promoting services. For example:

- 35% of Californians in 2002 did not have health insurance, and those without health insurance are much more likely to go without preventive care.[51] Transportation costs could be a factor in paying for health insurance.
- Those that have less money tend to be more obese, reflecting nutrition choices that are not as healthy. In National Center for Health Statistics data for 2001-2004, approximately 35% of those making less than 200% of poverty level are obese, while 30% of those making above 200% of the poverty level or more are obese.[52]

Taking public transit is cheaper than owning a car. In the United States, a household with 2 adults that uses public transit saves an average of $6,251 per year compared to an equivalent household that owns 2 cars.[53] Poor rural households are three times more likely to be without a car than non-poor rural households. However, public transportation serves only about 60% of counties nationwide, and 28% of those counties have limited service.[54]

Existing conditions

Transportation as a percent of income. Based on transportation costs for the Western Region and the average income in Humboldt County ($33,093), 27% of the average income before taxes is spent on transportation expenses. This compares to 15% in the Western Regions of the US.[55]

Transportation Costs in California. The table below shows transportation costs in California.

In urban areas low-income households allocated a smaller proportion of their household expense to transportation than in higher-income households, which were more likely to incur the expense of car ownership.[56]

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[51] Ayanian JZ, Weissman JS, Scheider EC, Ginsburg JA, Zaslavsky AM. 2000. Unmet health needs on uninsured adults in the United States. JAMA 284(16):2061-9.

[52] NCHS. Health, United States: Table 73. Overweight, obesity, and healthy weight among persons 20 years of age and over by sex, age, race and Hispanic origin, and poverty level: United States, 1960-1962 through 2001-2004. National Center for Health Statistics. Available at http://www.cdc.gov/nchs/data/hus/hus06.pdf#073

[53] Bailey L. January 2007. Public Transportation and Petroleum Savings in the US: Reducing Dependence on Oil. ICF International, Fairfax Virginia.

[54] Brown D. Rural governments face public transportation challenges and opportunities. USDA. Available at ww.ers.usda.gov/Briefing/Transport.

[55] Expense information: Consumer Expenditure Survey 2003-2004, Bureau of Labor Statistics. Accessed online on July 26, 2006: http://www.bls.gov/cex. Average median income in Humboldt County: US Census 2000.

[56] Rice L. Transportation Spending by Low-Income California Households: Lessons for the San Francisco Bay Area. Public Policy Institute of California. July, 2004. Available at: http://www.ppic.org/main/publication.asp?i=428.

Table ST.3. Median Annual Transportation Expenditures for California Households.[57]

	Low-Income Households		All Other Households	
	Dollar Amount	% of Household Budget	Dollar Amount	% of Household Budget
Transportation expenditures for all households	2,164	13	6,569	15
Public transit expenditures for transit users	360	2	434	1
Private vehicle expenditures for vehicle users	3,586	19	7,144	16

Analysis

Assumptions

- The average income in Humboldt County will remain relatively constant in relation to transportation expense in the region.
- People living in denser areas spend less on transportation, because employment and services such as schools and grocery stores are located near housing.
- Public transportation will continue to be relatively unavailable to those in outlying areas of the County.

Logic

- People living in non-urban areas need to own a car and need to drive more to access jobs, goods and services. It takes on the average $6000 - $9000 *nationally* a year to own and operate an automobile.[58] That alone accounts for almost 27% of the average income in Humboldt County.
- In urban areas, people can walk, bike or take public transit more – all these are cheaper.

Quantitative Analysis

The average Californian spends about $7,144 annually on private vehicle expenditure. There is no data on the location (urban vs. non-urban) of Humboldt residents that do not own a car. While the median household income for the different areas of Humboldt County is known, there is no data specifically on how much they spend on transportation, and current research into non-urban transportation has not looked into the average cost of transportation for the non-urban resident. A quantitative analysis is therefore not possible.

Conclusions

A) In Plan Alternative A, more population will live in proximity to schools, services, cultural offerings, jobs and retail outlets and are more likely to walk, bike or take public transportation. Thus, **expenses for transportation would decrease**, and Humboldt County residents would

[57] Public Policy Institute of California. July 2004. Research Brief: How much do California's Low-Income Households Spend on Transportation? Public Policy Institute of California. Available at www.ppic.org. Accessed on January 13, 2008.
[58] Planning for Active Transportation and Health. 2006. Humboldt County Transportation Disadvantaged Populations Report. Natural Resources, Redwood Community Action Agency. Availabe at http://www.nrsrcaa.org/path/pdfs/HumCoTDPReport5_06.pdf. Accessed on March 3, 2008.

have more income available for healthy choices, such as preventative health care, good nutrition, physical activity, and education expenses.

B) A moderate increase in people who live in settings encouraging automobile use takes place in Plan Alternative B, so **expenses for transportation would change little or increase slightly**.

C) Under Plan Alternative C, Humboldt residents would be most automobile dependent and therefore have **higher transportation costs**. People spending more on transportation have less money to spend on healthful choices such as nutritious food, relaxation, preventive health care, and education.

Caveats

Average transportation costs could be lowered by encouraging mixed-use development in currently developed areas and adopting policies that encourage less expensive transportation modes: walking, biking and use of public transportation.

Recommended Health-Promoting Mitigations:

- See other indicators for mitigations that would increase use of public transit, walking and biking as ways to decrease cost of transportation.

ST.3.a Ratio of miles of bike lanes/ pedestrian facilities to road miles

Health-Based Rationale

Sidewalks, roadway shoulders or other types of pedestrian facilities can enable people to walk and potentially decrease the number of pedestrian injuries. A high quality pedestrian environment can support walking both for utilitarian purposes and for pleasure. Recent studies in the U.S. show that people walk on average 70 minutes longer in pedestrian-oriented communities.[59] [60] Additionally, clearly delineated bike lanes can enable bicycle use and potentially decrease the number of bicyclist injuries.

Biking and walking can help people meet minimum requirements for physical activity. Health benefits of physical activity include a reduced risk of premature mortality and reduced risks of coronary heart disease, hypertension, colon cancer, and diabetes mellitus.[61] Regular physical activity also appears to reduce depression and anxiety, improve mood, and enhance ability to perform daily tasks throughout the life span.

Unsafe traffic mixes of motor vehicles, pedestrians, and cyclists lead to increased risk of injury and death (also, see Indicator ST.8 below).[62] Traffic volume increases the risk of pedestrian, cyclist and motorist injury and death, with pedestrians, cyclists, and motorized two-wheeled vehicle users bearing a disproportionate share of road injury burden.[63] [64]

Unlike driving, biking and walking do not contribute to noise or air pollution emissions. For the general population, long term exposure to moderate levels of environmental noise can adversely affect sleep, school and work performance, and cardiovascular disease.[65] Noise affects sleep both by waking people up and reducing the quality of sleep. According to the World Health Organization, reductions of noise by 6-14 dBA result in subjective and objective improvements in sleep. Chronic road noise can affect cognitive performance of children including difficulty keeping attention, concentrating and remembering, poorer reading ability, and poorer discrimination between sounds.[66] Noise is also associated with higher stress and stress hormone levels.[67] In addition, increased rates of biking and walking may reduce driving trips, which can have an impact on air quality and thus, respiratory disease. According to the California Air Resources Quality Board, about half the air pollution in California is caused by cars and trucks.[68]

Existing conditions

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[59] Frank LD, Schmid TL, Sallis JF, Chapman J, Saelens BE. Linking objectively measured physical activity with objectively measured urban form: findings from SMARTRAQ. Am J Prev Med. 2005;28(2 Suppl 2):117-25

[60] Saelens BE, Sallis JF, Black JB, Chen D. Neighborhood-based differences in physical activity: an environment scale evaluation. Am J Public Health. 2003;93(9):1552-8.

[61] Task Force on Community Preventive Services. Increasing Physical Activity: A Report on Recommendations of the Task Force on Community Preventive Services. Morbidity and Mortality Weekly Report. October 26, 2001.

[62] World Health Organization (WHO), Edited by Margie Penden, Richard Scurfield, David Sleet, et al. World Report on road traffic injury prevention, 2004. Accessed at: http://www.who.int/world-health- day/2004/infomaterials/world_report/en/

[63] Ewing R, Frank L, Kreutzer R. Understanding the Relationship between Public Health and the Built Environment: A Report to the LEED-ND Core Committee. 2006.

[64] WHO, ibid.

[65] Dora C, Phillips M, eds. Transport, environment and health. WHO Regional Publications, European Series, No. 89. 1999. http://www.euro.who.int/document/e72015.pdf

[66] Noise and Health: Making the Link. London Health Commission, 2003. http://www.phel.gov.uk/hiadocs/noiseandhealth.pdf

[67] Evans G, Marcynyszyn LA. Environmental Justice, Cumulative Environmental Risk, and Health among Low- and Middle-Income Children in Upstate New York. Am J Pub Health 2004;94:1942-1944.

[68] CARB. 50 Things You Can Do. California Air Resources Quality Board. Available at http://www.arb.ca.gov/html/brochure/50things.htm.

Definitions of Class I, II, and III bicycle facilities. Class I bicycle facilities, typically referred to as a multi-use path, provide for bicycle and pedestrian travel on a paved right-of-way completely separated from any street or highway. The Caltrans design criteria require a minimum width of 8 feet for a two-way path. Class II bicycle facilities are often referred to as bike lanes. They provide a striped and stenciled lane for one-way travel on a street or highway. The minimum width of a lane is 4 feet. Class III facilities are generally referred to as bike routes. They provide for shared roadway use with motor vehicles and pedestrian traffic (not recommended), and are identified only by signing.

According to the HCOAG Regional Transportation Plan Update from 2006, all state highways have a Class II or III bike lane or shoulder (but may be 4 feet or less in some cases).[69] However, residents report a different experience; residents state that not all state highways have a bike lane or shoulder. Given that a 4 foot or less shoulder on a state highway is not healthfully bikeable, in this report we quantified only Class I or II bicycle facilities.

Humboldt County Road miles. There are 378 miles of state highways and 1400 miles of local city streets and county roads in the County.[70]

Total Miles of Bicycle Facilities. There are 387.9 miles of bike facilities in northern Humboldt, 22.7 in Southern Humboldt. This includes all 3 classes of bike facilities. 36.5 miles of these are Class I (30.5 miles of those are in northern Humboldt), 18.2 are class II (all of which are in northern Humboldt), and 356.1 are Class III.[71]

County ratio of bike lanes to roads. Currently, the ratio of all bike lanes to roads is 0.23 (410.6/1778). The ratio of Class I facilities to roads is 0.02, Class II to roads is 0.01 and Class III to roads is 0.20.

Location of bicycle and pedestrian facilities. The "Moving Goods and People" background report to the General Plan Update acknowledges that bike and pedestrian facilities are most commonly provided in the urban areas. The report also points out that many of the bike lanes do not meet current state standards (although programs are underway to improve the bicycle network) and pedestrian facilities meet only the minimum standard for the Americans with Disabilities Act, but have obstructions which force pedestrians and wheelchair users into road shoulders or bike lanes.[72]

Analysis

Assumptions

- There will be no increase in pedestrian and bicycle facilities (sidewalks, shoulder, bike paths, lanes, and routes).
- Plan Alternative A would allow for the least amount of new road construction while Plan Alternative C would require the most.

Quantitative Analysis

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[69] Telephone conversation with Lindsay Walker, CalTrans District 1 contact for bicycling.
[70] HCAOG 2006 Regional Transportation Plan Update.
[71] HCAOG. 2004 Regional Bicycle Transportation Plan Update. Humboldt County Association of Governments. Available at http://www.hcaog.net/docs/RBT.2004/TOC.htm. Accessed on January 22, 2008.
[72] Dyett & Bhatia. 2002. Humboldt County 2025 General Plan Update. Moving Goods and People: A Discussion Paper for Community Workshops. Available at http://co.humboldt.ca.us/planning/gp/meetings/moving_gp/moving.pdf. Accessed on December 13, 2007.

The Plan Alternatives do not currently specify how much new road construction would take place in the 3 Alternatives, making quantification impossible.

Qualitative Analysis

In 2003, a survey of Humboldt County residents was taken in relation to their opinions about many aspects of living in Humboldt County. 368 people responded and of those, 69 percent felt that the County should provide walking and biking paths closer to existing communities. The same survey asked residents why they chose to live in Humboldt County, and 62% stated that closer access to outdoor recreation including bicycling was a major reason why they live in Humboldt.[73]

People who participated in the Policy Charrette Values Exercise about biking/walking desire bike paths in the inner city, bicycling/walking opportunities and a culture that encourages these activities, exercise in everyday lifestyle, and a bike path from Arcata to Eureka.

People participating in the Health and GPU focus groups also understood the connection between land use planning that prioritized non-motorized forms of transportation and health. Participants understood that connected bike/pedestrian networks increase physical activity and reduce cardiovascular disease, diabetes and stress. They also felt that it is necessary to count the number of miles of non-motorized transportation routes and multi-use trails, and the number of bicycle-friendly roads to keep track of and encourage construction and maintenance of these.

When asked "How do land use decisions impact safe and quality environments for walking and biking?" participants noted: speed limits; safe, dry places to put bikes; lighting; traffic signals that are pedestrian and bike friendly; bike lanes that are marked, designated, mapped, identified in all communities and connecting communities; road corridors dedicated per mode (e.g. bike-only areas) or bike boulevards; continuous safe corridors; creating sidewalks; bike safety education; cross-walks that are well marked; and bike lanes in each village.

Disparities

The availability of safe places to walk and bike impacts those populations who do not rely on cars as much as other modes of transport. This includes children, seniors, the disabled, and low income residents.

Conclusions

A) **Plan Alternative A would result in the *smallest change* on ratio of bike lanes/pedestrian facilities to road miles.** By locating new residents in areas with existing road infrastructure, Plan Alternative A requires no increase in road construction, thus no change in the ratio of bike/pedestrian facilities to road miles.

B) **Plan Alternative B would result in a *slightly lower ratio* of bike/pedestrian facilities to road miles due to some *increase* in number of road miles with development.** Since most of the health benefits of having bicycle and pedestrian facilities are from increased physical activity, the decreased ratio of facilities for walking and biking would result in increased rates of chronic disease due to lack of physical activity, such as cardiovascular disease and diabetes.

C) **Plan Alternative C would result in the most significant *decrease* in the proportion of**

[73] 2003. Humboldt County General Plan Update Survey Results. Humboldt County Community Economic Development Services and Planning. Available at http://co.humboldt.ca.us/planning/gp/survey/results.htm. Accessed on November 18, 2007.

bike/pedestrian facilities to road miles due to the *largest increase* in road miles with development (residential, commercial and industrial). Thus, the health hazards related to decreased physical activity are likely to be the most significant with Alternative Plan C.

Recommended Health Promoting Mitigations:

- Redirect money that goes to cars to support alternative forms of transportation.
- Reduce speed limits on arterials, collectors, and local roads in non-urban areas.
- Establish a seat on HCOAG representing human-powered transport.
- Prioritize non-motorized modes of transportation in land use planning and construction (i.e., build more sidewalks and bike lanes).
- Raise the priority of non-motorized modes of transport in land use planning. For example, develop building design standards and revise zoning codes to emphasize pedestrian/bike safety, especially on key pedestrian, bike and transit corridors. Zoning codes to consider include those that look at: mixed use zoning, human activity presence, the building/sidewalk interface, parking design, and lighting.
- Develop streetscape standards that emphasize pedestrian and bike safety (e.g., lighting, trees, greenery, traffic calming measures).
- Collect data about pedestrian facilities throughout Humboldt County, much like information is tracked about the amount and condition of road surfaces; make this data public and use this data to guide development of pedestrian facilities;
- Promote and publish safe pedestrian and bike routes.
- Fund a bicycle and pedestrian safety staff position for the County, in HCOAG for example.
- Complete, build out and connect bike and pedestrian networks.
- Institute traffic calming measures, including clearly marked bike and pedestrian routes, bike boulevards, bulb outs, median islands on two or more lane streets, in urban areas to decrease speeds and firmly separate pedestrians/bikers from motor vehicles;
- Include paved shoulders on all roads in non-urban areas that can be used by bicyclists and pedestrians.
- Raise the priority of funding for trails and active recreation infrastructure and facilities.
- Increase the number of bicycle and pedestrian safety programs in schools and workplaces.

ST.3.b Proportion of commute trips and trips to school made by walking or biking

Health-Based Rationale
The health benefits of physical activity are well known: decreased risks for heart disease, diabetes, hypertension, and colon cancer, as well as an increased sense of well-being.[74] For children, benefits include also the importance of strengthening bones during a period of critical growth, increased confidence and self-esteem, and decreased risk of childhood obesity rates, which have skyrocketed over the past 30 years. Currently in the US, about 15% of children and adolescents can be labeled as having childhood obesity,[75] and up to 30% of adult obesity cases started in childhood.[76] In Humboldt County, 21.7% of adults are considered obese.[77] This is higher than California's rate of 19.1%, and also higher than the Healthy People 2010 objective of having only 15% of the population being obese.

Walking or biking to work or school helps people meet their daily requirements for physical activity. Health benefits of physical activity include the above–mentioned physical advantages, and physical activity also reduces depression and anxiety, improves mood, and enhances ability to perform daily tasks throughout the life span. A study in Gainesville, Florida, a region of the state with a fairly low population density and an average trip to school of just under 5 miles, looked at what would happen if you were able to change the features of the built environment to encourage walking to school. They found that with a 25 percent decrease walk time for the trip to school, the percent of those who walked increased from 4.5% to 5.5%. With a 25% decrease in biking time, the percentage who bike increased from 3.4% to 4.4%.[78] Through a simulation, the study also found that if the distance to school decreased to a 10-minute walk or 0.5 miles, the percentage of those who would walk increased by 129 percent, from 4.5% to 10.3%. For bicycling, by decreasing bike time to 2.5 minutes or 0.5 mile, the amount of children that biked to school increased from 3.4% to 11.1%, or a 226% increase.

Existing conditions
Percent of commute trips made by walking or biking, According to the 2000 Census, 8% of all commute trips in Humboldt are made by walking or biking,. The table below shows how many people choose walk or bike to work. In a comparison between urban and non-urban areas, more information would be necessary to understand differences between areas (e.g., Garberville and Redway). However, in looking at the increase in walking and biking when one lives in the central city vs. a Census County Division (CCD) of a city (a larger geographic area), it is instructive that those in the central city walk or bike more. According to the Census data and using the classification system described in the Summary Introduction, 9.0% of urban residents walk to work, while only 2.1% of non-urban residents do so.

Reasons for walking. In a survey of Humboldt County residents for the Pedestrian Needs Assessment of 2003, 53% of those surveyed stated that they walk daily, and the most commonly chosen response as to why they walk was for recreation (85% chose "recreation", 54% chose "shopping", 39% chose "work", 15% chose "school", and 9% chose simply "transit"). Given the survey results, it is likely that the US

[74] Task Force on Community Preventive Services. 2001. Increasing Physical Activity: A report on recommendations of the Task Force on Community Preventive Services. MMWR, Oct 26, 2001.
[75] CDC. 2004. Defining overweight and obesity. Available at http://www.cdc.gov/nccdphp/knpa/obesity/defining.htm. Accessed on December 16, 2007.
[76] Dietz WH. 2004. Overweight in childhood and adolescence. NEJM 350 (9): 855-7.
[77] Center for Health Statistics. 2004. Prevalence of obesity and healthy weight in California counties, 2001. Department of Health Services. Available at http://www.dhs.ca.gov/chs/OHIR/reports/countyhealthfacts/weight.pdf. Accessed on December 16, 2007.
[78] Ewing R, Forinash CV, Schroeer. 2005. Neighborhood Schools and Sidewalk Connections. TR News 237. March-April 2005. Available at http://onlinepubs.trb.org/onlinepubs/trnews/trnews237environment.pdf. Accessed on January 12, 2008.

Census information about people walking is low. The only question the Census asks is how people get to work.

Table ST.4. Percent of people who walk or bike to work[79]		
Area	**Walk**	**Bike**
California	2.9%	0.8%
Arcata CCD *	13.0%	4.2%
Arcata city	17.0%	5.2%
Eureka CCD *	5.4%	1.3%
Eureka city	7.7%	1.7%
Fortuna	3.6%	1.9%
McKinleyville	1.4%	1.6%
Garberville CCD *	8.5%	0.6%
Redway	16.5%	0
Hoopa	3.1%	1.6%

* Census County Division

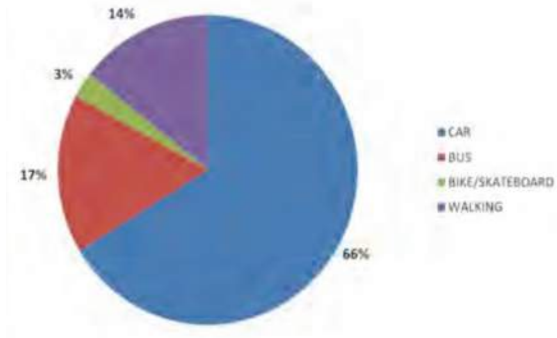
Reasons for not walking. Of those surveyed in the Pedestrian Needs Assessment, 27% stated that they did not walk because of safety concerns, 24% spoke of a lack of sidewalks, 21% said time was an issue, and 14% said having too much to carry entered into their choice.[80]

Walking to school. National data shows that in 1969, 50% of children walked to school. Today, only 12% walk to school.[81] In California in 2000-2001, 15.2% of children aged 0 – 17 walked to school and 1% biked.[82] For students in Humboldt County, 3% walked to school in 2006-07, and 14% biked (see chart below). Parents reported that long distances to school were the primary barrier to walking to school in a 1999 Centers for Disease Control survey,[83] and one of the highest ranked indicators of willingness to walk for all ages was 'trip distance' in a national meta-analysis.[84]

The figure below details transportation mode for trips to school.

[79] 2000 Census.
[80] Redwood Community Action Agency (RCAA). 2003. Humboldt County Regional Pedestrian Needs Assessment Study Update. Humboldt County Association of Governments.
[81] CDC. 2005. MMR Weekly. Barriers to Children Walking to or from School – United States, 2004. Centers for Disease Control and Prevention. Available at http://www.cdc.gov/MMWR/preview/mmwrhtml.mm5438a2.htm. Accessed on December 16, 2007.
[82] Caltrans. California Dept. of Transportation, 2000-2001. California Statewide Household Survey.
[83] Dellinger A, Staunton C. 2002. Barriers to Children Walking and Bicycling to School: United States, 1999. Morbidity and Mortality Weekly Report 51(32):701-4.
[84] Brennan Ramirez LK, Hoehner CM, Brownson RC, Cook R, Orleans T, Hollander M, Barker DC, Bors P, Ewing R, Killingsworth R, Petersmarck K, SchmidT, Wilkinson W. 2006. Indicators of activity-friendly communities. Am J Prev Med 31(6):515-24.

Figure ST.4. Transportation to school from the Humboldt County 2006-2007 Student BMI Study.[85]



Analysis

Assumptions
- Families with children will choose to live in cities at the same rate as others.

Logic
- A higher percentage of the population lives within walking/biking distance to schools in urban centers and a higher percentage of the population lives close to their workplace in urban centers.

Quantitative Analysis
Using the numbers above and classifying urban and non-urban as described in the Summary Introduction, 9.0% of the 64,409 people live in urban areas and 2.1% of the 62,109 people who live in non-urban areas walk to work. Therefore, the current county-wide percentage of those who walk to work is 5.6%.

With Plan Alternative A, 14,400 people would come to the urban areas. This would increase the percent of people who walked to work to 6% (9% of 78,809 + 2.1% of 62,109 divided by 140,918, the total population). Using similar analysis, with Plan Alternative B, 14,400 people would come to the urban areas and the same number would come to non-urban areas. Therefore the percent of people who would walk to work would remain the same, 5.6%. With Plan Alternative C, 14,400 people would come to the urban areas and the 28,800 would come to non-urban areas. Therefore the percent of people who would walk to work would decrease to 5.3%.

Conclusions

A) **Plan Alternative A, if adopted, would increase the number of people walking to work from 5.6% to 6%.** More Humboldt County residents would accrue the positive health benefits from walking to work of increased physical activity, decreased incidence of obesity and depression, better bone health, and enhanced ability to perform daily tasks throughout the lifespan.
B) **Plan Alternative B would mean that the percentage of those walking to work would remain virtually the same**, with no change on average in health status as a result of walking to work.
C) **Plan Alternative C would result in fewer people walking to work to only 5.3% of the population.** More people would not get a recommended amount of physical activity, thus incurring higher rates of chronic disease and depression.

[85] 2006-7 Humboldt Student BMI Study (DHHS).

Recommended Health-Promoting Mitigations:

- Ensure land use planning, including designs of residential neighborhoods, encourage walking and biking (i.e. with sidewalks and bike lanes and crosswalks);
- Implement educational program for residents regarding walking/safe routes to schools.
- Urban centers should offer companies incentives for locating in cities, increasing the chance that more of the population can access work by walking or biking.

ST.3.c Number and rate of bicycle/pedestrian injury collisions

Health-Based Rationale

Traffic injuries are a major cause of disability and death. Nationally, 12.6% of all traffic fatalities were pedestrians.[86] Vehicle volume predicts pedestrian injury rates. For example, in Boston's Chinatown, there were 3-5 more pedestrian injuries for each increase of 1,000 vehicles.[87] Speed also predicts pedestrian injury; the risk of child pedestrian injury was 3.6 times higher if the vehicles were traveling at high speeds in one study.[88] While pedestrian risk decreases with pedestrian flow, it is also true that greater population density is related to higher pedestrian injury.[89] [90]

Finally, while there are more pedestrian/auto accidents in urban areas simply because there are more people and more cars, the risk of fatality in a rural area is double or even triple the rate in urban areas (depending on what type of road the crash occurs). Very few of those fatalities occur on highways; more occur on collector and local roads, where there are more pedestrians.[91]

Existing conditions

Injury Collisions. According to the HCOAG Pedestrian Needs Assessment of June 2003, there were 163 injury collisions in Humboldt between 1999 and 2002, 10 of which were fatalities. Of those, 88 (54%) of the injury collisions were in Eureka and 24 (15%) were in Arcata.[92]

Location of Injury Collisions. The maps below shows the locations of injury collisions. Many pedestrian collisions in Eureka take place along Route 101, where traffic speed is slightly higher, although collisions are scattered throughout the city. In Eureka, 20 of the 88 collisions were on Route 101 (where it is called 4th and 5th Streets).[93]

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86 Federal Highway Administration. 2006. Speeding in rural areas. US Dept. of Transportation. Available at http://safety.fhwa.dot.gov/speed_manage/docs/speeding_rural.pdf.

87 Brugge D, Lai Z, Hill C, Rand W. 2002. Traffic injury data, policy, and public health: lessons from Boston Chinatown. Journal of Urban Health 79(1):87-103.

88 Roberts I, Marshall R, Lee-Joe T. 1995. The urban traffic environment and the risk of child pedestrian injury: a case-cross over approach. Epidemiology 6:169-171

89 Leden L. 2002. Pedestrian risk decreases with pedestrian flow: A case study based on data from signalized intersections in Hamilton, Ontaria. Accident Analysis and Prevention 34:457-464.

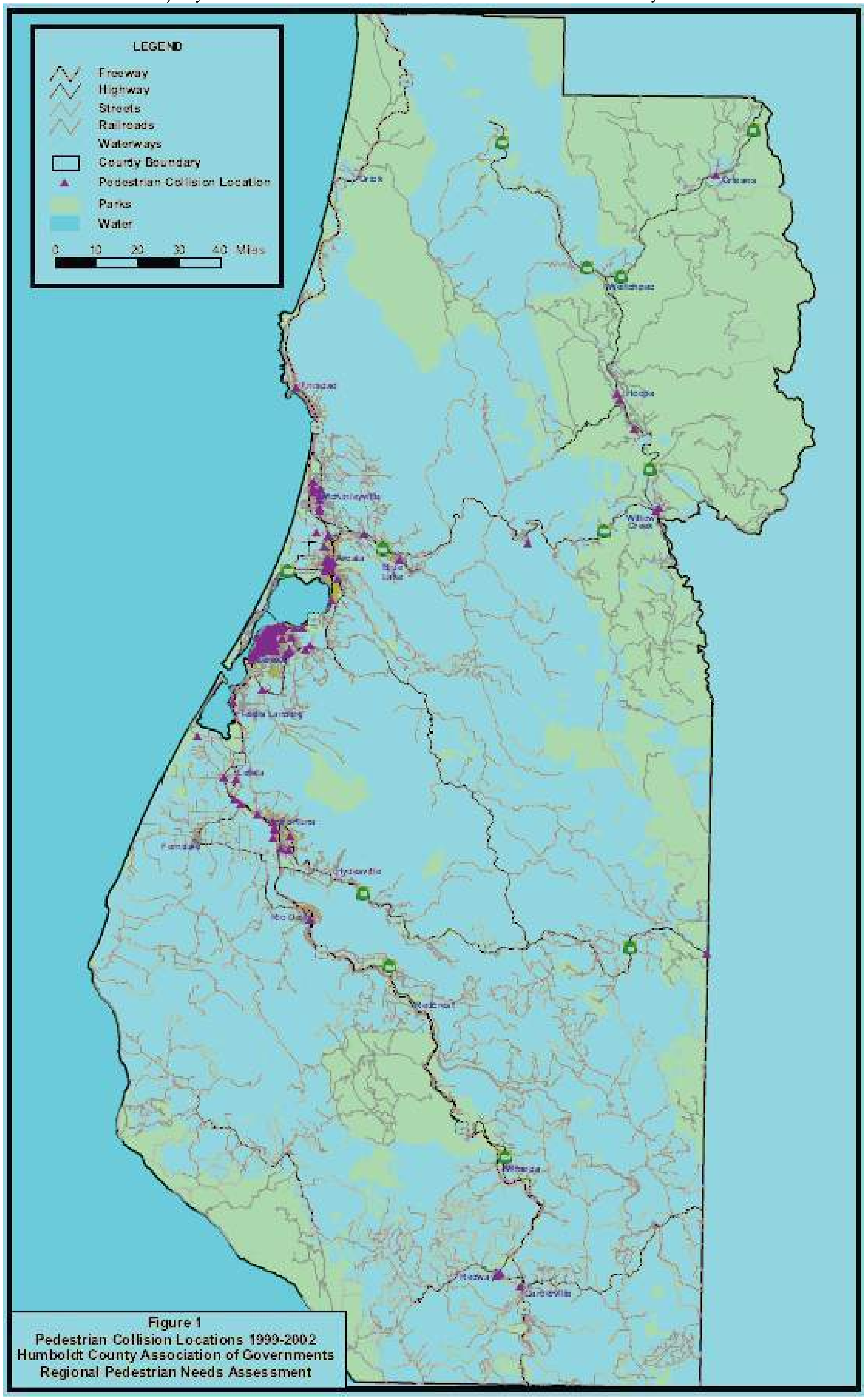
90 LaScala EA, Johnson FW, Gruenewald PJ. 2001. Neighborhood characteristics of alcohol-related pedestrian injury collisions: A geostatistical analysis. Prevention Science 2(2):123-134.

91 Federal Highway Administration, ibid.

92 HCOAG. 2003. Humboldt County Regional Pedestrian Needs Assessment Study Update. Humboldt county Association of Governments.

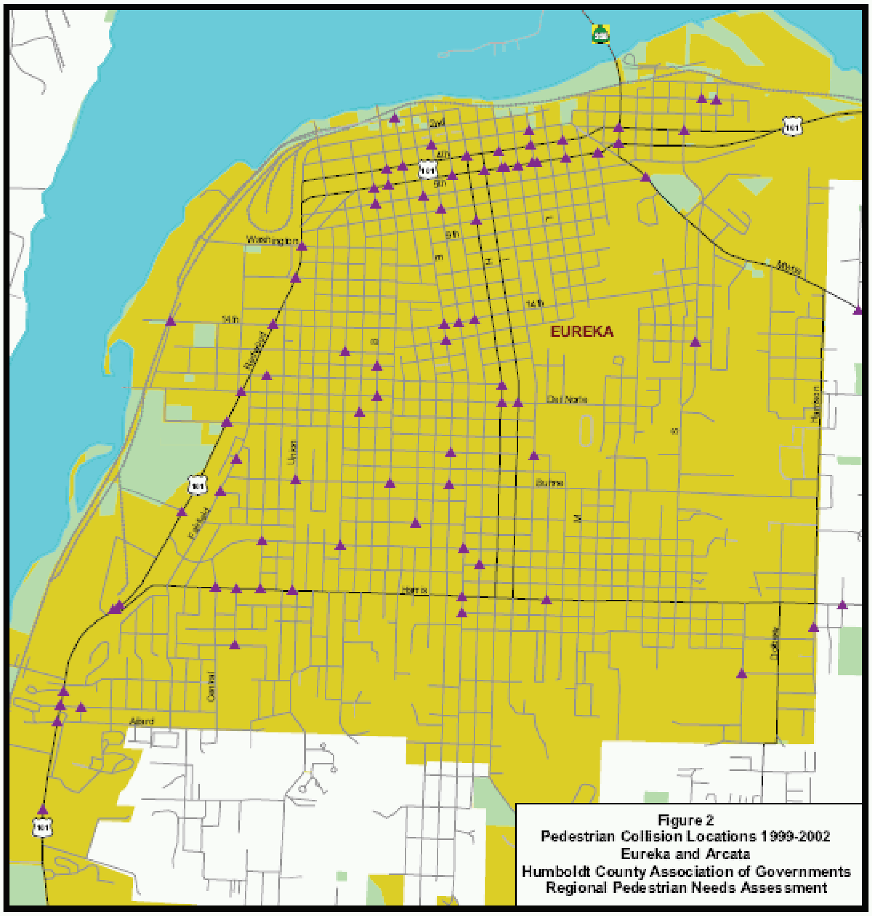
93 Hight J. 2004. Dangerous crossings: Car wreck highlights perilous Eureka intersections. North Coast Journal, September 30, 2004. Available at http://www.northcoastjournal.com/093004/news0930.html.

Figure ST.5. Locations of injury collisions 1999-2002 in Humboldt County.[94]



[94] HCOAG. 2003. Humboldt County Regional Pedestrian Needs Assessment Study Update. Humboldt county Association of Governments.

Figure ST.6. Locations of injury collisions 1999-2002 in Eureka.[95]



Urban vs. Rural Statistics. The National Safety Council estimates that 85.7% of all *non-fatal* pedestrian crashes in the United States occur in urban areas and 14.3% occur in rural areas.[96] The number of traffic related *fatalities* (pedestrian, bicyclist, AND motor vehicle fatalities) in the US in 2005 was 24,837 in rural areas and 18,606 in urban areas (i.e., 56% of the *fatalities* were in rural areas and 44% were in urban areas), despite the fact that the rural population is only 21% of the US.[97] 72% of all *pedestrian fatalities* in 2003 occurred in urban areas.[98]

The figure below shows data from the Fatal Accident Reporting System, the National Highway and Traffic Safety Administration and the National Center for Statistics and Analysis. It demonstrates the higher amount of rural fatalities regarding motor vehicle collisions.

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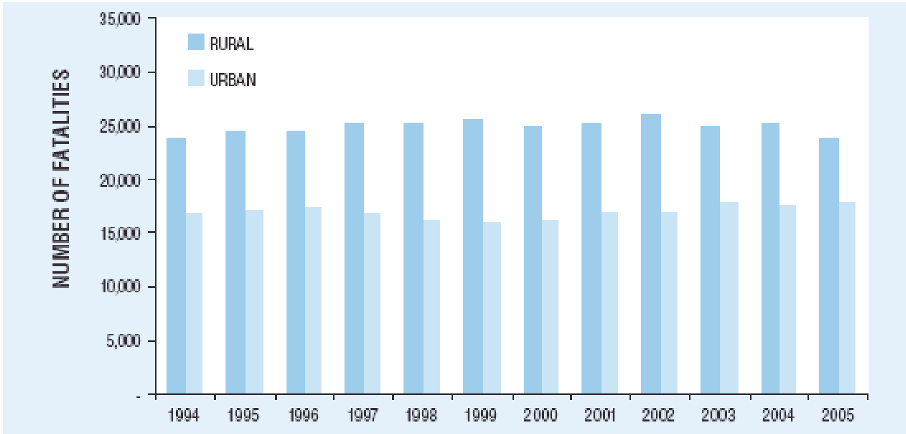
[95] HCAOG. 2003. Humboldt County Regional Pedestrian Needs Assessment Study Update. Humboldt County Association of Governments.
[96] National Highway Traffic Safety Administration. 2003. Traffic Safety Facts. Washington DC, 2004.
[97] National Highway Traffic Safety Administration. 2005. Fatality Analysis Reporting System Encyclopedia. Available at http://www-fars.nhtsa.dot.gov/States/StatesPedestrians.aspx. Accessed on January 16, 2008.
[98] NHTSA. 2003. Ibid.

Figure ST.6. Traffic accident related fatalities as a function of location from 1994 to 2005.[99]



Source: NCSA, NHTSA, FARS 1994-2005

Analysis

Assumptions

- There will be few changes in traffic laws.
- There will be no mitigations implemented regarding pedestrian and bike safety.

Logic

- In areas with large numbers of people walking and more traffic, risk of pedestrian injury collisions increases.

Quantitative Analysis

The only numbers available are that there were 163 crashes involving pedestrians in Humboldt County; unfortunately, the Humboldt County Association of Governments report does not break down the location of injuries specifically except to say that 112 of them were in either Eureka or Arcata. Therefore it is impossible to quantitatively predict the future number of injury collisions and pedestrian injuries.

Qualitative Analysis

Many of the participants in the Health and GPU focus groups gave witness to the dangers of walking along non-urban roads that do not have proper pedestrian facilities (i.e., sidewalks or shoulders). Many participants said that they do not walk in those areas due to fear of injury.

People who participated in the Policy Charrette Values Exercise about biking/walking desire that it is safe to walk everywhere in the County, that neighborhoods are walkable and likeable, putting people before cars, and that they rarely need to drive their cars.

Humboldt County residents have already recognized that pedestrian safety is important by making it the first goal in the Pedestrian Needs Assessment Study Update 2003[100]:

GOAL 1: Make Humboldt County a pedestrian safe environment.

- Objective A: Safety. Maximize safety for pedestrians and all other roadway users alike.
- Objective B: Conflicts. Minimize potential conflicts between pedestrians, motor vehicles, and bicycles.

[99] NCSA, NHTSA, FARS 1994-2005.

[100] HCOAG. 2003. Humboldt County Regional Pedestrian Needs Assessment Study Update. Humboldt county Association of Governments.

Disparities

- Pedestrian collisions are more common in low income areas. This could reflect greater residential density, greater traffic volume, lower auto ownership, and/or greater number of alcohol outlets.[101]
- The only non-urban area mentioned in the Pedestrian Needs Assessment that had a slightly higher rate of pedestrian collisions was Hoopa.
- Children, particularly boys aged 5-9, are the most at risk for crashes as they tend to dart out into the street. The rates of crashes with older people tends to be lower, perhaps reflecting that older people walk with more caution. However, when an elderly person is struck by a vehicle, the odds of them dying are higher than other ages. There is a 20% risk of dying for those struck who are over age 75 versus 8% for those under age 14.[102]

Conclusions

A) Under Plan Alternative A, **pedestrian injury due to collisions with motor vehicles may decrease, given research that shows that when pedestrian/bike volume increase enough, it causes drivers to either slow down or take other routes.[103] Without reaching this critical point, however, there could be an increased risk of pedestrian injury due to the increase in vehicle volume in urban areas. Overall, there would be a lower risk of pedestrian *fatality*** as speeds in urban areas are lower; the literature tells us that motor vehicle collisions with pedestrians are more often fatal in non-urban areas and areas with higher speeds.

B) Plan Alternative B would result in the **smallest change in pedestrian injury and fatality**, however there may be some slight increase simply due to a population increase. More people, especially more people outside of urban centers, implies more cars, more driving, and more accidents.

C) Under Plan Alternative C, **pedestrian injury would potentially *increase* due to the increased population in non-urban areas traveling to cities for goods and services.** There may also be an *increase* in pedestrian fatality as there will be more people driving in non-urban areas at higher speeds.

Recommended Health-Promoting Mitigations:

- Institute traffic calming measures, including clearly marked bike boulevards, bulb outs, median islands on two or more lane streets, in urban areas to decrease speeds and firmly separate pedestrians/bikers from motor vehicles.
- Increase amount and quality of pedestrian facilities in urban areas.
- Reduce speed limits on arterials, collectors, and local roads in non-urban areas.
- Improve signage in both non-urban and urban areas.
- Improve and encourage use of public transportation to reduce driving.
- Develop streetscape standards that emphasize pedestrian and bike safety (lighting, trees, greenery, and traffic calming measures).
- Develop building design standards and revise zoning codes to emphasize pedestrian/bike safety, especially on key pedestrian, bike and transit corridors. Zoning codes to take into consideration are those that look at mixed use zoning, human activity presence, encouraging building lines to embrace the sidewalk, require better parking design, lighting).

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[101] Zajac SS, Ivan JN. 2003. Factors influencing injury severity of motor vehicle-crossing pedestrian crashes in rural Connecticut. Accident Analysis and Prevention 35(3):369-379

[102] US DOT. PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System: Crash Statistics. US Department of Transportaiton. Federal Highway Administration.

[103] Jacobsen PL. 2003. Safety in numbers: More walkers and bicyclists, safer walking and bicycling. Inj Prev 9:205-9.

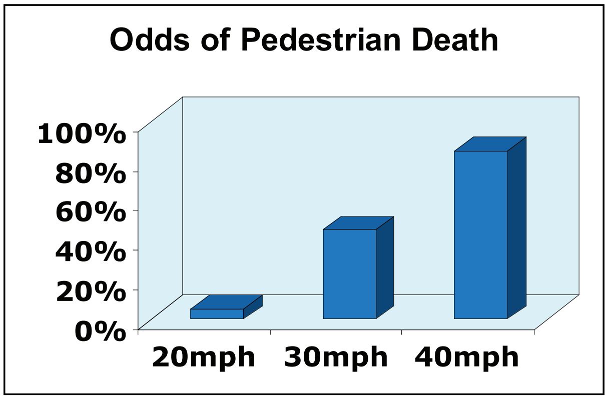
- Improve signalization of crossing and routes.
- Clearly mark and classify bike and pedestrian routes.

ST.3.e Proportion of population living on residential streets with less than 35 mph speed limits.

Health-Based Rationale

Vehicle speed predicts severity of pedestrian injuries. With vehicle speeds below 20 mph the probability of serious or fatal injury is less than 20%; with speeds above 35 mph, most injuries are fatal or incapacitating.[104] [105] Excess and inappropriate speed is widespread and may contribute to around 30% of road traffic crashes and deaths. An average increase in speed of 1 km (0.625 miles)/hour is associated with a 3% higher risk of a crash involving an injury. Pedestrians have a 90% chance of surviving car crashes at 30 km/hour (18 mph) or below, but less than a 50% chance of surviving impacts at 45 km/hour (28 mph) or above.[106] In a New Zealand study, the risk of child pedestrian injury was 3.6 times higher if the vehicles were traveling at high speeds. [107]

Figure ST.7. Odds of pedestrian death in a collision with a motor vehicle as a function of speed.



In 1999, 60% of all US motor vehicle fatalities and 64% of all speeding related fatalities occurred on rural roads.[108] In rural areas, traffic fatalities involve higher speeds than in urban areas, as the figure below shows.

[104] Leaf WA, Preusser DF. 1999. Literature review on vehicle travel speeds and pedestrian injuries. National Highway Traffic Safety Administration. Washington DC. US Department of Transportation. Available at http://www.nhtsa.dot.gov/people/injury/research/pub/HS809012.html.

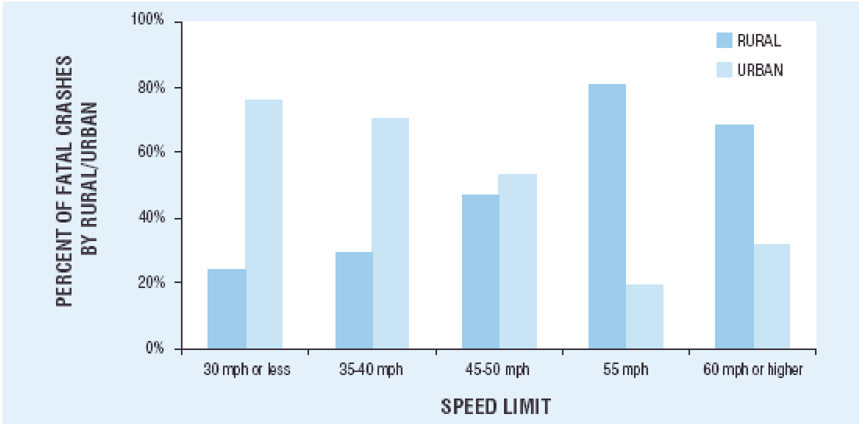
[105] Taylor M, Lynam D, Baruay A. 2000. The effects of driver's speed on the frequency of road accidents. Transport Research Laboratory. TRL Report 421. Crowthorne UK.

[106] World Health Organization (WHO), Edited by Margie Penden, Richard Scurfield, David Sleet, et al. World Report on road traffic injury prevention, 2004. Accessed at: http://www.who.int/world-health- day/2004/infomaterials/world_report/en/

[107] Roberts I, Marshall R, Lee-Joe T. 1995. The urban traffic environment and the risk of child pedestrian injury: a case-cross over approach. Epidemiology 6:169-171.

[108] Federal Highway Administration Safety. 2000. Speeding in rural areas. US Dept. of Transportation.

Figure ST.8. Fatal crashes by speed limit and location, 2005.[109]



Source: NCSA, NHTSA, FARS 2005

Existing Conditions

Existing data on this indicator is not available. Given rural nature of County, most roads are not low speed limits and most low speed roads are in urban areas.

Analysis

Logic

- Urban areas have lower speed limits; putting more people in urban areas would increase the proportion of people living on roads with lower speeds.
- Existing non-urban roads have higher speed limits. New roads constructed under C would be non-urban and have high speed limits. More people in non-urban areas would decrease the proportion of people living on roads with lower speeds.

Quantitive Analysis

Given the lack of data on existing conditions and the lack of information on new road construction under the various Plan Alternatives, a quantitative analysis was not possible.

Qualitative Analysis

People surveyed for the General Plan Update noted that on Route 101 in downtown Eureka there is a lot of traffic, congestion, pedestrian hazards and areas with high speed.

Conclusions

A) Because urban streets tend to have lower speed limits, **Plan Alternative A is likely to increase the proportion of people living on roads with lower speeds.** Thus there would be a decrease in pedestrian fatality due to motor vehicle collisions.

B) Given that growth in urban and non-urban areas would not change the proportion of the population urban vs. non-urban areas significantly, **Plan Alternative B would result in the least change in the proportion of residents living on roads with lower vs. higher speed limits**, and the least change in pedestrian fatality due to motor vehicle collisions on higher speed streets.

C) Since Plan Alternative C allows for the most growth in non-urban areas where speeds are higher, **it**

[109] NCSA, NHTSA, FARS 2005.

is likely to decrease the proportion of people living on roads with lower speeds, with the likely result of more pedestrian fatalities.

Recommended Health-Promoting Mitigations

See mitigations suggested for indicator ST.3.c.

ST.3.f Percent of population who have access to pedestrian facilities.

Health-Based Rationale

Pedestrian facilities include sidewalks, wide shoulders on non-urban roads and other areas designated for pedestrians.

According to the Centers for Disease Control, adults should engage in moderate intensity physical activities for at least 30 minutes on 5 or more days of the week.[110] In many places, walking is a primary source of physical activity and sidewalks and streets are the place people walk most commonly.[111] Having access to walkable streets would likely increase physical activity. For example, in one study, men and women who reported positive changes in the convenience of walking were more than twice as likely to increase their walking.[112] The rate of walking is nearly 13% lower among rural residents than among suburban residents,[113] and rural residents are more likely than urban/suburban individuals to report barriers to physical activity. These barriers include fewer sidewalks, limited access to exercise facilities, and lower social support for physical activity.[114] [115] Having access to places to walk increases the possibility that one walks recommended amounts. In a study in Atlanta, 34% of individuals who live in walkable neighborhoods walk; they drove 26 miles per day on average. Only 3% of individuals that live in car dependent neighborhoods walk, and they drove 43 miles per day.[116]

Walkable streets also increase social cohesion. Residents living in neighborhoods they categorized as walkable were 28% more likely to know their neighbors, 15% more likely to trust others, 14% more likely to be politically active, and 20% more likely to participate in social activities with others.[117] Social cohesion and participation are indicators of good health. For example, in one study for every one standard deviation increase in group membership in a community, mortality decreased by 83.2 individuals per 100,000.[118] And in Alameda County in 1979, researchers found that men and women who lacked ties to others were 1.9 to 3.1 times more likely to die during the follow-up period than those who had many contacts.[119]

Existing conditions

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[110] CDC. 2007. Physical Activity for Everyone. Centers for Disease Control and Prevention. Available at http://www.cdc.gov/NCCDPHP/dnpa/physical/recommendations/index.htm. Accessed on January 12, 2008.

[111] Powell KE, Martin LM, Chowdhury PP. 2003 Places to walk: convenience and regular physical activity. Am J Public Health Sep;93(9):1519-21.

[112] Humpel N, Marshall AL, Leslie E, Bauman A, Owen N. 2004. Changes in neighborhood wlaking are related to changes in perceptions of environmental attributes. Annals of Behavioral Medicine 27(1):60-67.

[113] Eyler AA, Brownson RC, Bacak SJ, Housemann RJ. 2003. The epidemiology of walking for physical activity in the United States, *Med. Sci. Sports Exerc.* **35**:1529–1536.

[114] Parks SE, Housemann RA, Brownson RC. 2003. Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the United States. *J. Epidemiol. Community Health* **57**:29–35.

[115] Wilcox S, Castro C, King AC, Housemann RA, Brownson RC. 2000. Determinants of leisure time physical activity in rural compared with urban older and ethnically diverse women in the United States. *J. Epidemiol. Community Health* **54**:667–672.

[116] Frank LD, Saelens BE, Powell KE, Chapman JE. 2007. Stepping toward causation: do built environemtns or neighborhood preferences explain physical activity, driving, and obesity? Soc Sci Med 65(9):1898-914.

[117] Leyden KM. 2003. Social capital and the built environment: the importance of walkable neighborhoods. Am J Public Health. 93(9):1546-51.

[118] Kreuter MW, Lezin N. 2002. Social capital theory: Implications for community-based health promotion. In Emerging Theories in Health Promotion Practice and Research. Eds DiClemente RJ, Crosby RA, Kegler MC. Jossey-Bass: San Francisco, CA.

[119] Berkman LF, Syme SL. 1979. Social networks, host resistance and mortality: a nine-year follow up study of Alameda County residents. American Journal of Epidemiology 109:186-204.

No data is available on number of people with access to pedestrian facilities currently. Many residents in focus groups said that lack of sidewalks and safe shoulders on non-urban roads was one of the primary reasons they did not walk.

Analysis

Assumptions

- There are more pedestrian facilities currently in urban areas.
- New pedestrian facilities will not be built in any scenario unless specific policies are put in place.

Logic

- Because there are more pedestrian facilities in urban areas, housing that would locate more people in urban areas would increase the number of people who have access to pedestrian facilities. Locating more housing in non-urban areas would decrease the number of who have access to pedestrian facilities.

Quantitative Analysis

A detailed quantitative analysis not possible without baseline data about the percentage of residents in urban areas vs. non-urban areas with access to pedestrian facilities.

Qualitative Analysis

Many participants in the Health and GPU focus groups held in December 2007 commented on pedestrian facilities and sidewalks. Themes included:

- A connected network of sidewalks can support health through encouraging social cohesion.
- Accessibility is needed for those of all means and abilities.
- Investment in roads should be reduced and investment for bike and pedestrian facilities and paths should be increased.
- Connected bike and pedestrian networks will increase physical activity and reduce cardiovascular disease, diabetes and stress.
- Affluent areas often have contiguous sidewalks, whereas lower-income areas often don't have that infrastructure completeness.
- Sidewalks are important for seniors – they can get around well on scooters but not without sidewalks. Sidewalks also have blockages, such as poles and other utilities, that need to be addressed.
- Lack of sidewalks on non-urban roads impacts physical activity.
- Because there are no sidewalks or proper shoulders on some roads people drive more often than they want to. Walking is not safe.

Participants felt that planning has impact on walking through creating walkable streets, car-less commercial centers, and continuous safe corridors, through improved lighting, through rezoning opportunities to encourage mixed use, through reducing sidewalk obstructions, and through pedestrian facility design appropriate to geographic area.

Goal 2 of the Humboldt County Pedestrian Needs Assessment Study Update in 2003 is to improve access to pedestrian facilities by improving connectivity from important destinations and improving function, such as access, convenience, and directness.

Disparities

Those who are unable to use motorized transport are disproportionately affected by the lack of pedestrian facilities. They rely on those facilities to do errands and get daily exercise. These populations include children, seniors, the disabled, and low-income residents who may not be able to afford a car.

Conclusions

A) **Plan Alternative A would offer more residents of the growing population of Humboldt County access to pedestrian facilities.** In Alternative Plan A, growth will occur in the urban areas where sidewalks and pedestrian facilities already exist.
B) **Plan Alternative B would offer the least change in access to pedestrian facilities** since it does not significantly alter the ratio of urban population to non-urban. Growth in each area would mean that the same proportion of people have access to sidewalks and pedestrian facilities.
C) **Plan Alternative C will decrease the proportion of Humboldt's population that has acces to pedestrian facilities.** Population growth will happen at a greater rate in non-urban areas where pedestrian facilities, by Humboldt resident participant report, are not widespread.

Recommended Health-Promoting Mitigations:

- Establish a seat on HCAOG representing human-powered transport.
- Increase amount and quality of pedestrian facilities in urban areas.
- Reduce speed limits on arterials, collectors, and local roads in non-urban areas.
- Improve signage in both non-urban and urban areas.
- Prioritize funding for trails and active recreation infrastructure and facilities.
- Pursue policies, programs, and investments to make walking the first, best, and safest choice for more local-serving trips.
- Increase the priority of funding to pave shoulders on all roads in non-urban areas that can be used by bicyclists and pedestrians.

Public Infrastructure Indicators

PI.2.b Proportion of households within ½ mile of a public elementary school

Health-Based Rationale

Nationally, only 13% of children aged 5 to 15 walk to school. According to the Centers for Disease Control and Prevention, long distances to school are a primary barrier to walking to school. Danger from traffic was the second most important barrier.[1] Research on travel mode choice also shows that when schools are located closer to home, more children walk and/or bicycle to school and vehicle pollution emissions fall.[2] 31% of children that live within one mile of school walk, compared to only 2% of children living within two miles of school.[3]

Having schools closer to the places children live is important. Walking to and from school can be an important source of exercise for children, many of whom are not getting enough exercise currently. School yards are also places children and others can play and socialize when schools are not in session. In 2003-2004 Public Health Staff weighed school aged children and determined that the percentage overweight was 21% compared to NHANES 1999-2000 national prevalence of 15.5%.

Walking to school is safer when schools are close. The more children are exposed to traffic on their way to school, as measured by the number of intersections they have to cross, the higher their risk of being hit by a car.[4]

Existing conditions

Elementary Schools: There are 48 public elementary schools (that are not charter schools) in the Humboldt County. Of those, 19 are in urban areas. The table below lists those schools and their locations.

---

[1] Dellinger A, Staunton C. Barriers to Children Walking and Bicycling to School. Morbidity and Mortality Weekly Report. 2002;51:701-704.

[2] Ewing R, Forinash CV, Schroeer W. Neighborhood Schools and Sidewalk Connections. What are the impacts on travel mode choice and vehicle emissions. Transportation Research News. March-April 2005 pp 4-10.

[3] CA Center for Physical Activity. Background facts about children's health and safety. Available at http://www.cawalktoschool.com/files/2006/background_facts.pdf.

[4] Macpherson A, Roberts I, Pless B. 1998. Children's exposure to traffic and pedestrian injuries. Am J Public Health 88:1840-1845.

Table PI.1. Names and Locations of Public Elementary Schools

School Name	Address	City
Ambrosini (Norman G.) Elementary	3850 Rohnerville Road	Fortuna
Birney (Alice) Elementary	717 South Ave	Eureka
Cutten Elementary	4182 Walnut Dr	Cutten
Ferndale Elementary	164 Shaw Ave	Ferndale
Fieldbrook Elementary	4070 Fieldbrook Road	Mckinleyville
Freshwater Elementary	75 Greenwood Heights Drive	Eureka
Garfield Elementary	2200 Freshwater-Kneeland Road	Freshwater
Grant Elementary	3901 G St	Eureka
Jefferson Elementary	1000 B St	Eureka
Lafayette Elementary	3100 Park St.	Eureka
Lincoln Elementary	216 W Harris St	Eureka
Pacific Union Elementary	3001 Janes Road	Arcata
Pine Hill Elementary	5230 Vance Street	Eureka
Ridgewood Elementary	2060 Ridgewood Dr.	Cutten
South Bay Elementary	6077 Loma Ave.	Fields Landing
South Fortuna Elementary	2089 Newberge Road	Fortuna
Arcata Elementary	2400 Baldwin St.	Arcata
Toddy Thomas Elementary	2800 Thomas St.	Fortuna
Washington Elementary	3322 Dolbeer St.	Eureka
Agnes J. Johnson Elementary	73 School Road	Weott
Big Lagoon Elementary	269 Big Lagoon Park Road	Trinidad
Blue Lake Elementary	631 Greenwood Ave	Blue Lake
Bridgeville Elementary	38717 Kneeland Road	Bridgeville
Casterlin Elementary	24790 Alderpoint Road	Blocksburg
Cuddeback Elementary	300 Wilder Road	Carlotta
Dow's Prairie Elementary	3940 Dow's Prairie Road	Mckinleyville
Eagle Prairie Elementary	95 Center St.	Rio Dell
Ettersburg Elementary	4500 Ettersburg Road	Ettersburg
Green Point Elementary	180 Valkensar Lane	Blue Lake
Honeydew Elementary	1 Wilder Ridge Road	Petrolia
Hoopa Valley Elementary	Hwy. 96	Road Hoopa
Hydesville Elementary	3050 Johnson Road	Hydesville
Jack Norton Elementary	Telescope Peak Road	Pecuan
Jacoby Creek Elementary	1617 Old Arcata Road	Bayside
Kneeland Elementary	9313 Kneeland Road	Kneeland
Loleta Elementary	700 Loleta Dr.	Loleta
Maple Creek Elementary	15933 Maple Creek Rt.	Korbel
Mattole Elementary	29289 Chambers Road	Petrolia
Morris Elementary	2395 Mc Kinleyville Ave.	Mckinleyville
Murphy (Stanwood A.) Elementary	417 Church St.	Scotia
Orick Elementary	120918 Hwy. 101	Orick
Orleans Elementary	38216 Hwy. 96	Orleans
Peninsula Union Elementary	909 Vance Avenue Samoa	Samoa
Redway Elementary	344 Humboldt Ave. Redway	Redway
Trinidad Elementary	300 Trinity St	Trinidad
Trinity Valley Elementary	730 Hwy. 96	Willow Creek
Weitchpec Elementary	Hwy. 169 and Weitchpec Road	Hoopa
Whitethorn Elementary	16851 Bricelano-Thorne Road	Whitethorn

The figures below show the locations of these schools.

Figure PI.1. The locations of the public elementary schools in the County. See Appendix B of the Summary for details about the mapping methods.

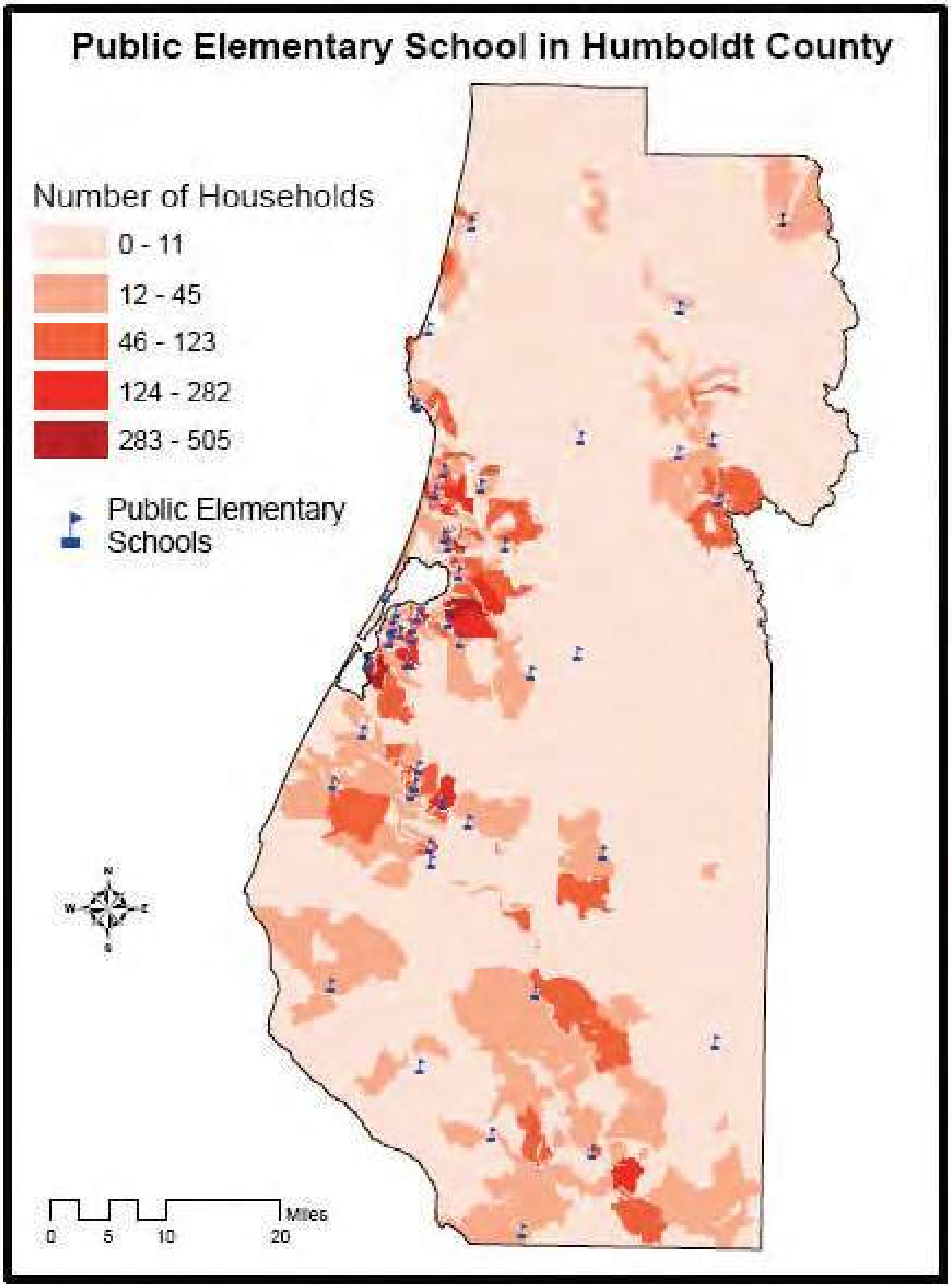
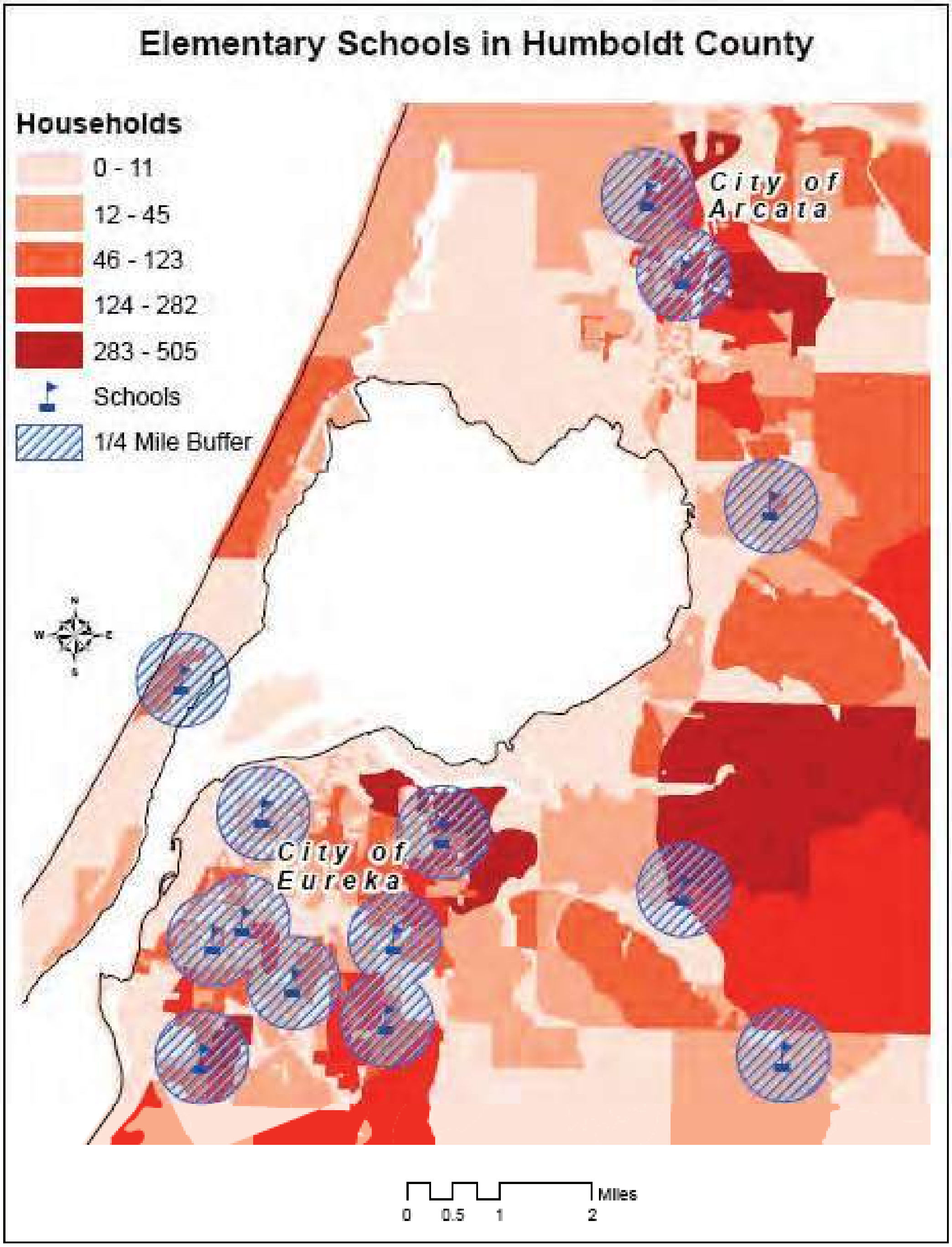


Figure PI.2. The locations of the public elementary schools in the area around Eureka and Arcata, showing a ¼ mile buffer around each school. Note that this buffer is smaller than the buffer used for this indicator. See Appendix B of the Summary for details about the mapping methods.



Proportion of Households within ½ mile of elementary schools: The table below summarizes current data for the proportion of households within 0.5 miles of a public elementary school. See Appendix B of the Summary for details about the calculations.

Table PI.2. Percent of Households within a ½ mile of a public elementary school	
Area	**% of households**
Humboldt County	35.3 %
Areas with urban zip codes	41.4%
Areas with non-urban zip codes	24.1%
Eureka and Arcata	43.6%
McKinleyville	21.4%

Analysis

Assumptions

- The analysis below assumes that most students go the school closest to their homes and that distance to school is a primary barrier to walking, as is true in other places. It is assumed that increasing proximity to schools would lead to more children walking to school.
- The proportion of households near elementary schools in urban and non-urban areas is not expected to change; only the overall proportion of households near elementary schools in the County is expected to change.

Logic

- A higher percent of households in urban areas are currently within ½ a mile of an elementary school than in non-urban areas currently. Therefore, building housing in urban areas will likely lead to more households being within ½ a mile of an elementary school in the future.

Quantitative Analysis

Of the 51238 households in County, 33443 are located in urban areas (based on the zipcode classification described in the summary introduction) and 17795 are in non-urban areas.

Under Plan Alternative A, 6000 new houses would be built in urban areas. Therefore, there would be 39443 urban households and the number of non-urban households would remain the same (17795). Since 41.4% of households in urban areas are currently within a ½ mile of a public elementary school and it was assumed that this would not change, 16329 (41.4% of 39443) households in urban areas would be near elementary schools. Similarly, since 24.1% of households in non-urban areas are within a ½ mile, 4289 households in non-urban areas would be so in the future. Therefore, 36.0% of total households in the County ((16329+4289)/(39443+17795)) would be expected to be located within a ½ mile of a public elementary school.

Using a similar analysis, the number of households within a ½ mile of a public elementary school under Plan Alternatives B and C can be calculated. With 6000 new urban and 6000 new non-urban households in Plan Alternative B, 34.9% of total households in the County ((16329+5735)/(39443+23795)) would be expected to be located within a ½ mile of a public elementary school. With 6000 new urban and 12000 new non-urban households in Plan Alternative C, 34.0% of total households in the County ((16329+7181)/(39443+29795)) would be expected to be located within a ½ mile of a public elementary school.

Qualitative Analysis

Accessible childcare and schools were repeatedly raised as issues of concern to Humboldt residents in the focus groups.

Disparities

Rural populations, such as the Native American tribes, would likely not see a change in their proximity to schools.

Conclusions

A) With 6000 new households in urban areas and no new households in non-urban areas, Plan Alternative A would bring the highest proportion of new households into areas that have higher numbers of schools and areas in which more of the existing households are within a ½ mile of a public elementary school. **Therefore under Plan Alternative A the proportion of households within a ½ mile of a public elementary school would increase to 36%.** This will allow more children to engage in physical activity by walking to school and lead to less school-related driving. It will also increase the number of households that have close access to school yards for off-hours activities.

B) With 6000 new households in urban areas and 6000 new households in non-urban areas, Plan Alternative B would bring similar numbers of households into areas that currently have both high and low proximity to elementary schools. **Under Plan Alternative B the proportion of households within a ½ mile of a public elementary school would decrease slightly to 34.9%.** Slightly fewer children will walk to school and there will be more school-related driving. It will also decrease the number of households that have close access to school yards for off-hours activities.

C) With 6000 new households in urban areas and 12000 new households in non-urban areas, Plan Alternative C would bring more new households into areas that currently have fewer households near elementary schools. **Under Plan Alternative C the proportion of households within a ½ mile of a public elementary school would decrease to 34.0%.** Fewer children will walk to school and there will be more school-related driving. It will also decrease the number of households that have close access to school yards for off-hours activities.

Caveats

An increase in the number of children walking to school could lead to an increase in collisions between cars and children if the routes to school are not safe. Precautions should be taken to ensure that there are safe routes to school in all scenarios.

Recommended Health-Promoting Mitigations:

- Ensure all new large communities that are developed have a public elementary school by having developers pay a fee for the construction of a local school.

PI.3.a Proportion of population within ¼ mile of public parks

Health-Based Rationale

Both the number of neighborhood parks in proximity to one's residence and the types of amenities at the park (i.e., lighting, sports fields) predict the duration of physical activity in children. For example, each additional park within a half mile increased physical activity by 2.8%.[5] One review of studies showed that access to places for physical activity combined with outreach and education can produce a 48 percent increase in the frequency of physical activity.[6] According to the CDC, enhanced access to spaces for physical activity resulted in 25% more people exercising 3+ days per week.[7]

Evidence also shows that contact or views of the natural environment can improve functioning in children with Attention Deficit and Hyperactivity Disorder (ADHD) and problem solving and cognitive function in people living in public housing.[8 9]

Access to parks and open spaces has an impact on stress, depression, and mental functioning. People dissatisfied with their available green spaces have 2.4 times higher risk for mental health issues.[10] Parks also contribute to neighborhood social cohesion and support. Parks increase neighborly interaction and socialization.[11] Social networks and interaction have been linked to improvements in physical and mental health.

More generally, living in proximity to green space is associated with reduced self-reported health symptoms, better self-rated health, and higher scores on general health questionnaires.[12]

Existing conditions

General information: Humboldt County has many federal, state, county, and local parks and these parks are one of the reasons many people choose to live in the County. There are 7.5 sq mi public open space/1000 persons in Humboldt County. Seventeen percent of land in Humboldt is publicly owned. Of the 2,287,000 acres of land in the county, 262,000 are national forests and 15,000 are other public lands.[13]

Existing Parks: The 55 local parks, 12 County parks, 14 State Parks and Areas, 1 National Park, and 4 other park-like areas (e.g., the Arcata Community Forest) are listed in the table below.

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5 Cohen DA, Ashwood JS, Scott MM, Overton A, Evenson KR, Staten LK, Porter D, McKenzie TL, Catellier D. Public parks and physical activity among adolescent girls. Pediatrics. 2006;118(5):e1381-1389.
6 Kahn EB. The effectiveness of interventions to increase physical activity. American Journal of Preventative Medicine. 2002;22:87-88.
7 CDC. 2001. Increasing physical activity: A report on recommendations of the Task Force on Community Preventive Services. Available at http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5018a1.htm.
8 Taylor AF, Kuo FE, Sullivan WC. Coping With ADD: The Surprising Connection to Green Play Settings. Environment And Behavior. 2001;33(1) 54-77.
9 Kuo FE. Coping With Poverty Impacts of Environment and Attention in the Inner City. Environment And Behavior. 2001;33(1):5-34.
10 Guite HF, Clark C, Ackrill G. 2006. The impact of physical and urban environment on mental well-being. Public Health 120:1117-1126.
11 Sullivan WC, Kuo FE, DePooter Sf. 2004. The fruit of urban nature: Vital neighborhood spaces. Environment and Behavior 36(5):678-700.
12 Vries S, de Verheij RA, Groenewegen PP, Spreeuwenberg P. Natural environments - healthy environments? An exploratory analysis of the relationship between green space and health. Environment and Planning. 2003;35:1717-1731.
13 NW California Resource Conservation and development Council Area Plan 2008-2013.

PI.3. Parks in Humboldt County

Park Name	Address	City
Carson Park	West Carson Street and H Street	Eureka
Clara Mae Berry Park	3rd Street and O Street	Eureka
Cooper Gluch	1720 10th St.	Eureka
Hammond Park	14th Street and E Street	Eureka
Halvorsen Park	1201 Waterfront Drive	Eureka
Ross Park	12th Street and M Street	Eureka
20/30 Park	West Carson Street and Pine Street	Eureka
Jacob-Haney Ball Field	2605 Union Street	Eureka
Mrytle Grove Cemetery	Myrtle Street and Cousins Street	Eureka
Lundbar Hills Park	4708 Frederick Street	Eureka
Sequoia Park	3414 W Street	Eureka
Hartman/Kennedy Ball Fields	3555 W. Street	Eureka
Highland Park	Highland Avenue and Glen Street	Eureka
Freshwater	Freshwater Pool Road and Freshwater-Kneeland Road	Freshwater
Fort Humboldt State Historic Park	3431 Fort Avenue	Eureka
Headwaters Forest Reserve	Elk River Road and Wrigley Road	Eureka
Hiller Park	795 Hiller Road	McKinleyville
Larissa Park	Larissa Circle and Reasor Road	McKinleyville
Pierson Park	1608 Pickett Road	McKinleyville
Azalea State Reserve	Azalea Ave and N Bank Road	McKinleyville
Little River State Beach	Little River Drive and Crannell Road	Clam Beach
Arcata Ball Park	888 F Street	Arcata
Arcata Community Park	321 Community Park Way	Arcata
Redwood Park	Park Avenue and Shirley Blvd	Arcata
Arcata Plaza	801 G Street	Arcata
Arcata Skate Park	900 Sunset Blvd.	Arcata
Bayside Park	930 Old Arcata Road	Arcata
Bloomfield	1835 Zehndner Ave.	Arcata
Cahill Park	1300 Stromberg Ave	Arcata
California Park	California Avenue and Dunbar Court	Arcata
Chevret-Vaissade Park	1760 Felix Ave	Arcata
D Street Linear Park	1301 D Street	Arcata
Ennes Park	1851 Stewart Ave	Arcata
Ennes Park Expansion	Wyatt Ln and Stewart Ave	Arcata
Greenview	1116 Lewis Ct	Arcata
Larson Park	901 Grant Ave	Arcata
Mountain View Park	2117 Sandra Ct	Arcata
Pacific Union Park	Ribeiro Lane and Ribeiro Court	Arcata
Rotary Park	101 F Street	Arcata
Shay Park	1385 Foster Ave.	Arcata
Stewart Park	1090 15th Street	Arcata
Sunny Brae Park	Virginia Way and Marilyn Avenue	Arcata
Valley West Park	1340 Hallen Drive	Arcata
Vinum Park	1450 F Street	Arcata
Westwood Manor Park	2175 Wisteria Way	Arcata

Windsong Park	Maria Court and Janes Road	Arcata
Woodland Heights	Woodland Court and Diamond Drive	Arcata
Table Bluff Park	Table Bluff Road	Arcata
Mad River	150 Mad River Rd	Arcata
Arcata Community Forest	Fickle Hill Road and Fernwood Drive	Arcata
Arcata Marsh & Wildlife Sanctuary	S I Street and Marina Way	Arcata
Perigot Park	South Railroad Ave	Blue Lake
Pamplin Grove Park	State Highway 36	Carlotta
Van Duzen: Swimmers Delight	CA-36 and Redwood House Road	Carlotta
Grizzly Creek Redwoods	16949 HWY 36	Carlotta
Firemen's Park	100 Berding St	Ferndale
Russ Park	Grizzly Bluff Road and Lincoln Avenue	Ferndale
Centerville County Park & Beach	Centerville Road and Poole Road	Ferndale
Field's Landing Boat Ramp	Railroad Avenue and 3rd Street	Fields Landing
Rohner	5 Park Street	Fortuna
Newburg	S. Main Street and Newburg Street	Fortuna
Southern Humboldt Community Park	934 Sprowel Creek Road	Garberville
Tooby Memorial Park	West River Lane and Connick Creek Road	Garberville
Benbow Lake State Rec. Area	445 Lake Benbow Drive	Garberville
Richardson Grove	Oak Flat Campground Road	Garberville
Pookey's Park	Bair Rd and Loop Rd	Hoopa
Redwood National Park	Alder Camp Road and Coastal Loop Road	Klamath
Crab Park	Cannibal Island Road	Loleta
Humboldt Bay Nat. Wildlife Refuge	1020 Ranch Road	Loleta
Humboldt Redwoods	Avenue of the Giants and Pesula Road	Burlington
Prairie Creek Redwoods	US-101 and Redwood Highway	Berry Glenn
A. W. Way	Mattole Road and Miner Lane	Petrolia
Rio Dell Fireman's Park	Pacific Ave and West Center St.	Rio Dell
Samoa Boat Ramp	Jetty Road and Bunker Road	Samoa
Samoa Dunes State Rec. Area	Jetty Road and Bunker Road	Samoa
Big Lagoon	Big Lagoon Park Road and B Street	Trinidad
Clam Beach	Clam Beach Road and US-101	Trinidad
Luffenholtz Beach & County Park	Luffenholtz Road and Trinidad Scenic Drive	Trinidad
Moonstone Beach	Moonstone Beach Road and Scenic Drive	Trinidad
Harry A. Merlo St. Rec. Area	US-101 and Hammond Truck Road	Trinidad
Humboldt Lagoons	US-101 and McDonald Creek Road	Trinidad
Patrick's Point	4150 Patricks Point Drive	Trinidad
Trinidad State Beach	Stagecoach Road and Anderson Lane	Trinidad
Veterans Park	Gower Lane and Chilton Road	Willow Creek
Candy Stick Park	Camp Kimtu Road and Chilton Road	Willow Creek

The figures below show the locations of these parks.

Figure PI.3. The locations of the parks in the County. See Appendix B of the Summary for details about the mapping methods.

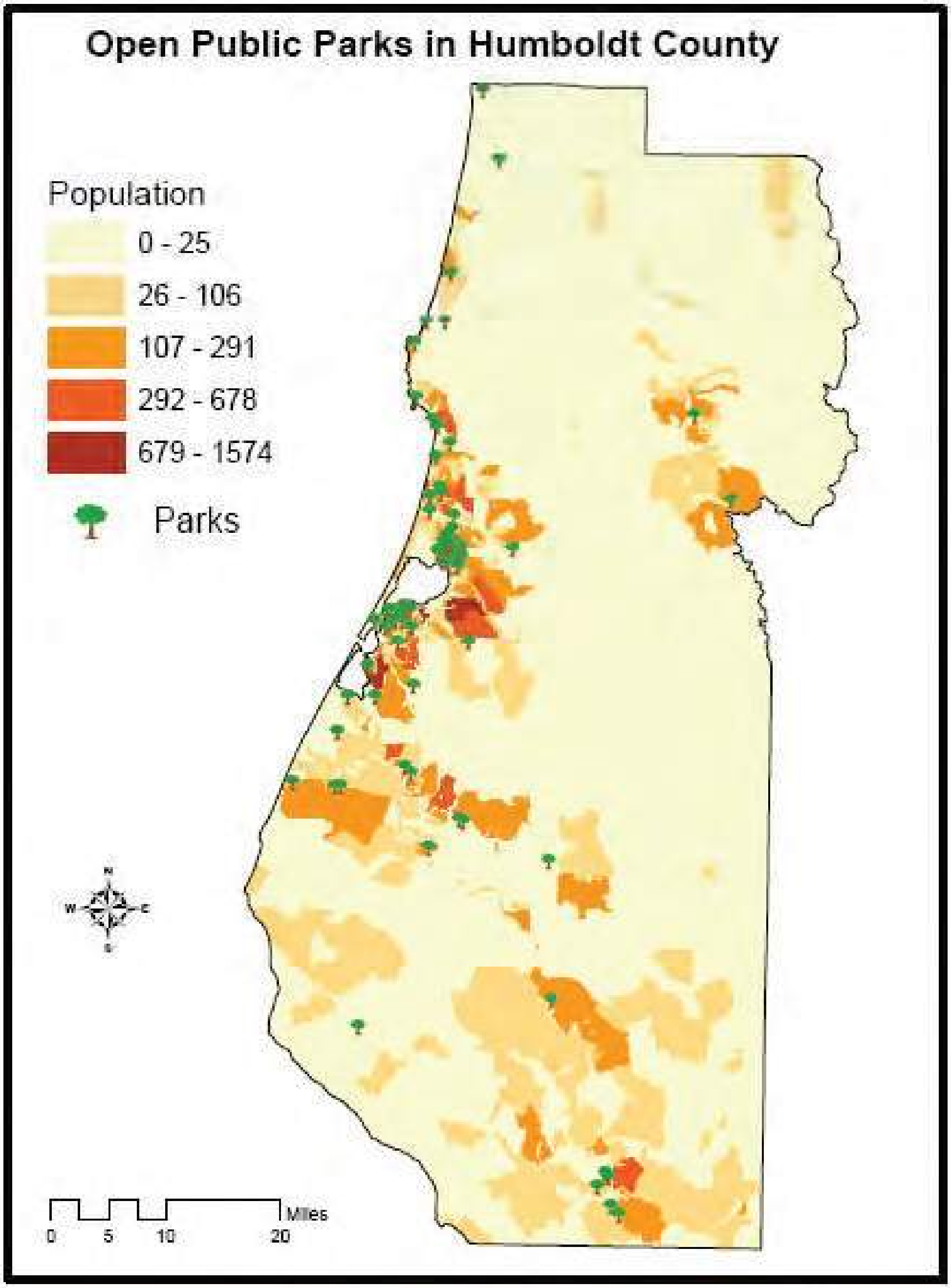
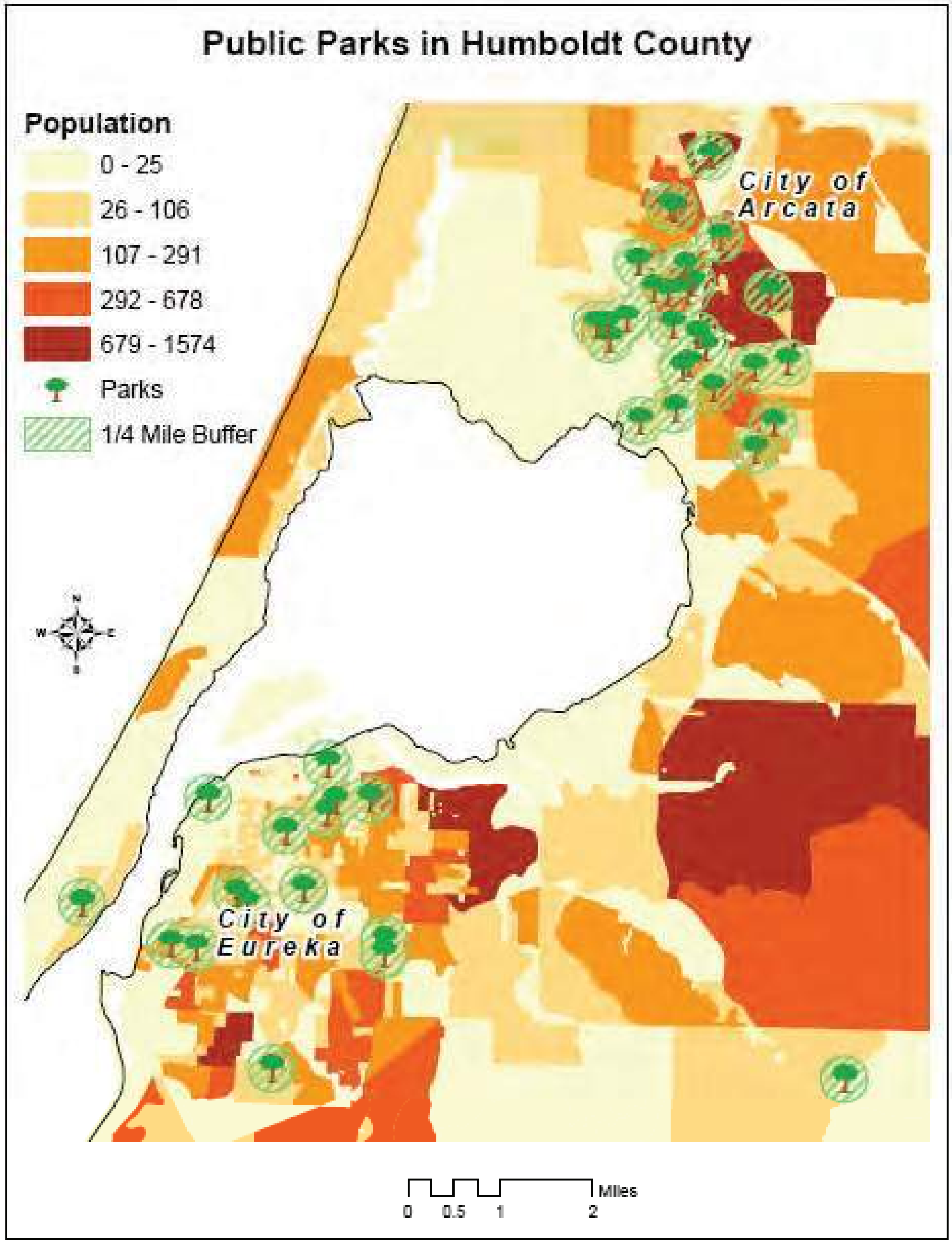


Figure PI.4. The locations of the parks in the area around Eureka and Arcata, showing a ¼ mile buffer around each school. See Appendix B of the Summary for details about the mapping methods.



Proportion of population within ¼ mile of a park: The table below summarizes current data for the proportion of the population within ¼ mile of a public park. See Appendix B of the Summary for details about the calculations.

Table PI.4. The Percent of the Population within ¼ mile of a public park	
Area	**% of population**
Humboldt County	21.0 %
Areas with urban zip codes	28.9%
Areas with non-urban zip codes	6.6%
Eureka and Arcata	33.8%

McKinleyville	9.9%

Analysis

Assumptions
- It is assumed that increasing proximity to parks would lead to more people using those parks to get exercise.
- The proportion of the population near parks in urban and non-urban areas is not expected to change; only the overall proportion of the population near parks in the County is expected to change.

Logic
- A higher percent of people in urban areas are currently within a ¼ mile of a park than in non-urban areas currently. Therefore, building housing in urban areas will likely lead to more people being within a ¼ mile of a park in the future.

Quantitative Analysis
Of the 126,518 people in County, 81734 are located in urban areas (based on the zipcode classification described in the summary introduction) and 44784 are in non-urban areas.

Under Plan Alternative A, 14,400 new people would live in the new housing that would be built in urban areas. Therefore, there would be 96134 urban people and the number of non-urban people would remain the same (44784). Since 28.9% of people in urban areas are currently within a ¼ mile of a park and it was assumed that this would not change, 27783 (28.9% of 96134) people in urban areas would be near parks. Similarly, since 6.6% of people in non-urban areas are within a ¼ mile, 2956 people in non-urban areas would be so in the future. Therefore, 21.8% of the total population in the County ((27783+2956)/(96134+44784)) would be expected to be located within a ¼ mile of a public park.

Using a similar analysis, the number of people within a ¼ mile of a park under Plan Alternatives B and C can be calculated. With 14,400 new urban and 14,400 new non-urban people in Plan Alternative B, 20.4% of total population in the County ((27783+3906)/(96134+59184)) would be expected to be located within a ¼ mile of a park. With 14,400 new urban and 28,800 new non-urban people in Plan Alternative C, 19.2% of the total population in the County ((27783+4857)/(96134+73584)) would be expected to be located within a ¼ mile of a park.

Qualitative Analysis
In the Humboldt General Plan Update survey, 86.4% of respondents said that the surrounding natural environment was extremely important to the quality of life in Humboldt County and 85.1% said that quality of the natural environment was a major factoring why they decided to live in the county.[14] People want to retain outdoor space & feel, so ensuring parks are available is important. Preserving the rural nature of the County was important to residents. Publicly accessible parks (not just urban parks) were recognized for their importance to the economy (tourism and others), physical activity, and mental health.

[14] http://co.humboldt.ca.us/planning/gp/survey/results.htm.

Disparities

People without access to cars (the poor, seniors, children) need to be able to access parks by walking or biking. As shown in the map of the area around Eureka and Arcata below, areas with lower incomes often have less access to parks.[15]

Figure PI.5. A map that correlates youth in poverty with locations of parks in the Arcata and Eureka area.

15 http://www.stewardshipcouncil.org/youth_investment/gis_maps/Loc-Eureka_youth-povdot_22x34.pdf.


Public Land Access
Public Park *
Area within 500m of Public Park
Golf Course
Other Public Open Space
Major Land Uses
Includes various Institutional, Commercial, and Industrial Land Uses and Complexes
Arcata
Humboldt State University
Mad River Slough Wildlife Area
Arcata Marsh & Wildlife Sanctuary
Manila
Arcata Bay
Samoa
Humboldt Bay National Wildlife Refuge
Fay Slough Wildlife Area
Murray Field Airport
Myrtletowne
Fairhaven
Eureka Municipal Airport
Samoa Dunes Recreation Area
Humboldt Bay
Eureka
Elk River Wildlife Area
Youth Living in Poverty
Numbers of Youth under 18 years per Census Block Group
No Youth in Poverty
1 - 50
51 - 100
101 - 200
201 - 350
351 - 500
501 - 1885
Youth Population = 0
Stewardship Council
Youth Investment Program
EDAW
Eureka
Youth Living in Poverty

Conclusions

A) With 14,400 new people in urban areas and no new people in non-urban areas, Plan Alternative A would bring the highest proportion of new people into areas that have higher numbers of parks and areas in which more of the existing population is within a ¼ mile of a park. **The proportion of the population within 0.25 miles of a park would *increase* to 21.8%, allowing more people to engage in physical activity at those parks and allowing more people to enjoy other health benefits from being near them (e.g., mental health).**

B) With 14,400 new people in urban areas and 14,400 new people in non-urban areas, Plan Alternative B would change the proportion of people living near parks least. **The proportion of the population within 0.25 miles of a park would *decrease* to 20.4%, allowing fewer people to engage in physical activity at those parks and allowing fewer people to enjoy other health benefits from being near them (e.g., mental health).**

C) With 14,400 new people in urban areas and 28,800 new people in non-urban areas, Plan Alternative C would bring more new people into areas of the County that are farther from parks. **The proportion of the population within 0.25 miles of a park would *decrease* to 19.2%, allowing fewer people to engage in physical activity at those parks and allowing fewer people to enjoy other health benefits from being near them (e.g., mental health).**

Recommended Health-Promoting Mitigations:

- Enact a Humboldt County discount for national, state, and county parks.
- Ensure schoolyards are available in off hours for community use.
- Build new parks in new developments.
- Ensure funding for parks is maintained.
- Ensure that forests, parks and wetlands in the County are not being converted to other uses.
- Increase funding and protection for national, state, and county parks to draw residents to them.

PI.5.a Percentage of seniors within a ½ mile of senior center

Health-Based Rationale
The National Council on Aging's definition of senior center is "a community focal point on aging where older persons as in individuals or in groups come together for services and activities that enhance their dignity, support their independence and encourage their involvement in and with the community."[16]

The types of programs that are available in senior centers include: health and wellness programs, transportation services, arts and humanities programs, volunteer opportunities, meal programs, educational opportunities, employment assistance, financial assistance, recreation assistance, intergenerational programs, information, referral, and counseling, social and community action opportunities.[17] Seniors participate to use all these programs, but recreational activities, socializing and healthy meals are cited as the most important activities.[18] [19] [20]

Senior centers can provide a social environment and help seniors develop a social support system. This can reduce loneliness and depression, and enhance life satisfaction. One study, showed that more than 90% of respondents participating in senior center activities felt that their health was the same or better compared to a year earlier. Over 75% of respondents felt that the center helped them remain independent. Statistically significant correlations were found between attending health promotion programs and practicing healthy behavior; hours spent at the center and possessing a healthy mental outlook; and hours spent at the center and practicing healthy behavior.[21] Another study found that 80% of respondents felt they benefited from opportunities to make friends and from opportunities to have a healthy meal. A majority of respondents also felt that the senior center was important in making them feel like a part of a group, having fun, improving their quality of life, maintaining new friendships, feeling more relaxed, providing a place to go each day, and improving their physical health.[22]

Specific health programs available at senior centers have also been shown to have benefits including increasing healthy behavior and subsequent health knowledge[23], decreasing depression, increased physical activity[24] and increasing physical functioning.[25]

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[16] National Council on the Aging. (1979) Senior Center Standards: Guidelines for Practice. Washington, DC.
[17] Wagner, DL. (1995). Senior Center Research in America: An Overview of What We Know. The National Council on the Aging, Inc.
[18] Jirovec, RL, JA Erich, & LJ Sanders. (1989). Patterns of Senior Center Participation Among Low Income Urban Elderly. Journal of Gerontological Social Work, 13. (3/4), 115-132.
[19] Gelfand, D, W Bechill, & R Chester. (1991). Journal of Gerontological Social Work, 17. (1/2), 145-161.
[20] Sabin, EP. (1993). Frequency of Senior Center Use: A Preliminary Test of Two Models of Senior Center Participation. Journal of Gerontological Social Work, 20. (1/2), 97-114.
[21] Aday, RH. (2003). Identifying Important Linkages Between Successful Aging and Senior Participation. National Council on Aging/American Society on Aging.
[22] Gitelson, R, J McCabe, T Fitzpatrick, A Case. (2003). Measuring the benefits of Senior/Adult Centers. 2003 NCOA/ASA Workshop on Senior Centers, Arizona State University West.
[23] Campbell, J and R Aday. (2001). Benefits of a Nurse-Managed Wellness Program: A Senior Center Model. Healthy People. 34-43.
[24] Phelan, EA, B Williams, S Leveille, S Snyder, EH Wagner, & JP LoGerfo. (2002). Outcomes of a Community-Based Dissemination of the Health Enhancement Program. Journal of the American Geriatrics Society, 50. 1519-1524.
[25] Wallace, JI, DM Buchner, L Grothaus, S Leveille, L Tyll, AA LaCroix, & EH Wagner. (1998). Implementation and Effectiveness of a Community-Based Health Promotion Program for Older Adults. Journal of Gerontology, 53A. (4), 301-306.

Proximity of seniors to a senior center is believed to play an important role in the decision making regarding whether to participate and how frequently to participate.[26]

Existing conditions

Number of Seniors: According to the census, there were 18524 people over 62 in Humboldt County in 2000. This represents about 14.6% of the population.

Existing Senior Centers: Twenty facilities with a range of services for seniors, from a place to share a meal to more comprehensive services, operate within the County. Some of these services are open to the public and others are only open to those living in specific communities.[27] The table below lists these facilities and their locations.

Table PI.5 Senior Centers

Senior Center Name	Address	City
Arcata Lunch Site - HSRC	321 Community Parkway	Arcata
Blue Lake Rancheria	428 Chartin Road	Blue Lake
Bridgeville Community Center	38717 Kneeland Road	Bridgeville
Ferndale Senior Resource Agency	509 Coppini Lane	Ferndale
Fortuna Senior Services, Inc	1800 Riverwalk Drive	Fortuna
Fortuna Lunch Site - HSRC	2130 Smith Lane	Fortuna
Fortuna Adult Day Services - HSRC	2280 Newburg Road	Fortuna
Mattole Valley Community Center	29230 Mattole Rd	Petrolia
Rio Dell Senior Services	325 Second Avenue	Rio Dell
Humboldt Sr Resource Ctr	1910 California St	Eureka
Alder Bay Retirement Community	1355 Myrtle Ave	Eureka
Silvercrest	2141 Tydd St	Eureka
SunBridge Care & Rehab	2353 23rd St	Eureka
Timber Ridge	2740 Timber Ridge Lane	Eureka
McKinleyville Senior Resource Ctr	1620 Pickett	McKinleyville
Timber Ridge at McKinleyville	1400 Nursery Way	McKinleyville
Sequoia Springs	2401 Redwood Way	Fortuna
St. Lukes Manor	2321 Newberg Road	Fortuna
Southern Humboldt Senior Care, Inc.	470 Maple St	Garberville
Healy Senior Center	456 Briceland Road	Redway

[26] Miltiades, HB, SA Grove, and C Drenovsky. Understanding The Impact Of Senior Community Center Participation On Elders' Health And Well-Being: An Analysis Of York And Clearfield Counties. Downloaded from www.aging.state.pa.us/aging/lib/aging/SeniorCenterstudy.pdf on 1/31/08.

[27] Personal communication from Area 1 Agency on Aging. http://www.a1aa.org/.

The figures below show the locations of these senior centers.

Figure PI.6. The locations of the senior centers in Humboldt. See Appendix B of the Summary for details about the mapping methods.

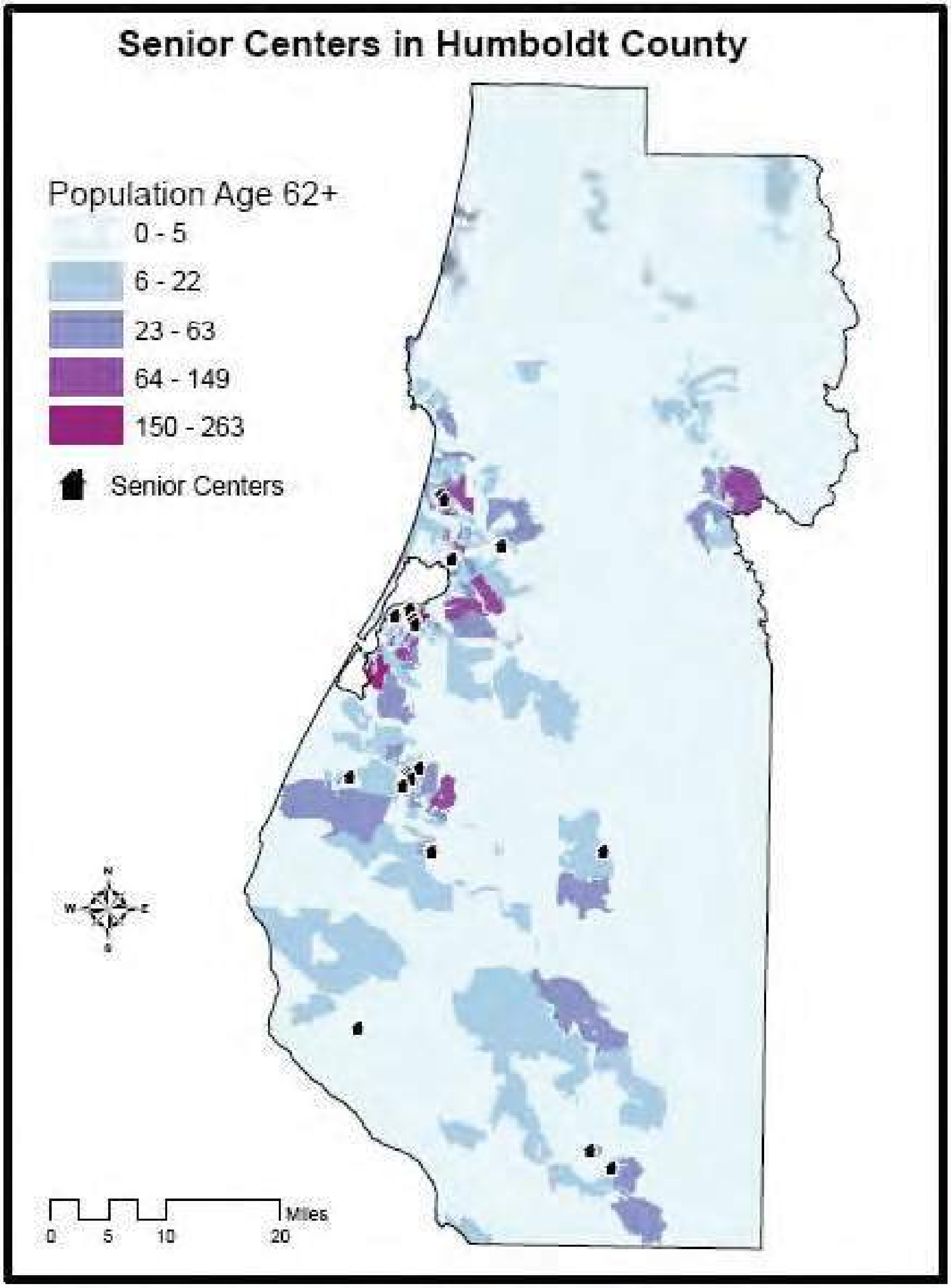
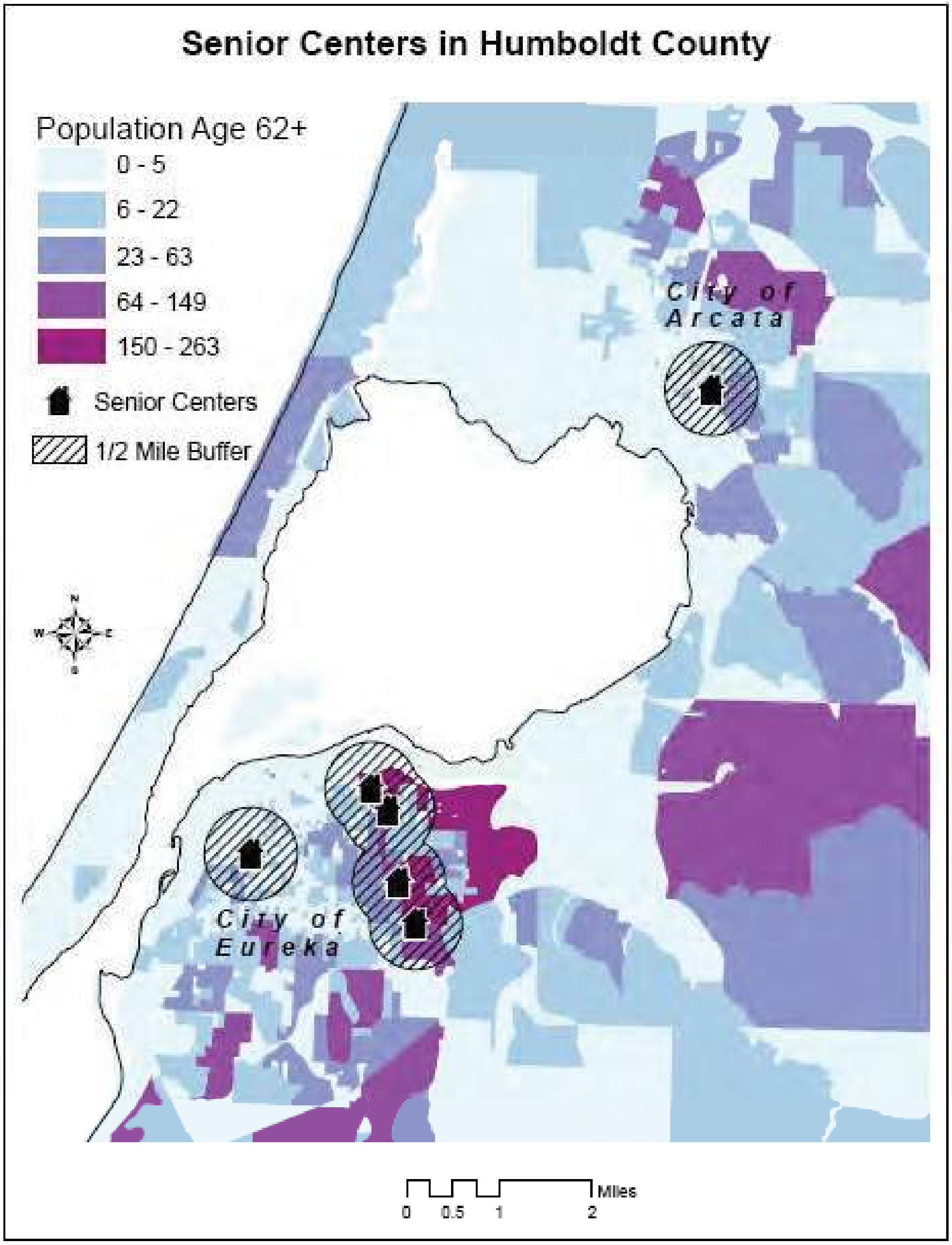


Figure PI.7. The locations of the senior centers in the area around Eureka and Arcata, showing a ½ mile buffer around each senior center. See Appendix B of the Summary for details about the mapping methods.



Proportion of seniors within a ½ mile of a senior center: The table below summarizes current data for the proportion of the seniors within ½ mile of a senior center:

Table PI.6. Percent of Seniors within 0.5 miles of a senior center

Area	% of seniors
Humboldt County	21.4 %
Areas with urban zip codes	24.7%
Areas with non-urban zip codes	14.9%
Eureka and Arcata	24.5%

McKinleyville	21.5%

Analysis

Assumptions

- According to the Humboldt Planning Department, the senior population is expected to more than double to over 35,000 by 2025 and this will represent 24.1% of the population. Population growth, and therefore the number of seniors in the county, varies between the scenarios. To reach 24.1% of the population from its current 14.6%, the existing population will age AND many of the new residents of the County will have to be seniors. For this analysis, it is assumed that 24.1% of the total population in each Plan Alternative is seniors and that half the increase will come from aging and half from new seniors moving to the County.
- This analysis also assumes that current aging population does not move as they get older and that as seniors move to the County they choose to live equally where development is occurring.

Logic

- A higher percent of seniors in urban areas are currently within a ½ mile of a senior center than in non-urban areas currently. Therefore, building housing in urban areas will likely lead to more seniors being within a ½ mile of a senior center in the future.

Quantitative Analysis

Of the 18,524 seniors in County, 12,393 (67%) are located in urban areas (based on the zipcode classification described in the summary introduction) and 6131 (33%) are in non-urban areas.

Under Plan Alternative A, the total population in the County would be the existing population (126,518) plus the new population (14,400), which is 140,918. The new senior population would be 24.1% of the total population, or 33,961 people. There are 18,524 seniors currently, so 15,438 of these seniors would be new. It was assumed that half of that increase (7719) would come from the current population aging in place, and the other half would be new seniors coming to the County. Therefore, the new senior population in urban areas would be the sum of the existing senior population in urban areas (123,393) plus 67% of half of the 7719 seniors aging in place plus the 7719 seniors coming to the County (all of these seniors would move to urban areas in this scenario, since that is where the new housing would be built). This means that 25,284 seniors would live in urban areas. In non-urban areas, there would be the 8678 seniors, which is the sum of the existing seniors (6131) and 33% of the 7719 seniors aging in place. Of the urban seniors, 24.7% or 6245 would be within a ½ mile of a senior center. Of the non-urban seniors, 14.9% (1293) would be within this distance. In total, 22.2% ((6245 + 1293)/(33,961)) would be within a ½ a mile of a senior center.

Using a similar analysis, the number of seniors within a ½ mile of a senior center under Plan Alternatives B and C can be calculated. With 14,400 new urban and 14,400 new non-urban people in Plan Alternative B, 21.0% of total seniors in the County ((0.247*(12,393+0.67*9454+0.5*9454)+ 0.149*(6131 + 0.33*9454 + 0.5*9454)) / 0.241*(126,518+28,800)) would be expected to be located within a ½ mile of a senior center. With 14,400 new urban and 28,800 new non-urban people in Plan Alternative C, 20.6% of total seniors in the County ((0.247*(12,393+0.67*11189+0.33*11189)+ 0.149*(6131 + 0.33*11189 + 0.67*11189)) / 0.241*(126,518+43,200)) would be expected to be located within a ½ mile of a senior center.

Qualitative Analysis

The growing senior population was raised numerous times in focus group discussions and is clearly an important issue for current Humboldt residents. The accessibility, affordability and quality of elder care came up several times, as did the impacts of elder care on the care-givers. The growing population of seniors was considered to be one of the most important issues that the General Plan update could address.

Disparities

Some populations of seniors may be less likely to participate in senior services and centers and may prefer to rely on family for support.

Conclusions

A) With 14,400 new people in urban areas and no new people in non-urban areas, Plan Alternative A would bring the highest proportion of new seniors into areas that have higher numbers of senior centers and areas in which more of the existing seniors are within a ½ mile of a senior center. **The proportion of seniors within 0.5 miles of a senior center would *increase* to 22.2%, allowing more seniors to engage in the services available and allowing more of them to enjoy the social networks facilitated by those centers.**

B) With 14,400 new people in urban areas and 14,400 new people in non-urban areas, Plan Alternative B would change the proportion of seniors living near senior centers least. **The proportion of seniors within 0.5 miles of a senior center would *decrease* to 21.0%, allowing fewer seniors to engage in the services available and allowing fewer of them to enjoy the social networks facilitated by those centers.**

C) With 14,400 new people in urban areas and 28,800 new people in non-urban areas, Plan Alternative C would bring more new seniors into areas of the County that are farther from senior centers. **The proportion of seniors within 0.5 miles of a senior center would *decrease* to 20.6%, allowing fewer seniors to engage in the services available and allowing fewer of them to enjoy the social networks facilitated by those centers.**

Recommended Health Promoting Mitigations:

- Increase awareness about existing senior centers.
- Increase funding for senior centers.
- Create additional services for seniors.
- Increase transportation services for seniors.

PI.4.d Percentage of population within 2 miles of a medical center

Health-Based Rationale

The use of primary care and preventative health care services is dependent on a number of factors including physical access to health facilities, transportation, and health insurance status. The timely use of primary care has a role in preventing morbidity and hospitalizations from a number of chronic diseases, including asthma and diabetes. Research has specifically found that Federally Qualified Health Centers in medically underserved areas can lower preventable hospitalization rates.[28]

Given that many patients miss appointments at health clinics due to transportation problems[29], better proximity to health care could improve access. A 10 mile travel distance or 30 minute travel time from home to health care services is specified in Medi-Cal regulations[30], but even this standard can make it nearly impossible for car-less households to get prompt access to healthcare.

Existing conditions

Medical Facilities: There are 152 medical facilities in Humboldt County, including private practices, hospitals, institutional medical facilities (e.g., at the Humboldt State University), community clinics, women's health clinics, an asthma clinic, and providers of health services for children, veterans, those with developmental disabilities. Of these, 47 are non-private practice facilities with distinct addresses. That list of 47 facilities was used for the calculations for this indicator.

[28] Epstein AJ. The role of public clinics in preventable hospitalizations among vulnerable populations. Health Serv Res. 2001;36(2):405-20.

[29] Butrick E. 1999. Factors in nonattendance in extended evening clinics in Contra Costa County. Unpublished paper for Contra Costa Health Services.

[30] California Code of Regulations, Title 22, Section 53885, "Travel Distance Standards."

Table PI.7 Non-private Practice Medical Facilities in Humboldt County with Distinct Addresses

Medical Practice Name	Address	City
Mobile Medical Office	1522 Third Street	Eureka
North Coast Womens Health	1930 Myrtle Avenue	Eureka
St. Joseph Hospital Urgent Care	2200 Harrison Avenue	Eureka
Eureka Internal Medicine	2280 Harrison Ave, Suite B	Eureka
Six Rivers Planned Parenthood	2316 Harrison Avenue	Eureka
Redwood Family Practice	2350 Buhne Street, Suite A	Eureka
Skilled Healthcare, LLC	2355 23rd Street	Eureka
Eureka Community Health Center	2412 Buhne Street	Eureka
Eureka Allergy and Asthma Care Specialists	2504 Harrison Avenue, Ste A	Eureka
St Joseph Hospital	2700 Dolbeer Street	Eureka
Redwood Coast Regional Center	525 2nd Street #300	Eureka
Eureka Veterans Clinic	714 F Street	Eureka
Eureka Veterans Mental Health	714 F Street	Eureka
Humboldt County Correctional Facility	826 4th Street	Eureka
Health Care Medical Associates	2607 Harris Street, Ste B	Eureka
Eureka Family Practice	2675 Harris Street	Eureka
Center For Womens Health Care	2773 Harris St. #A	Eureka
Eureka Pediatrics	2800 Harris St.	Eureka
Humboldt County Mental Health 1	720 Wood Street	Eureka
US Coast Guard Air Station	1001 Lycoming Ave	McKinleyville
McKinleyville Community Health Center Pediatrics	1644 Central Avenue, Ste A	McKinleyville
Mc Kinleyville Community Health Center	1644 Central Avenue, Suite F	McKinleyville
Humboldt Family Medical Care	1733 Central Avenue	McKinleyville
Mc Kinleyville Family Practice Med Clinic	1735 Central Ave	McKinleyville
Eureka OB-GYN Associates	2192 Central Ave, Suite B	McKinleyville
Eureka Pediatrics	2192 Central Avenue #A	McKinleyville
Humboldt State University	1 Harpst Street	Arcata
United Indian Health Services	1600 Weeot Way	Arcata
Mad River Hospital	3800 Janes Road	Arcata
Humboldt Open Door Clinic	770 10th St.	Arcata
North Country Clinic	785 18th St.	Arcata
Six Rivers Emergency Physicians	3800 Janes Road	Arcata
Redwood Memorial Hosp ER	3300 Renner Dr	Fortuna
Redwood Internal Medicine	3304 Renner Dr.	Fortuna
Redwood Pediatrics	3305 Renner Dr	Fortuna
Redwood Women's Health Center	3307 Renner Drive	Fortuna
UIHS - Fortuna Health Center	940 Main Street	Fortuna
Southern Humboldt Community Clinic	509 Elm Street	Garberville
K'IMA:W Medical Center	1200 Airport Road	Hoopa
Southern Trinity Health Services	153-A W Van Duzen Road	Mad River
Orick Community Health Center	120918 HIGHWAY 101	Orick
Karuk Tribal Health Clinic of Orleans	93051 Highway 96	Orleans
Redwood Rural Health Center	101 West Coast Road	Redway
Eel Valley Rural Health Clinic	129 E. Wildwood Ave	Rio Dell
Scotia Medical Clinic	500 B Street	Scotia
Willow Creek Family Health Center	38883 Highway 299	Willow Creek
Six Rivers Medical Clinic	850 State Highway 96	Willow Creek

The figures below show the locations of these medical facilities.

Figure PI.8. The locations of the medical facilities in Humboldt. See Appendix B of the Summary for details about the mapping methods.

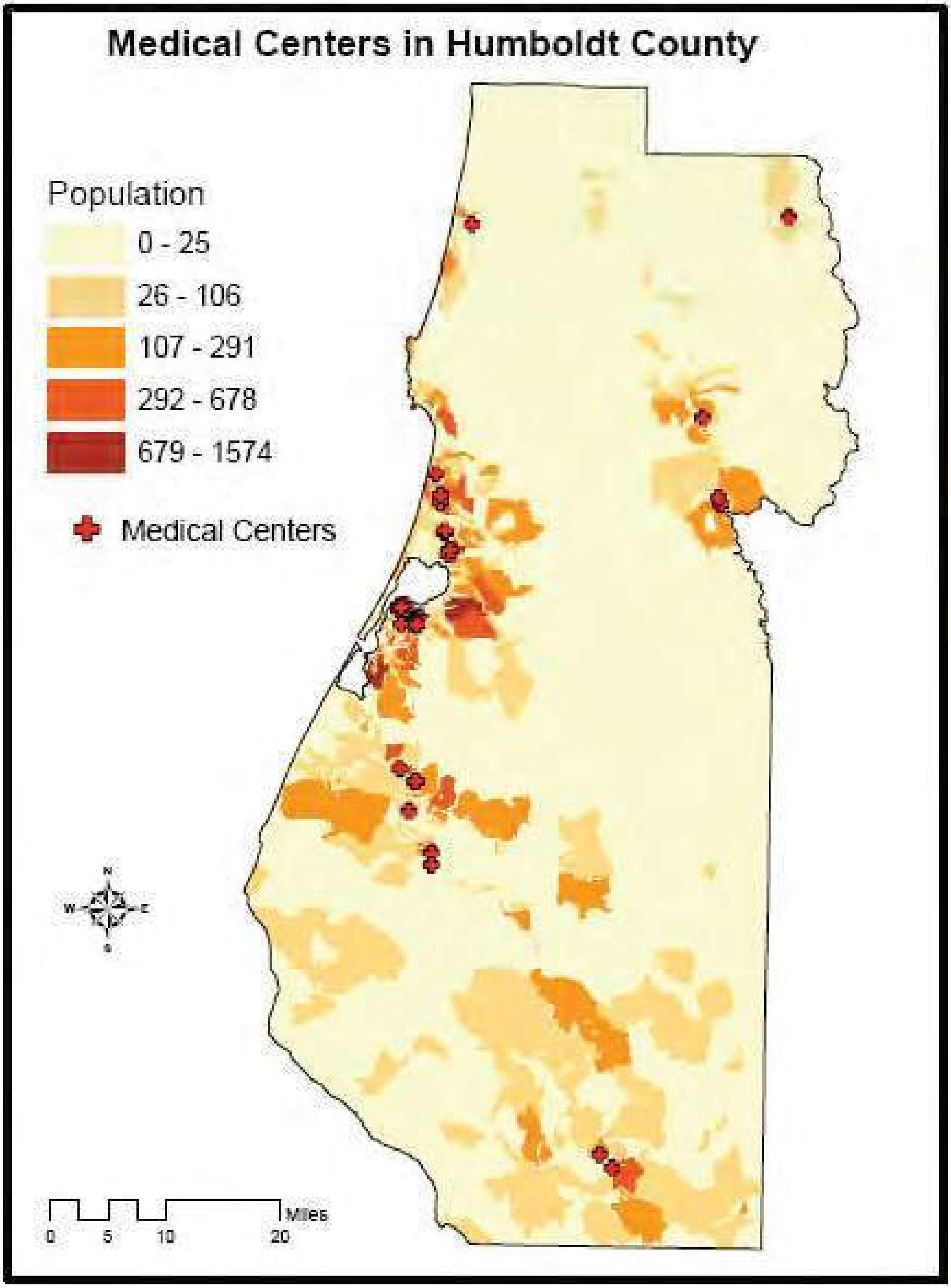
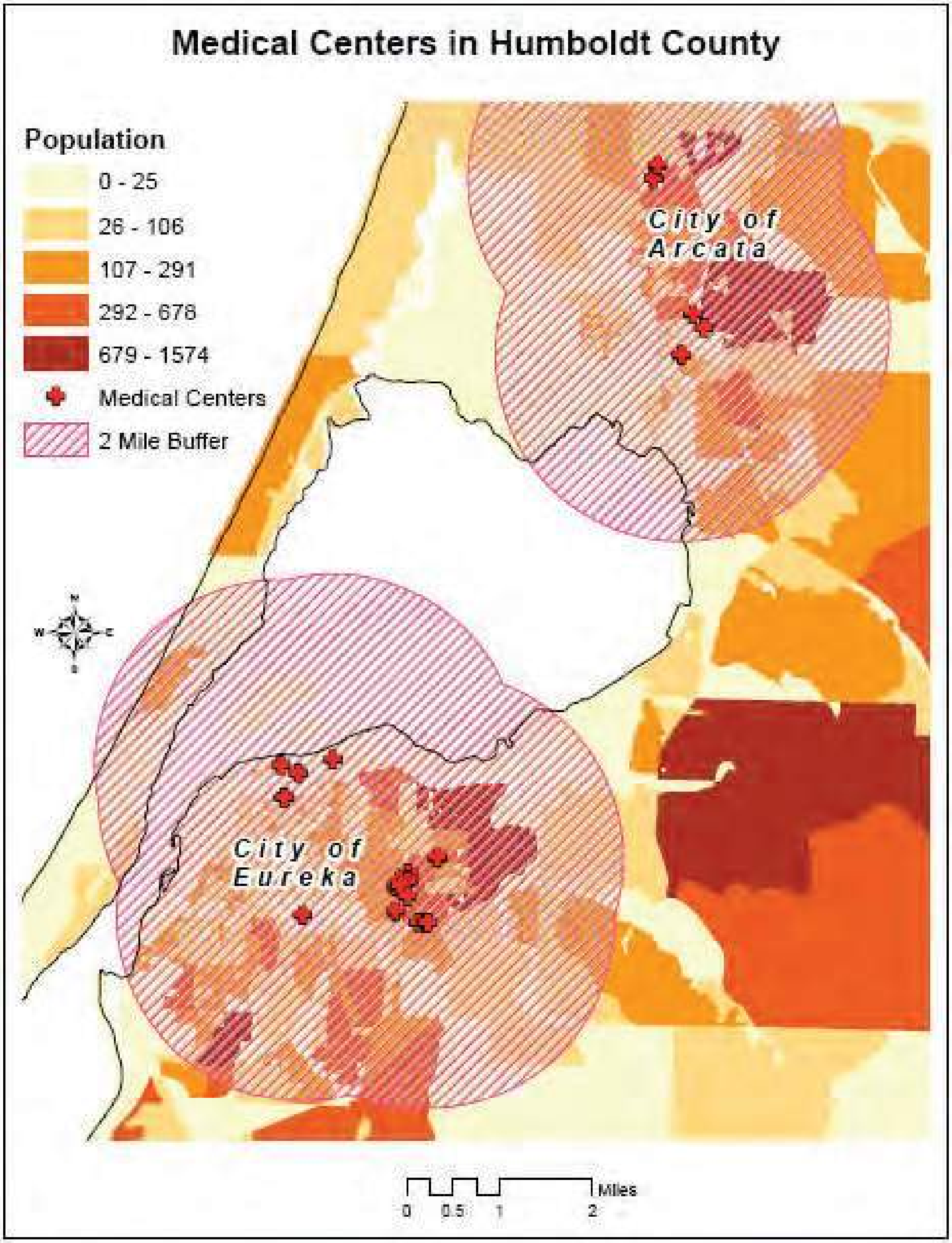


Figure PI.9. The locations of the medical facilities in the area around Eureka and Arcata, showing a 2 mile buffer around each facility. See Appendix B of the Summary for details about the mapping methods.



Proportion of seniors within 2 miles of a medical facility: The table below summarizes current data for the proportion of the population within 2 miles of a medical center:

PI.8. Percent of population within 2 miles of a non-private practice medical facility	
Area	**% of population**
Humboldt County	72.2 %
Areas with urban zip codes	82.6%
Areas with non-urban zip codes	53.5%
Eureka and Arcata	83.2%
McKinleyville	85.4%

Analysis

Assumptions

- The proportion of the population near medical facilities in urban and non-urban areas is not expected to change; only the overall proportion of the population near medical facilities in the County is expected to change.

Logic

- A higher percent of people in urban areas are currently within 2 miles of a medical facility than in non-urban areas currently. Therefore, building housing in urban areas will likely lead to more people being within 2 miles of a medical facility in the future.

Quantitative Analysis

Of the 126,518 people in County, 81734 are located in urban areas (based on the zipcode classification described in the summary introduction) and 44784 are in non-urban areas.

Under Plan Alternative A, 14,400 new people would live in the new housing that would be built in urban areas. Therefore, there would be 96134 urban people and the number of non-urban people would remain the same (44,784). Since 82.6% of people in urban areas are currently within 2 miles of a medical facility and it was assumed that this would not change, 79,407 (82.6% of 96134) people in urban areas would be near medical facilities. Similarly, since 53.5% of people in non-urban areas are within 2 miles, 23,959 people in non-urban areas would be so in the future. Therefore, 73.4% of the total population in the County ((79407+23959)/(96134+44784)) would be expected to be located within 2 miles of a non-private practice medical facility.

Using a similar analysis, the number of people within 2 miles of a medical facility under Plan Alternatives B and C can be calculated. With 14,400 new urban and 14,400 new non-urban people in Plan Alternative B, 71.7% of total population in the County ((79407+32000)/(96134+59184)) would be expected to be located within 2 miles of a non-private practice medical facility. With 14,400 new urban and 28,800 new non-urban people in Plan Alternative C, 70.0% of the total population in the County ((79407+39367)/(96134+73584)) would be expected to be located within 2 miles of a non-private practice medical facility.

Disparities

In some cities and counties in California, areas with minority populations have access to fewer hospitals and medical services. The analysis carried out here did not investigate whether this is true in Humboldt County. This question should be investigated further in the future.

Conclusions

D) With 14,400 new people in urban areas and no new people in non-urban areas, Plan Alternative A would bring the highest proportion of new people into areas that have higher numbers of medical facilities and areas in which more of the existing population is within 2 miles of a medical facility. **The proportion of the population within 2 miles of a non-private practice medical facility would *increase* to 73.4%, making it easier for more people to access medical services and to get timely medical care.**

E) With 14,400 new people in urban areas and 14,400 new people in non-urban areas, Plan Alternative B would change the proportion of people living near medical facilities least. **The proportion of the population within 2 miles of a non-private practice medical facility would *decrease* to 71.7%, increasing the difficulty some people will have accessing medical services to get treatment.**

F) With 14,400 new people in urban areas and 28,800 new people in non-urban areas, Plan Alternative C would bring more new people into areas of the County that are farther from medical services. **The proportion of the population within 2 miles of a non-private practice medical facility would *decrease* to 70.0%, making it more difficult for more people to access medical services and to get timely medical care.**

Caveats

The availability of health insurance could be another important factor regarding access to healthcare services by Humboldt County residents. This analysis did not research the impact of insurance on access.

Alternative Health-Promoting Mitigations:

- Increase awareness of transportation options available for people to access medical facilities.
- Increase transportation available to bring people to medical facilities.

PI.1.d Proportion of zip-codes without childcare facilities

Health-Based Rationale

Today, the majority of U.S. children live in families in which all parents work.[31] Access to childcare is essential for working parents to maintain employment and/or education. Accessible high-quality childcare provides children with valuable opportunities for cognitive, behavioral and educational development, and results in positive physical health outcomes.[32] [33] [34] [35]

While the availability of childcare facilities is dependent on market demand, parents are more likely to use childcare if it is available to them. The accessibility of childcare to working parents depends on many factors besides its supply and demand. In order to be practical for families, childcare facilities must be in close proximity to their homes and/or workplaces and have sufficient capacity to meet demand. For low-income families, the costs of childcare can consume a major portion of income, leaving less money for food, housing and other essentials. According to a survey of employees in Humboldt County, 58 percent reported that they experienced problems in arranging for childcare, some of which include:

- Friends or relatives unavailable
- Lack of flexible hours or drop in care
- Lack of substitute care when provider is sick
- Lack of care during the summer
- A shortage of available child care
- Lack of before-and after-school care and weekend care
- Lack of infant care
- Lack of transportation.[36]

Existing Conditions

Demand for Childcare: One in five labor force participants in Humboldt County is a parent living in a household in which all parents work.[37] In 2003, there were over 13,000 Humboldt County children between the ages of 0 and 12 with all parents in the labor force.[38]

"Rural" Humboldt County parents make up over half the total parents in the county, so there may be a greater demand for childcare in non-urban areas than in urban areas.[39]

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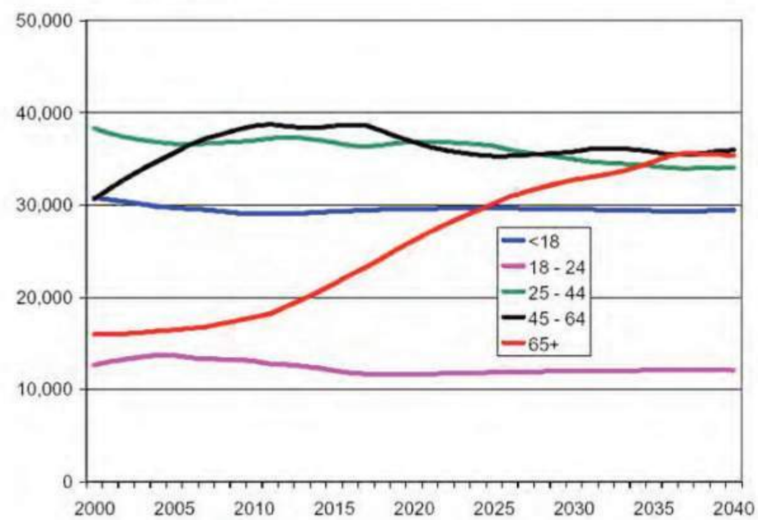
[31] National Economic Development and Law Center, 2004. The Economic Impact of the Child Care Industry in Humboldt County.
[32] Karoly LA. Early Childhood Interventions: Proven Results, Future Promise. RAND Corporation, 2005.
[33] Schweinhart LJ. The High / Scope Perry Preschool Study Through Age 40. The High Scope Press, 2004.
[34] Campbell FA, Pungello E. 2000. High quality child care has long-term benefits for poor children. Paper presented at the 5th Head Start National Research Conference, Washington DC. June 28-July 1, 2000.
[35] Anderson LM, Shinn C, St. Charles J. 2002. Community interventions to promote healthy social environments: Early childhood development and family housing. A report on Recommendations of the Task Force on Community Preventive Services. Morbidity and Mortality Weekly Review 51:1-8.
[36] Humboldt County Office of Education. Local Child Care Planning Council of Humboldt County, May 2005. Child Care Needs Assessment.
[37] National Economic Development and Law Center, 2004. The Economic Impact of the Child Care Industry in Humboldt County.
[38] Humboldt County Office of Education. Local Child Care Planning Council of Humboldt County, May 2005. Child Care Needs Assessment.
[39] Humboldt County Office of Education. Local Child Care Planning Council of Humboldt County, May 2005. Child Care Needs Assessment.

As shown on the Figure PI.10 below, between 2000 and 2040, there is a slight decline in projected population growth for youth under the age of 18. Thus, demand for childcare is not expected to increase in the county overall.

Figure PI.10. Projected Humboldt County Population by Age Group 2000-2004.[40]



Supply of Childcare: As of 2004, the childcare industry in Humboldt County, including licensed childcare centers, licensed family childcare homes, Head Start and Early Head Start programs, license-exempt before-and after-school programs, and programs funded by the California Department of Education had the capacity to serve just 5,000 children at any one time.[41] Comparing this capacity to the population of children under age 12 with both parents in the workforce, the formal childcare industry has the capacity to serve only 38 percent of these working families. While not all working families utilize formal childcare arrangements (for example, families may keep one parent home with children, or place children with family, friends or neighbors), this information indicates that there is a significant demand for childcare in Humboldt County.

There are approximately 274 formal child care facilities in Humboldt County, including:

- 159 licensed family child care homes
- 26 licensed child care centers
- 21 Head Start and Early Head Start Programs
- 30 child development programs funded by the California Department of Education
- 38 license-exempt before- and after-school programs.[42]

The table below details the numbers of children and childcare services available by area in the County.

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[40] Provided by Michael Richardson, Department of Community Development Services, Humboldt County.
[41] Humboldt County Office of Education. Local Child Care Planning Council of Humboldt County, May 2005. Child Care Needs Assessment.
[42] Humboldt County Office of Education. Local Child Care Planning Council of Humboldt County, May 2005. Child Care Needs Assessment.

Table PI.9. Number of children 0-14 years and capacity of licensed childcare[43 44]

Cities (by zipcode)	Total Population 0-14 years (2000)	2004 Total Licensed Childcare Center Capacity	2004 Licensed Family Childcare Homes Capacity	
Humboldt County	22,200		Full time	Part time
Northern		1,193	114	134
95519 Fieldbrook & McKinleyville	3,372	321	46	87
05521 Arcata & Manila	2,536	568	59	111
95524 Bayside	292	56	8	5
95525 Blue Lake	278	60	0	7
95530 Crannell				
95546 Hoopa & Weitchpec	945	74		
95550 Korbel & Maple Creek	42			
95555 Orick	108	15		
95556 Orleans	127	15	1	14
95564 Fairhaven & Samoa	89			
95570 Moonstone Beach, Trinidad & Westhaven	314	64		
95573 Willow Creek	280	20	0	0
Central		1,644	259	356
95501 Eureka – N	4,218	720	136	208
95502	34	48		
95503 Eureka – S	4,520	876	123	149
95534 Cutten				
95537 Field's Landing	45			
95549 Kneeland	55			
Southern		1,014	112	199
95511 Alderpoint	54			
95514 Blocksburg	50	6		
95526 Bridgeville, Dinsmore & Van Duzen	140	37		
95528 Carlotta	222	64		
95536 Ferndale	615	39	12	13
95540 Alton, Fernbridge, Fortuna, Newberg, Rohnerville	2,587	464	57	93
95542 Briceland & Garberville	427		1	4
95545 Honeydew	10			
95547 Hydesville	246		12	12
95551 Loleta	310	57	4	16
95553	162	13		
95554 Myers Flat	111			
95558 Petrolia	44			
95559 Phillipsville & Redcrest	34			
95560 Redway	332	178	20	22
95562 Rio Deli	745	97	2	10
95565 Scotia & Shively	346	54	4	30
95569 Holmes, Pepperwood & South Fork	59			

[43] Humboldt County Office of Education. Local Child Care Planning Council of Humboldt County, May 2005. Child Care Needs Assessment.
[44] U.S. Census 2000.

95571 Weott	44			
95587	33			
95589 Whitethorn	110	15		
95440 Benbow				
95447				

Proportion of zip-codes without childcare facilities: Of the 40 Humboldt zip codes, 18 (45%) had no licensed childcare facilities listed. Of the 40 Humboldt zip codes, 24 (60%) had no licensed family child care homes listed.

Non-urban areas of Humboldt County include fewer childcare facilities than urban areas:

- In the 2005 Child Care Needs Assessment, only 25% of licensed childcare providers are located in "outlying rural areas".
- This report stated that 21 of 29 zip codes (72%) had no licensed family child care homes.[45]

The location of childcare facilities plays a large role in its accessibility: according to the Local Child Care Planning Council of Humboldt County, available transportation, commute patterns, and parental preferences differ between urban and non-urban areas. According to the Council, with its number of parents making up over half of the total county population, "Humboldt's rural population faces a number of unique barriers to child care including a shortage of suitable child care facilities stemming from houses that lack access to utilities or do not meet standards set by the Community Care Licensing Division. Furthermore, low population density, economic and transportation barriers often make child care businesses in rural areas financially unfeasible."[46]

Analysis

<u>Assumptions</u>

- Based on projections discussed above, the population of children between the ages of 0 and 14 in Humboldt County will remain approximately steady for the next 25 years.

<u>Logic</u>

- Because there is currently no projected increase in the population of people under age 18 between the years 2000 and 2040, this analysis considers potential shifts in the residential locations of families with young children needing daycare, as a result of Plan Alternatives A through C.
- Under Plan Alternative A, future children needing daycare in Humboldt County would be centrally located in urban areas, while in Plan Alternatives B and C, children would be increasingly spread into non-urban areas.
- Childcare facilities located in areas with higher population density and public transportation are more feasible for both providers and working parents. Plan Alternatives that house children in locations with higher population densities would provide the largest number of families with childcare opportunities.
- However, a shift of the county's population into non-urban areas (e.g., under Plan Alternatives B and C) is likely to eventually shift some childcare businesses away from urban centers and

45 Humboldt County Office of Education. Local Child Care Planning Council of Humboldt County, May 2005. Child Care Needs Assessment.
46 Humboldt County Office of Education. Local Child Care Planning Council of Humboldt County, May 2005. Child Care Needs Assessment.

into outlying regions. This may result in a higher proportion of Humboldt County zip-codes including childcare facilities, which is what is being measured by Indicator PI.5.

Qualitative Analysis

Accessible childcare was raised as an issue of concern to Humboldt residents in the focus groups.

Disparities

- The K-12 population is significantly larger in the Latino and Native American populations of Humboldt County.[47] Thus, there may be a greater demand for childcare among these groups. In addition, this suggests the need for bilingual childcare providers.
- The majority of the population and the services are currently concentrated along the Highway 101 corridor.[48] Communities living outside of this corridor, including Native American tribes, may continue to have disproportionately less proximity to childcare facilities under all three scenarios.
- In Humboldt County, there are an increasing number of jobs that require non-traditional hours and rotating shifts.[49] Parents of young children who have non-traditional working hours such as these are less likely to have the opportunity to use childcare.
- People without access to cars may have more difficulty transporting children to childcare than people who own cars.

Conclusions

A) By concentrating both families with children and childcare providers in the same areas, and by locating both in regions with access to public transportation, Plan Alternative A would best meet the demand for childcare by working parents. However, **Plan Alternative A is expected to result in the highest proportion of zip-codes without childcare facilities**. The proportion of the County's population living within non-urban zip-codes may not have access to childcare under Plan Alternative A, which is detrimental to health because it may be difficult for parents to work and earn a sufficient income.

B) Plan Alternative B would result in half of incoming families moving to urban areas, and the other half moving to non-urban areas. Families with children in urban areas would most likely be in close proximity to childcare providers and public transportation, while families in non-urban communities could have less access to childcare. The overall demand for childcare may not be met as much as it would under Plan Alternative A. However, **Plan Alternative B is expected to result in a lower proportion of zip-codes without childcare facilities than Plan Alternative A.** Under this Plan Alternative, non-urban populations may have greater access to new childcare facilities in their areas, which is important for the health of working families.

C) Plan Alternative C would result in one-third of incoming families moving to urban areas, with the majority moving to non-urban areas. Families who do live in urban areas would most likely be in close proximity to childcare providers and public transportation. The overall demand for childcare might not be met by Plan Alternative C as much as it would under Plan Alternatives B or A. On the other hand, **Plan Alternative C is expected to result in the lowest proportion**

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[47] Humboldt County Office of Education. Local Child Care Planning Council of Humboldt County, May 2005. Child Care Needs Assessment.

[48] Humboldt County Office of Education. Local Child Care Planning Council of Humboldt County, May 2005. Child Care Needs Assessment.

[49] Humboldt County Office of Education. Local Child Care Planning Council of Humboldt County, May 2005. Child Care Needs Assessment.

of zip-codes without childcare facilities. Non-urban populations would potentially experience the health benefit of having childcare facilities nearby. Access to childcare would enable these non-urban parents to maintain jobs, and it would enable children to gain from development opportunities such as socializing with other children. However, having childcare facilities within one's zip-code does not guarantee that nearby facilities have enough room for all children living within the zip-code.

Caveats

- While sprawling residential patterns may shift childcare facilities into more non-urban zip-codes, this does not guarantee that nearby facilities have enough room for all children living within the zip-code.
- While non-urban families may have access to childcare facilities within their zip-codes under the Plan Alternatives that propose non-urban development, they would likely have to travel longer distances to reach them than would urban families, who may be able to reach childcare services on foot or by public transportation.
- An increased overall resident population (e.g. under Plan Alternative C) could lead to more childcare facilities opening up throughout the county (especially out of home).
- This analysis does not encompass informal childcare. Some families choose friends and relatives (license-exempt caregivers) to care for their children, and programs for school age children are often not licensed by the state. The demand for childcare changes with age -- i.e. demand for infant care is higher than demand for preschool-age care, because preschoolers have preschool and programs like Head Start. Also, demands for school-age childcare may vary considerably depending upon availability of after-school programs, older siblings/friends, and other alternative after-school care arrangements. Thus, separating childcare demand by age categories is important for the identification of greatest need. Additionally, it is important to note that certain types of care are more expensive than others.
- One drawback of looking at data within areas defined by zip codes is that individual communities that are not delineated by zip-codes may be lacking childcare services.

Recommended Health-Promoting Mitigations:

- Continue to make federal and state subsidies for after-school programs and childcare available.
- Provide incentives for new childcare facilities by easing the process of obtaining and maintaining a childcare license.
- Offer low-interest loans or grants to childcare operators for the establishment and operation of childcare facilities.
- Support increased investment in employer-sponsored childcare assistance programs.
- Improve public transportation so that families without vehicles can transport children to childcare.
- Ensure that all future communities have licensed childcare facilities.
- Include childcare centers and Family Child Care Homes in zoning plans in all communities.
- Allow childcare centers in all zones besides Open Space and zones that are inappropriate for health and safety reasons.
- Encourage placement of childcare facilities within office parks, industrial developments, multi-modal transportation hubs and commercial areas.
- Support placement of childcare facilities near commute routes and public transit
- Encourage childcare facilities within multi-family housing projects.

PI.2.d Fast food establishments within ½ mile of high schools and middle schools

Health-Based Rationale

High Schools in particular tend to have limited on-site kitchen and eating facilities and allow students to leave campus for lunch. Fast food restaurants tend to be clustered around schools, within short walking distance.[50] Fast food restaurants encourage poor nutrition,[51] and proximity to them is associated with diet-related disease rates.[52]

Humboldt County students have a higher rate of overweight and obesity than the national average. In 2003-2004, county public health staff weighed and measured students at local schools, determining the rate for overweight for 5th grade boys to be 30.1% compared to a 16.8% national rate.

Nearly 18 percent of Humboldt County youth between 0 and 18 years of age are overweight for their age, compared to 13.4% of youth in the state.[53]

Existing Conditions

Fast food restaurants near middle and high schools. The table and figures below show the number of fast food restaurants (defined as restaurants that prepare and serve food quickly) currently near middle and high schools in the County.

Table PI.10. Summary of fast food establishments within ½ mile of high schools and middle schools in six Humboldt County cities

Location	Number of fast food restaurants within ½ mile of high schools and middle schools
Southern Humboldt	2
Arcata	6
Eureka	4
Fortuna	4
Hoopa	0
McKinleyville	6

Figure PI.11. Fast food establishments within a ½ mile of high schools and middle schools in various Humboldt County cities and towns.[54]

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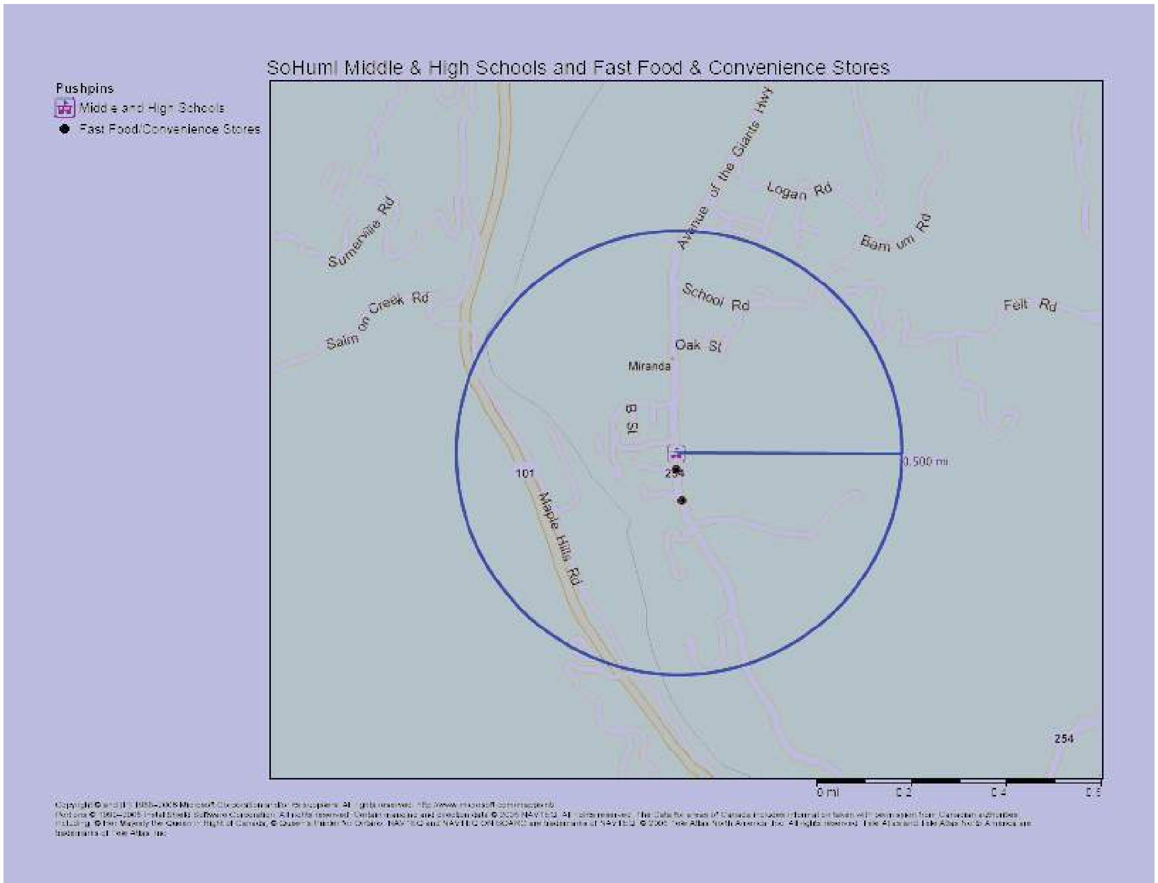
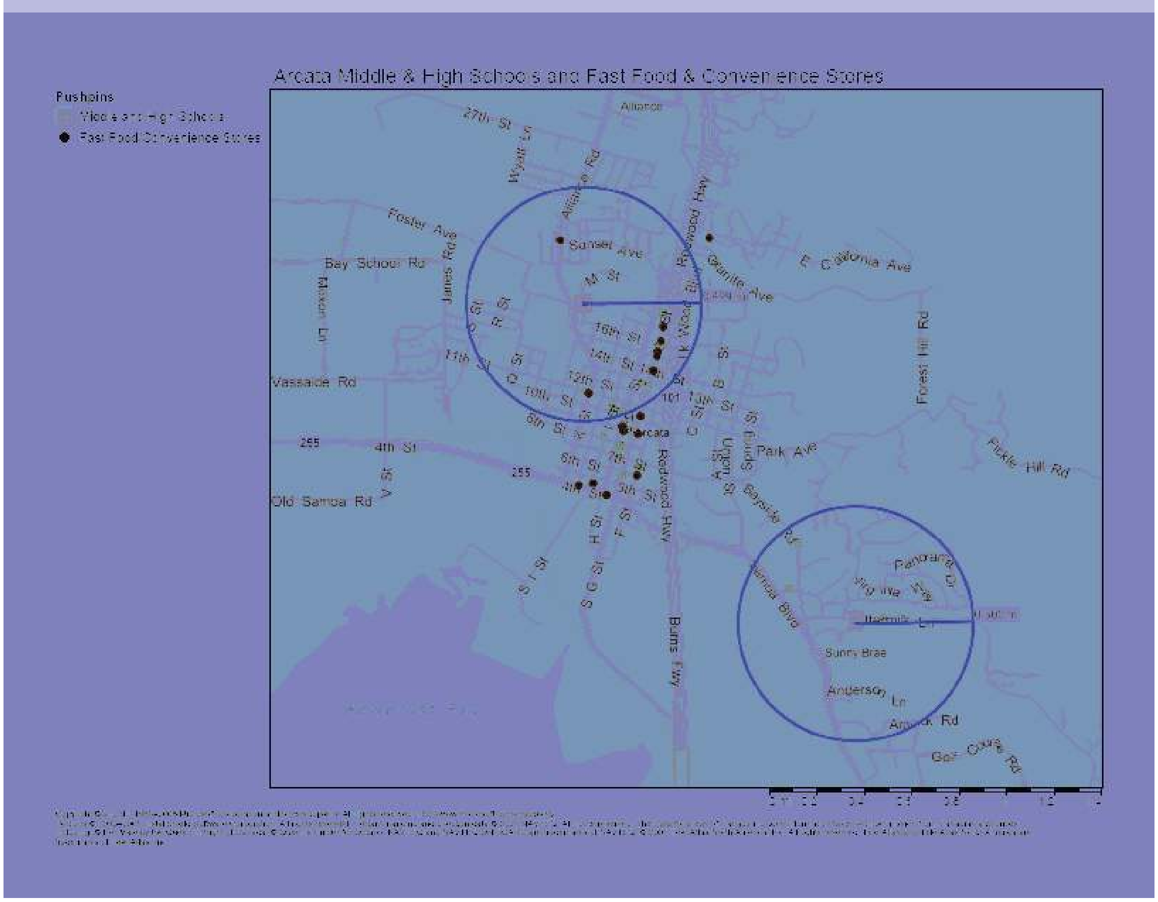
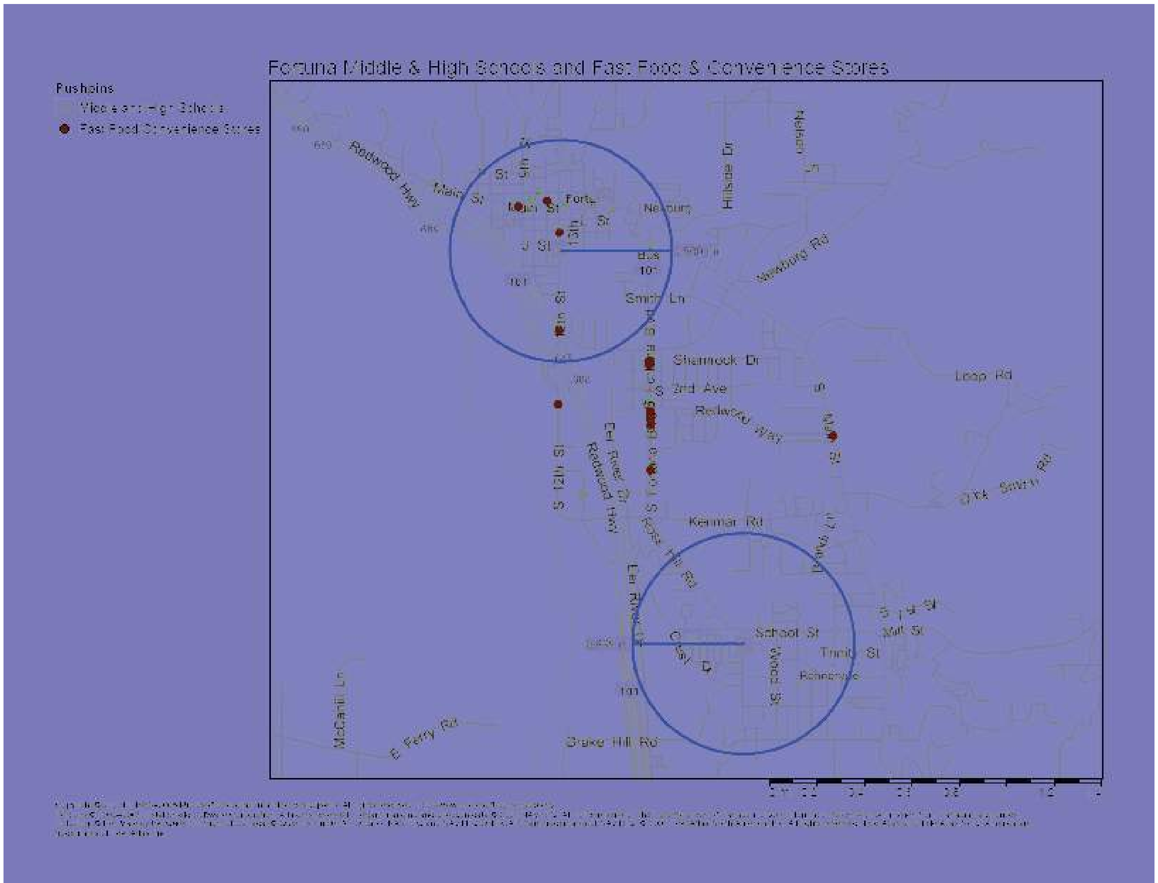
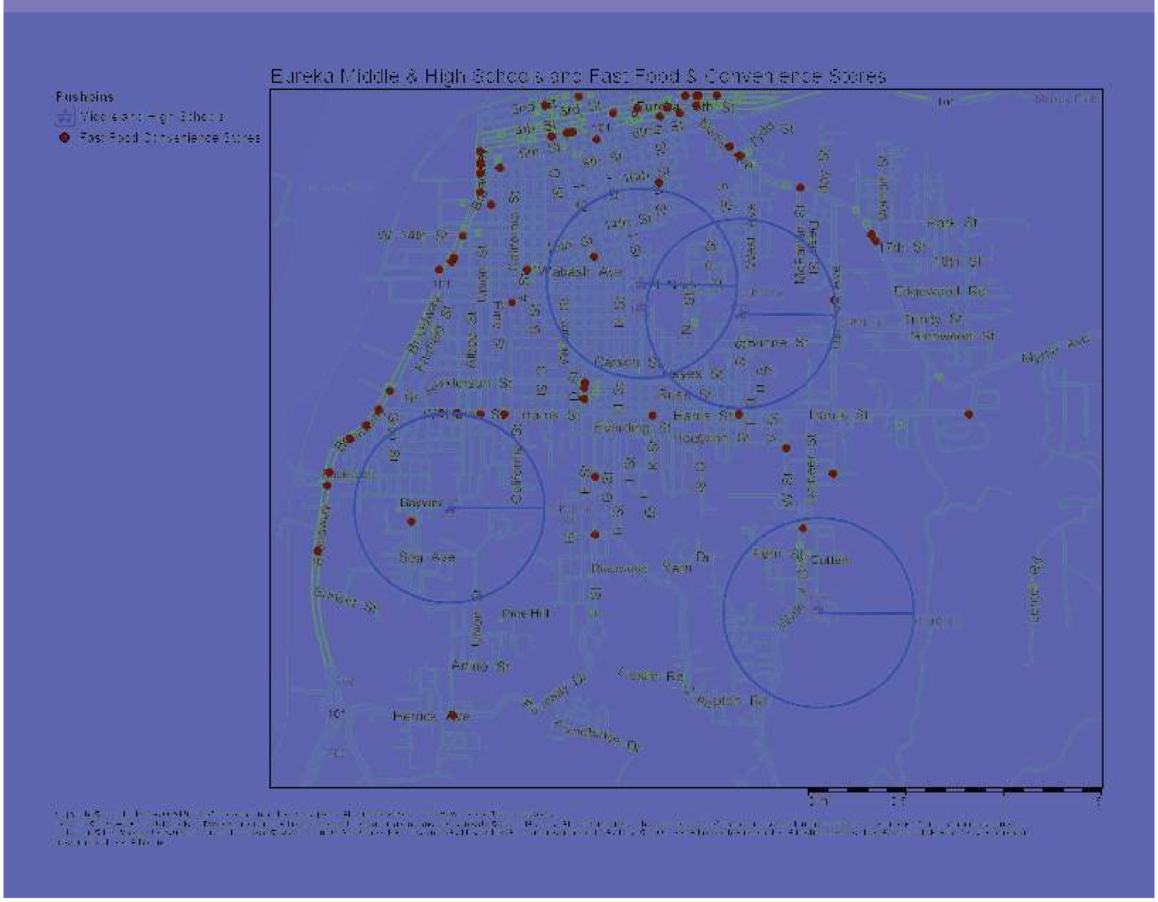
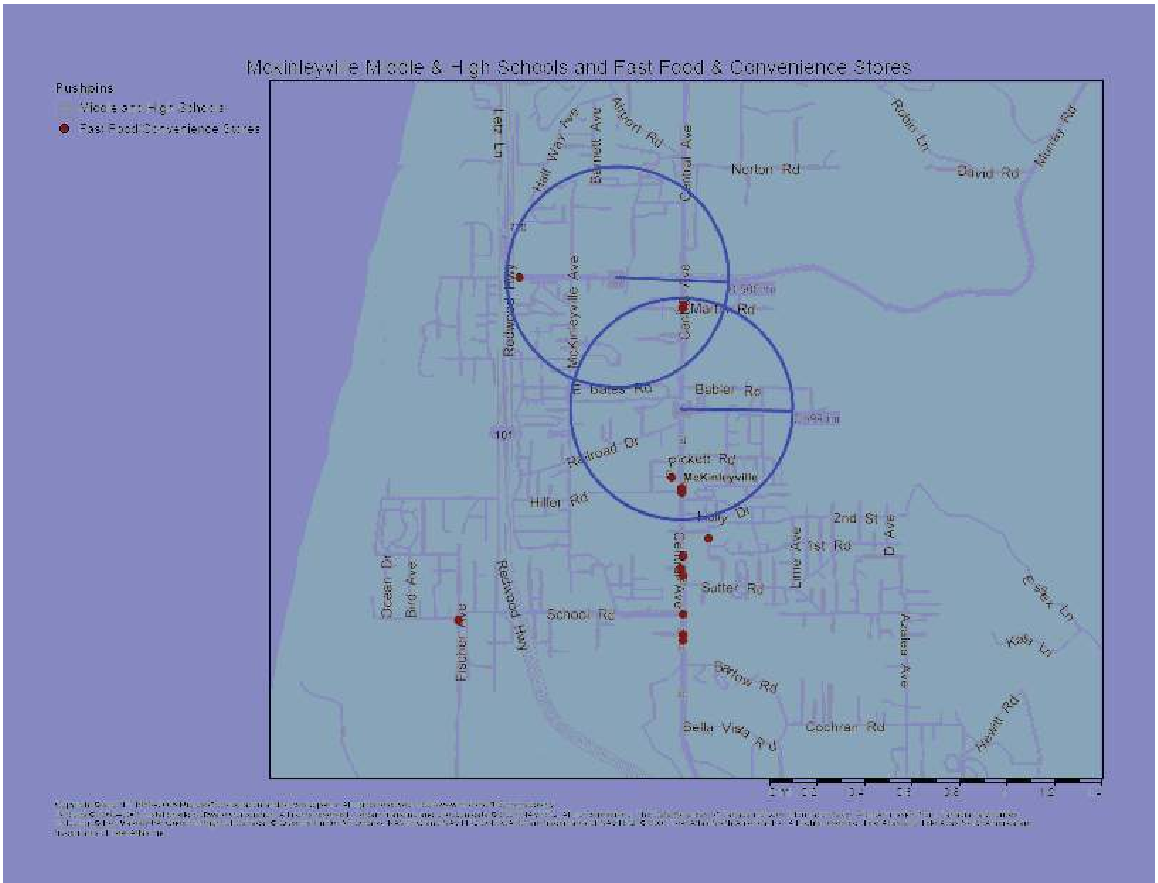
50 Austin SB, Melly SJ, Sanchez BN, Patel A, Buka S, Gortmaker SL. Clustering of fast-food restaurants around schools: a novel application of spatial statistics to the study of food environments. Am J Public Health. 2005 Sep;95(9):1575-81.
51 US Dept of Health and Human Services. 2001.The Surgeon General's call to action to prevent and decrease overweight and obesity. US Dept of Health and Human Services, Public Health Service, Office of the Surgeon General. Available at http://www.surgeongeneral.gov/topics/obesity.
52 Morland K, Wing S, Diez Roux A, Poole C. 2002. Neighborhood characteristics associated with the location of food stores and food service places. American Journal of Preventive Medicine 22(1);23-29.
53 California Health Interview Survey. Available at http://www.chis.ucla.edu/.
54 Humboldt County Health and Human Services Environmental Health Division.


SoHumI Middle & High Schools and Fast Food & Convenience Stores
Pushpins
Middle and High Schools
Fast Food/Convenience Stores
Avenue of the Giants Hwy
Logan Rd
Barnum Rd
Sumerville Rd
Salmon Creek Rd
School Rd
Felt Rd
Oak St
Miranda
B St
101
Maple Hills Rd
0.500 mi
254
0 mi
0.2
0.4
0.6


Arcata Middle & High Schools and Fast Food & Convenience Stores
Pushpins
Middle and High Schools
Fast Food/Convenience Stores
Alliance
27th St
Wyatt Ln
Alliance Rd
Foster Ave
Sunset Ave
Redwood Hwy
E California Ave
Bay School Rd
James Rd
M St
Granite Ave
Mitzen Ln
Q St
R St
16th St
14th St
12th St
11th St
10th St
Vassaide Rd
Forest Hill Rd
Park Ave
Pickle Hill Rd
4th St
255
Arcata
Old Samoa Rd
A St
H St
F St
G St
I St
Union St
Spring St
Bayside Rd
Buttermilk Ln
Sunny Brae
Anderson Ln
Golf Course Rd
Burns Fwy


Fortuna Middle & High Schools and Fast Food & Convenience Stores
Pushpins
Fast Food Convenience Stores


Eureka Middle & High Schools and Fast Food & Convenience Stores
Pushpins
Fast Food Convenience Stores


Mckinleyville Middle & High Schools and Fast Food & Convenience Stores
Pushpins
Fast Food/Convenience Stores
Norton Rd
David Rd
Robin Ln
Murray Rd
Airport Rd
Central Ave
Barnett Ave
Half Way Ave
Letz Ln
Redwood Hwy
McKinleyville Ave
Babler Rd
E Bates Rd
Railroad Dr
Pickett Rd
McKinleyville
Hiller Rd
Holly Dr
2nd St
1st Rd
D Ave
Lime Ave
Sutter Rd
School Rd
Ocean Dr
Bird Ave
Fischer Ave
Azalea Ave
Essex Ln
Kaly Ln
Barlow Rd
Bella Vista Rd
Cochran Rd
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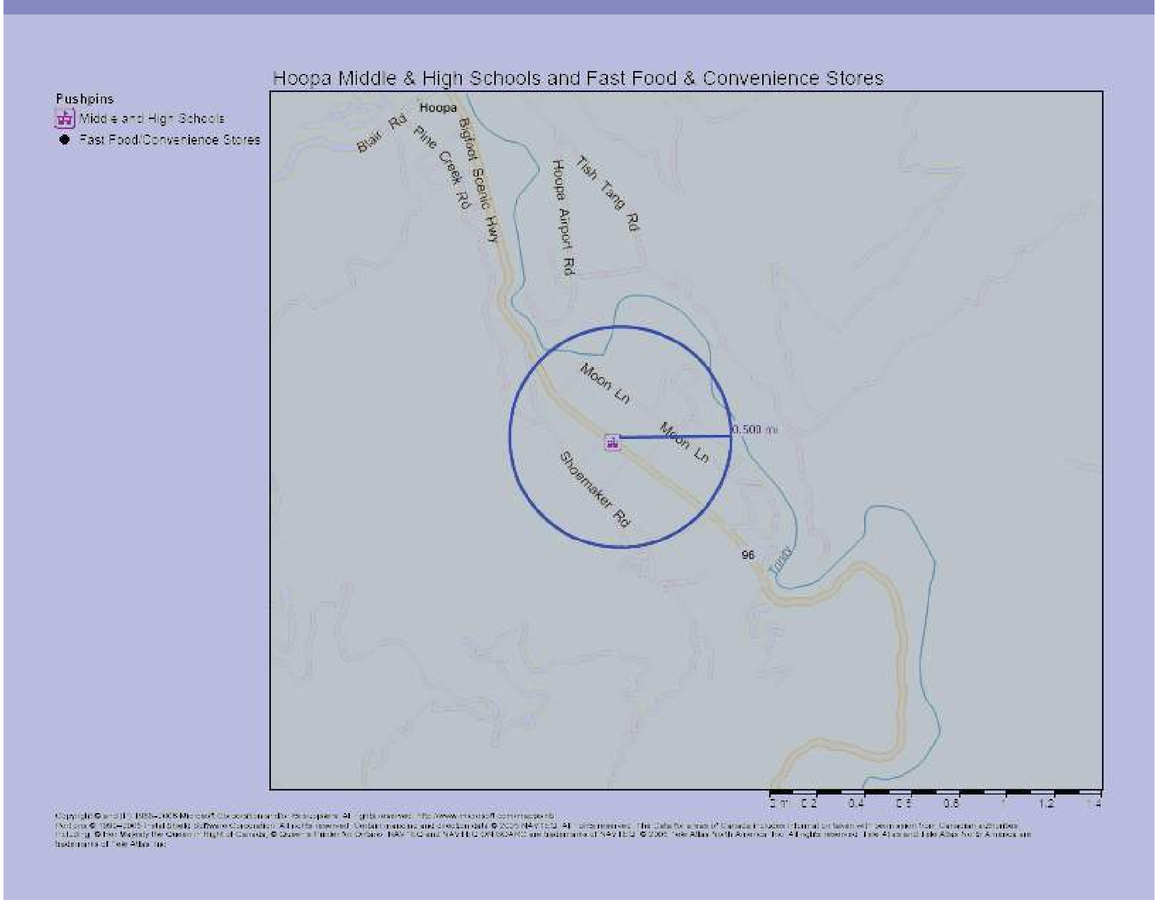
Hoopa Middle & High Schools and Fast Food & Convenience Stores
Pushpins
Middle and High Schools
Fast Food/Convenience Stores
Hoopa
Blair Rd
Pine Creek Rd
Bigfoot Scenic Hwy
Hoopa Airport Rd
Tish Tang Rd
Moon Ln
Moon Ln
0.500 mi
Shoemaker Rd
96
0 mi 0.2 0.4 0.6 0.8 1 1.2 1.4

Analysis

Assumptions

- Urban areas attract a greater number of fast food establishments than non-urban areas since population density is a factor considered in fast food location choice.

Logic

- An increase in Humboldt County's population is expected to increase demand for food establishments in general. The more housing that is developed, the more people are expected to move into the county, thereby increasing the demand for fast food establishments.
- Additional schools in the County are not anticipated because the youth population is expected to remain generally constant between 2000 and 2040.
- Each Plan Alternative proposes the same quantity of housing units (i.e. 6,000) within urban areas. Plan Alternative C proposes the most total housing units in the county, and is therefore associated with the highest demand for food establishments including fast food restaurants. Plan Alternative B proposes the next highest number of total housing units in the county, followed by Plan Alternative A. Due to drawing the lowest quantity of new residents to the county of the three Plan Alternatives, Plan Alternative A is likely to result in the fewest new fast food restaurants in the county.
- New fast food restaurants may be located in any area that is relatively dense with potential customers, but evidence suggests that they are often located near schools.[55]

Qualitative Analysis

Focus group participants expressed their desire for access to healthy foods in Humboldt County. For example, access to farmers markets was raised as a main priority.

Disparities

- Because fast food establishments are preferentially located in urban regions, urban students will be affected more than non-urban students.

Conclusions

A) Because Plan Alternative A proposes the least amount of total housing developments (i.e. 6,000 housing units), this scenario is associated with the lowest demand for additional food establishments in the county. This Plan Alternative is likely to lead to the **least additional fast food establishments within ½ mile of high schools and middle schools.** From a health perspective, this is the best Plan Alternative in terms of limiting unhealthy food choices for students.

B) Plan Alternative B proposes twice the overall housing developments proposed by Plan Alternative A. Based on a higher population growth than is expected under Plan Alternative A, Plan Alternative B is associated with a higher demand for additional food establishments in the county. This Plan Alternative has the potential to lead to **more fast food establishments within ½ mile of high schools and middle schools than Plan Alternative A.** From a health perspective, this is the next best Plan Alternative in terms of limiting unhealthy food choices for students.

[55] Austin SB, Melly SJ, Sanchez BN, Patel A, Buka S, Gortmaker SL. Clustering of fast-food restaurants around schools: a novel application of spatial statistics to the study of food environments. Am J Public Health. 2005 Sep;95(9):1575-81.

C) Plan Alternative C proposes three times the overall housing units proposed by Plan Alternative A. Based on the highest expected population growth of the three Plan Alternatives, Plan Alternative C is associated with the highest demand for additional food establishments in the county. Plan Alternative C has the potential to lead to the **most fast food establishments within ½ mile of high schools and middle schools of the three Plan Alternatives.** From a health perspective, this is the worst Plan Alternative. Fast food establishments offer few healthy food options, and their close proximity to schools makes it difficult for students to eat nutritiously.

Caveats

- Under scenarios proposing more housing developments (i.e., Plan Alternative C), fast food restaurants could be placed in non-urban areas in addition to urban areas.

Recommended Health-Promoting Mitigations:

- Institute zoning restrictions against the placement of fast food establishments within ½ mile of a school.
- Increase the number of schools serving meals on site and improve the nutritional quality of foods served on campuses.

PI.2.a Accessibility of full-service grocery store/supermarket or store carrying produce

Health-Based Rationale

Research suggests that people's dietary choices may be influenced by the availability of food stores in their residential area.[56] Supermarkets may provide access to a greater variety of cheaper and healthier foods, including fresh fruits and vegetables. This access helps to facilitate healthier dietary choices. Research has found that the presence of a supermarket in a neighborhood predicts higher fruit and vegetable consumption and a reduced prevalence of overweight and obesity.[57] [58] The longer the distance necessary to travel to a full-service grocery store, the higher one's body mass index (BMI). For example, a 5'5" person who travels 1.75 miles or more to get to a grocery store is expected to weigh approximately five pounds more than someone who did not have to travel that far.[59]

For pedestrians in certain areas, it is necessary to walk long distances or take public transit to access a supermarket. Geographic proximity does not equal access, due to impediments such as freeways, major highways, or steep hills. In many communities characterized by sprawling development, supermarkets have followed land use and transportation growth, migrating into suburban areas. This often leaves urban corner stores, with limited selection and higher prices, as the main source of local groceries in densely populated areas of the state.[60] [61]

Existing Conditions

Locations of grocery stores. As shown on the map below, most grocery stores are concentrated in the western region of the county, in proximity to Highway 101. Urban areas that are more densely populated, such as Eureka, Arcata, McKinleyville, and Fortuna, include more grocery stores than non-urban towns such as Trinidad and Ferndale.

Nine percent of the population in Humboldt County does not own cars, and many individuals without cars live outside of towns.[62] These people are particularly vulnerable to inadequate nutrition as a result of not being close to grocery stores.

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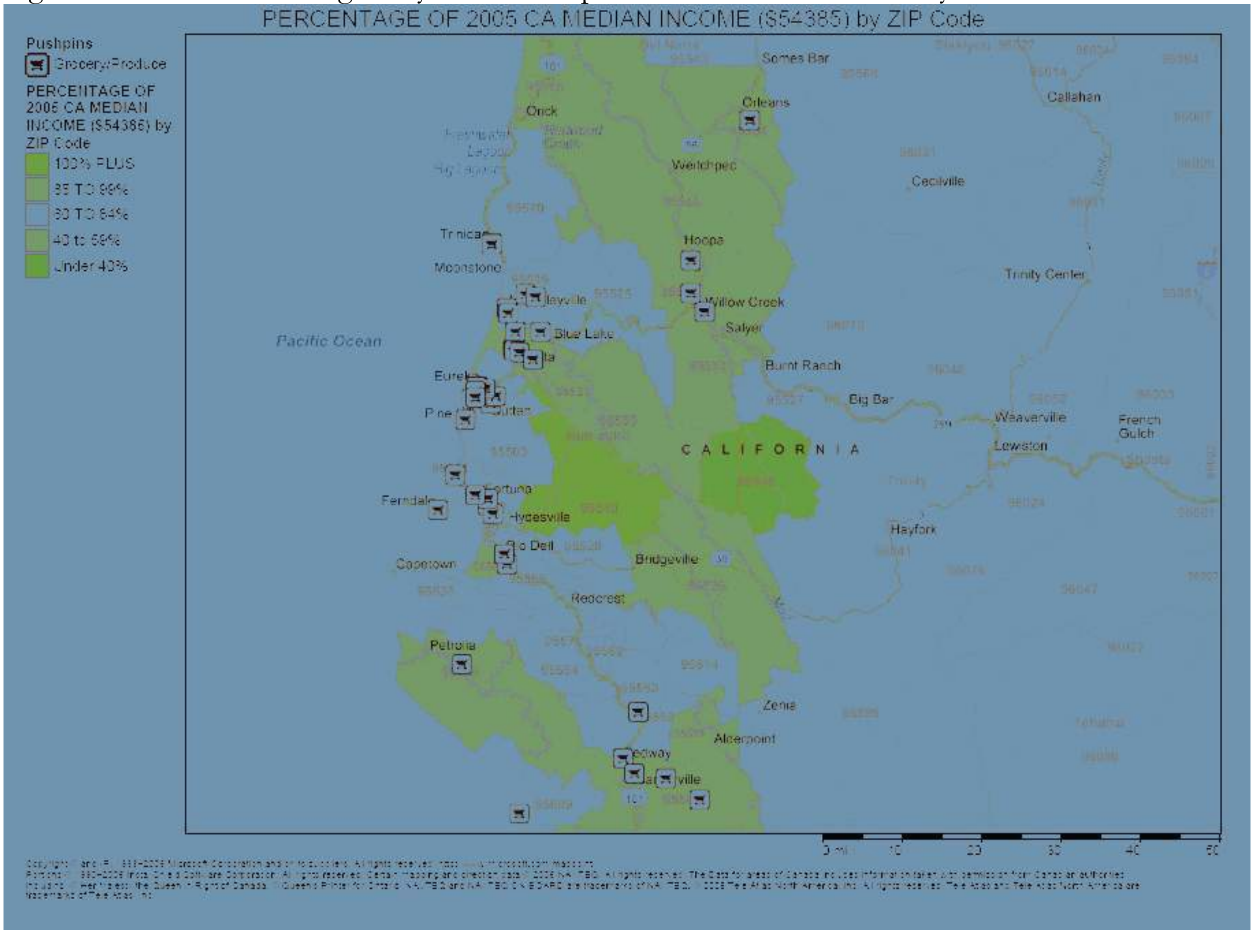
56 Morland K, Wing S, Diez Roux A, Poole C. 2002. Neighborhood characteristics associated with the location of food stores and food service plans. Am J Prev Med. 22:23-29.
57 Morland K, Diez Roux AV, Wing S. Supermarkets, other food stores, and obesity: the atherosclerosis risk in communities study. Am J Prev Med. 2006;30(4):333-9.
58 Inagami S, Cohen DA, Finch BK, Asch SM. You are where you shop: grocery store locations, weight, and neighborhoods. Am J Prev Med. 2006;31(1):10-7.
59 Drewnowski A, Darmon N, Briend A. 2004. Replacing fats and sweets with vegetables and fruits – a question of cost. American Journal of Public Health 94(9):1555-1559.
60 House Select Committee on Hunger 1990. Obtaining food: Shopping constraints of the poor. Committee Report. Washington DC: US Government Printing Office.
61 Morland K (ET AL?). 2002. Neighborhood characteristics associated with the location of food stores and food service places. Am J Prev Med 22:23-29.
62 U.S. Census 2000.

Figure PI.12. Locations of grocery stores with produce in Humboldt County.[63]



Analysis

Assumptions

- Existing grocery stores and other markets selling fresh produce are assumed to remain in the same locations for the next 25 years.
- Corresponding to the demand associated with projected population growth in Humboldt County, additional grocery stores are expected to open up within the next 25 years.

Logic

- Large, corporate-owned chain stores, which are often sources of healthy food items at relatively low prices, are preferentially located in middle- or high-income neighborhoods.[64]
- Sprawling development leads to higher home prices, which leads to higher income communities. With sprawling housing development, new grocery stores may be built in non-urban areas rather than in urban centers.
- Exclusively urban infill development would encourage new grocery stores to locate within urban areas.

[63] Humboldt County Division of Environmental Health.
[64] Morland K, Wing S, Diez Roux A, Poole C. 2002. Neighborhood characteristics associated with the location of food stores and food service plans. Am J Prev Med. 22:23-29.

- Existing grocery stores that are located in residentially dense areas will continue to serve these more urban residents.

Qualitative Analysis

Focus group participants expressed their desire for access to healthy foods in Humboldt County. For example, access to farmers markets was raised as a main priority.

Disparities

- Humboldt County residents who do not own cars will be more affected by the placement of grocery stores within urban areas versus outside of them. In general, fewer households in poor neighborhoods have access to private transportation.[65]
- Because large, chain supermarkets, which carry the most healthy food at the lowest prices, are preferentially placed in wealthier neighborhoods,[66] low-income communities in Humboldt County will have less access to these stores.
- Low-income residents are more likely to consider small "corner stores" as inaccessible due to their cost. Thus, if existing or future grocery stores follow housing development into non-urban areas (i.e., under Plan Alternative C), these residents will not have easy access to groceries including fresh produce.
- Large, corporate-owned chain stores, at which the most healthy food can be found at the lowest prices, are four times more common in predominantly white neighborhoods compared to predominantly black neighborhoods.[67] Communities of color in Humboldt County may experience a disproportionate shortage of grocery stores and supermarkets carrying produce.

Conclusions

A) Plan Alternative A would likely encourage prospective grocery store owners to place stores within urban areas where the majority of the population resides. Thus, Plan Alternative A would likely give the **highest number of residents access within ½ mile of new full-service grocery stores/supermarkets or stores carrying produce.** From a health perspective, this is advantageous because access to produce and other healthy food choices encourages better nutrition.

B) Plan Alternative B may encourage prospective grocery store owners to place stores outside of urban areas, where land costs are cheaper and higher-income residents reside. **About the same number of residents would live within ½ mile of full-service grocery stores/supermarkets or stores carrying produce.** From a health perspective, a lower proportion of residents living in proximity to grocery stores carrying produce and other healthy foods would be detrimental because residents may be less likely to obtain nutritional food.

C) Because grocery stores are preferentially placed within non-urban areas when the community is characterized by sprawl, new grocery stores in the County may be located outside of densely populated urban areas. Under this scenario, the **lowest number of residents would have access within ½ mile of full-service grocery stores/supermarkets or stores carrying produce.** From a health standpoint, this is the least healthy of the three options. Residents

[65] Morland K, Wing S, Diez Roux A, Poole C. 2002. Neighborhood characteristics associated with the location of food stores and food service plans. Am J Prev Med. 22:23-29.

[66] Morland K, Wing S, Diez Roux A, Poole C. 2002. Neighborhood characteristics associated with the location of food stores and food service plans. Am J Prev Med. 22:23-29.

[67] Morland K, Wing S, Diez Roux A, Poole C. 2002. Neighborhood characteristics associated with the location of food stores and food service plans. Am J Prev Med. 22:23-29.

who do not live in close proximity to grocery stores selling healthy food would not be encouraged to make healthy nutritional choices.

Caveats

- This analysis does not include farmers markets, which offer some communities a great source of fresh produce.
- This analysis does not examine proximity of future housing to current grocery stores.

Recommended Health-Promoting Mitigations:

- Provide incentives for grocery stores selling produce to be located in all residential neighborhoods, regardless of resident income levels.

PI.6.a Residential density

Health-Based Rationale

Residential density can be defined as the number of residents or housing units per area unit of land. Along with residential density, access to goods and services in the neighborhood (neighborhood "completeness") affects health. Denser neighborhoods often combine residential and commercial uses, and provide greater access to resources including public transportation, libraries, and social services, grocery stores, and other retail shops and businesses.

Residential density is one measure of sprawl, or planned low-density. Sprawl is a term used to denote the continued growth of suburban neighborhoods that have sprawled from cities into more rural or "natural" areas. Residents of these areas typically live farther away from restaurants, grocery stores, jobs, and businesses. Research has found that people living in the most sprawling counties are likely to weigh six pounds more than people in the most compact counties.[68] In addition, increasing rates of diabetes, heart disease, and high blood pressure are linked with increasing degrees of sprawl.[69] [70] For example, a study examining the health effects of sprawl found that the 25 most sprawling counties in the U.S. had average hypertension rates of 25 per 100, while the 25 least sprawling counties had hypertension rates of 23 per 100.[71]

People living in sprawling communities drive more, because they typically need to travel longer distances between their homes and various destinations, and are too spread out to make public transportation, walking, or biking convenient or effective. The often long distances between suburban homes and workplaces means that people spend a significant amount of time each day in the car. The more hours that people spend driving or riding in cars increases the likelihood that they will be injured or killed in a car accident.[72] Vehicle miles traveled are directly proportional to air pollution and greenhouse gas emissions. Air pollutants, including ozone and particulate matter are causal factors for cardiovascular disease, respiratory disease and illness, and birth defects.[73] Greenhouse gases contribute to climate change and may increase heat-related illness and death, health effects related to extreme weather events, health effects related to air pollution, and water-borne, food-borne, vector-borne, and rodent-borne diseases.[74] [75] [76]

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[68] McCann B. and Ewing R. 2003. Measuring the health effects of sprawl: A national analysis of physical activity, obesity and chronic disease. Smart Growth America, Surface Transportation Policy Project.
[69] McCann B. and Ewing R. 2003. Measuring the health effects of sprawl: A national analysis of physical activity, obesity and chronic disease. Smart Growth America, Surface Transportation Policy Project.
[70] Ontario College of Family Physicians. Report on Public Health and Urban Sprawl in Ontario: A review of the pertinent literature. Available at http://www.ocfp.on.ca/English/OCFP/UrbanSprawl/default.asp?s=1.
[71] McCann B. and Ewing R. 2003. Measuring the health effects of sprawl: A national analysis of physical activity, obesity and chronic disease. Smart Growth America, Surface Transportation Policy Project.
[72] Ontario College of Family Physicians. Report on Public Health and Urban Sprawl in Ontario: A review of the pertinent literature.
[73] Ontario College of Family Physicians. Report on Public Health and Urban Sprawl in Ontario: A review of the pertinent literature.
[74] IPCC. Confalonieri U, Menne B, Akhtar R, Ebi KL, Hauengue M, Kovats RS, Revich B, Woodward A. 2007. Chapter 8: Human health. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE (Eds). Cambridge University Press, Cambridge, UK. Available at http://www.ipcc-wg2.org/index.html. Accessed on January 7, 2008.
[75] EPA. 2007. Climate Change – Health and Environmental Effects. US Environmental Protection Agency. Available at http://www.epa.gov/climatechange/effects/health.html. Accessed on January 7, 2008.
[76] Knowlton K, Lynn B, Goldberg RA, Rosenzweig C, Hogrefe C, Klein Rosenthal J, Kinney PL. 2007. Projecting Heat-Related Mortality Impacts Under a Changing Climate in the New York City Region. AJPH 97(11):2028-34.

Mixed residential and commercial neighborhoods, such as those offering a variety of retail options, quality destinations, and modes of transport, are typically associated with better health. One reason for this is that neighborhoods with a mix of shops and businesses within easy walking distance are more "walkable." Another word for a neighborhood like this, with the majority of one's necessary resources included within walking distance, is a "complete" neighborhood.[77] Complete neighborhoods, which are mixed-use neighborhoods in which people can walk to school, work, stores, parks, and restaurants, can lead to more exercise and less obesity by significantly reducing the need to drive.[78] [79] According to an evaluation of urban planning and public health in Atlanta, people who live in mixed-use neighborhoods are seven percent less likely to be obese than those living in a mix level equal to the lower regional average. In other words, this study reports, one who lives in a mixed-use community is expected to weigh ten pounds less than someone living in a low density, residential-only cul-de-sac subdivision.[80] An additional important health benefit associated with complete neighborhoods is a higher consumption of fruits and vegetables.[81] [82]

Social capital is a measure of connections within and between social networks, and includes objectives such as strong social relationships with one's community, promotion of healthy behaviors, and collective action and political engagement by social groups to secure material resources and policies that promote good health. Social capital is expected to be greater for residents of denser, walkable, mixed-use neighborhoods. This type of neighborhood design encourages spontaneous and intentional social engagement, because residents spend less time in cars and more in local schools, small stores, and other places were people interact.[83] Spontaneous interactions, such as accidentally encountering neighbors, brief conversations, or waving hello, can increase respect, trust, and a sense of connection.[84] [85]

Existing conditions

Residential Density of recent new construction: The average density of permitted development in Humboldt County for the period 1985-2000 was 1 unit per 10 acres.[86]

The following table shows residential density for various Humboldt County zip-codes, and is adapted from the 2000 U.S. Census.[87]

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77 Metropolitan Planning Commission of Nashville and Davidson County, Tennessee. Adopted February 13, 2003. Bellevue Community Plan: 2003 Update. Appendix H: Issues and Additional Actions. Available at ftp://ftp.nashville.gov/web/mpc/subarea6/2003UpdateMay2004/27AppendixH.pdf.

78 Handy, S. 1996 Understanding the link between urban form and non-work traveling behavior. Journal of Planning Education and Research. 15:183-98.

79 Inagami S, Cohen DA, Finch BK, Asch SM. You are where you shop: grocery store locations, weight, and neighborhoods. Am J Prev Med. 2006;31(1):10-7.

80 Goldberg D, Frank L, McCann B, Chapman J, Kavage S. 2007. New data for a new era: A summary of the SMARTRAQ findings. Linking land use, transportation, air quality, and health in the Atlanta region.

81 Morland K, Diez Roux AV, Wing S. Supermarkets, other food stores, and obesity: the atherosclerosis risk in communities study. Am J Prev Med. 2006;30(4):333-9.

82 Inagami S, Cohen DA, Finch BK, Asch SM. You are where you shop: grocery store locations, weight, and neighborhoods. Am J Prev Med. 2006;31(1):10-7.

83 Ontario College of Family Physicians. Report on Public Health and Urban Sprawl in Ontario: A review of the pertinent literature.

84 Leyden KM. Social capital and the built environment: the importance of walkable neighborhoods. Am J Public Health 2003 September;93(9):1546-51.

85 Jacobs J. The Death and Life of Great American Cities. New York: Random; 1961.

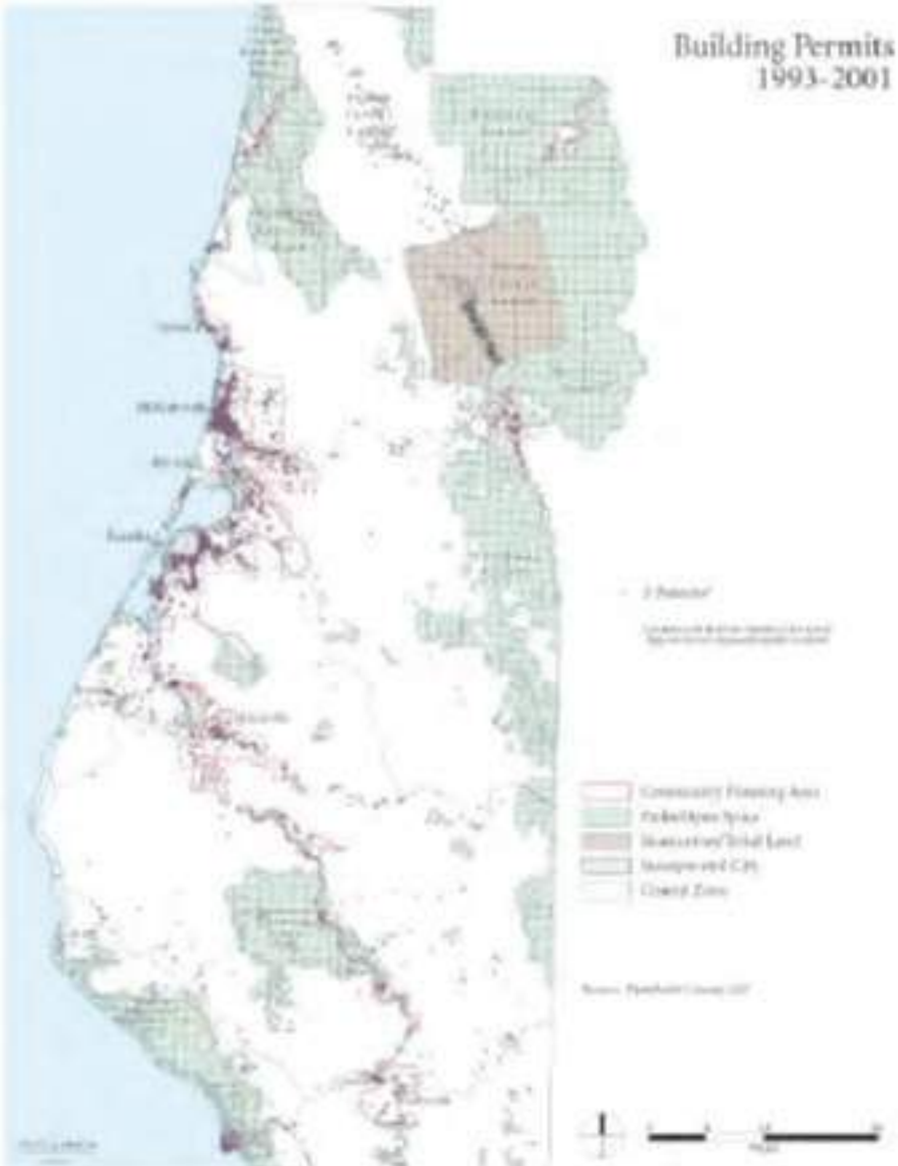
86 Smith, Michael D., and Steinberg, Steven J., January 2005. Room to Grow? An assessment of the Potential for Unincorporated Humboldt County to Accommodate Future Projected Population Growth.

87 U.S. Census 2000.

Table PI.11. Humboldt Residential Housing Density* (2000)			
Zip	Town	Population Density (person per square mile)	Housing Density (housing units per square mile)
95501	Eureka	3205	1478
95503	Eureka	220	94
95511	Alderpoint	6	2.5
95514	Blocksburg	2	1.1
95519	McKinleyville	204	84
95521	Arcata	290	129
95524	Bayside	129	52
95525	Blue Lake	12	6.3
95526	Bridgeville	3	2.3
95528	Carlotta	9	3.8
95536	Ferndale	14	6.5
95540	Fortuna	345	147
95542	Garberville	7	3.6
95545	Honeydew	2	1.8
95546	Hoopa	21	8.6
95547	Hydesville	158	69
95549	Kneeland	2	1.1
95550	Korbel	1	64
95551	Loleta	43	14
95553	Miranda	30	18
95554	Myers Flat	13	6.7
95555	Orick	10	5
95556	Orleans	3	1.6
95558	Petrolia	4	2.5
95559	Phillipsville	8	4.2
95560	Redway	30	16
95562	Rio Dell	308	98
95563	Sayler	22	17
95564	Samoa	201	89
95565	Scotia	51	18
95569	Redcrest	7	2.8
95570	Trinidad	23	14
95571	Weott	147	68
95573	Willow Creek	26	17
95587		4	2.8
95589	Whitethorn	9	6.2
96046		4	2.6
* Average housing units per acre			

The following figure shows density of new developments in Humboldt County between 1993 and 2001.[88]

Figure PI.13. Density of new developments in Humboldt County between 1993 and 2001.



[88] 2003 Housing Element Update to Humboldt County General Plan. (Approved December 16, 2003 Amended November 30, 2004).

Analysis

Assumptions

- Urban neighborhoods are generally "complete," offering resources in close proximity such as public transportation, grocery and retail stores, senior services, and childcare. The assumption is made here that new housing developments in urban communities will be part of complete neighborhoods, while new housing developments outside of urban communities will be residential only.

Logic

- If Humboldt County continues to develop at current densities, it will fall short of housing needs. As discussed in the housing section of this Health Impact Assessment, approximately 5,021 housing units are needed to house the projected population of Humboldt County in 2025. According to an assessment conducted by Dr. Michael D. Smith and Dr. Steven J. Steinberg, development at current densities would generate only 166 units. "In order to meet the projected housing need through the year 2025, over 30,000 acres outside of existing residentially-zoned land in sewer and water district-serviced areas would need to be developed, much of which consists of working agricultural and forest lands." However, according to Smith and Steinberg, it is possible to accommodate projected population growth by developing residentially-zoned lands within existing sewer and water serviced-areas by increasing the density of future residential development. Ninety percent of the development could be accommodated with a mix of large-lot suburban homes and larger-lot development.[89]
- According to Smith and Steinberg, residential development at a density of 5 units per acre is compatible with the County's rural community character. For example, many of the recent subdivisions built in McKinleyville (designated as non-urban in this analysis) have average densities greater than five units per acre.[90]
- Denser, walkable, "complete" neighborhoods lead to increased exercise, decreased weight, and more social capital. Denser areas also lead to less dependence on cars, which results in improved regional air quality, and thus fewer respiratory and cardiovascular conditions. An increase in pedestrians and bicyclists within urban areas leads to a reduced risk of traffic accidents for each individual pedestrian.[91] Less dense areas are not associated with these positive outcomes.
- Less dense development increases road congestion in urban areas because residents of less dense areas drive to urban areas for jobs and goods and services.

Quantitative Analysis

Based on an analysis of accommodating projected population growth in Humboldt County by developing housing at various residential densities, Smith and Steinberg quantified the feasibility of housing the projected population in the county using eight different density scenarios. The projected annual growth rate in the county is 0.5%, and their analysis includes higher growth rates in order to take into account the possibility of greater population growth than current state projections. They assume that 3,354 housing units are required by 2025, but according to projections made in October 2007,

[89] Smith, Michael D., and Steinberg, Steven J., January 2005. Room to Grow? An assessment of the Potential for Unincorporated Humboldt County to Accommodate Future Projected Population Growth.
[90] Smith, Michael D., and Steinberg, Steven J., January 2005. Room to Grow? An assessment of the Potential for Unincorporated Humboldt County to Accommodate Future Projected Population Growth.
[91] Geyer, Judy et al., 2005. Safety in Numbers – Data from Oakland, CA.

5,021 housing units are needed.[92] Therefore, their analysis does not accurately estimate whether housing needs would be met in each hypothetical scenario. Their results are presented in the following table, with the last column showing whether the updated housing demand of 5,021 would be met.

Table PI.12. Growth scenarios based on the analysis of Smith and Steinberg.

Scenario	Annual Growth Rate	Average Density (units per acre)	In/Out of Existing Infrastructure	2025 Dwelling Units Required	New Dwelling Unit Capacity	Meets Updated Housing Needs (5,021 units)?
1	0.5%	0.1	In	3,354	166	No
2	0.5%	5	In	3,354	8,273	Yes
3	0.5%	2.5	In	3,354	4,137	No
4	1%	5	In	7,058	8,273	Yes
5	1%	10	In	7,058	16,546	Yes
6	2%	5	In	15,661	8,273	No
7	2%	5	In and Out	15,661	17,132	Yes
8	2%	9.6	In	15,661	15,884	Yes

Qualitative Analysis

According to a recent master's thesis by Deborah T. Waxman at Humboldt State University, many county residents resist residential density, and instead favor homes on large, fenced-in, private lots. [93] However, this is not considered to represent the view of all county residents.

Though some people resist density, other top priorities among county residents are protecting the county's remaining working agricultural and timber lands from future conversion to other uses, preserving the county's unique rural character, and addressing the county's shortage of affordable housing.[94] [95] These values support higher residential density, or Plan Alternative A.

Disparities

- Elderly people who can no longer drive safely must have stores, medical offices, recreational and cultural facilities close to home or easily accessible by public transportation or must be dependent on others for access to these goods and services. Sprawling residential development makes independent access unlikely.
- Negative health effects of sprawl, such as overweight due to automobile travel rather than travel on foot, may disproportionately be faced by non-urban residents.

Conclusions

A) All housing development associated with Plan Alternative A is associated with an increase in residential density in central urban areas. **Plan Alternative A would lead to the greatest**

[92] General Plan Update & Updated Population and Housing Projections, October 2007 (powerpoint presentation).
[93] Waxman, Deborah T. Creating Affordable Housing in Humboldt County (Master's Thesis, Humboldt State University).
[94] Smith, Michael D., and Steinberg, Steven J., January 2005. Room to Grow? An assessment of the Potential for Unincorporated Humboldt County to Accommodate Future Projected Population Growth.
[95] Waxman, Deborah T. Creating Affordable Housing in Humboldt County (Master's Thesis, Humboldt State University).

proportion of County residents living in dense, complete neighborhoods. Complete neighborhoods are associated with the health benefit of access to goods and services, as well as other benefits such as increased physical activity, reduced levels of overweight and obesity, and better social cohesion.

B) Plan Alternative B corresponds to the same increase in residential density in central urban areas, plus an equal amount of housing being built outside of urban areas. Housing built outside of urban areas would likely lead to incomplete neighborhoods. Overall, **Plan Alternative B would lead to a lesser proportion of complete neighborhoods in the County than Plan Alternative A, but more than Plan Alternative C.** From a health standpoint, Plan Alternative is less beneficial than Plan Alternative A in terms of resident access to goods and services and the other health benefits listed above.

C) Most of the housing proposed by Plan Alternative C would be developed outside of urban areas, which would lead to sprawling development. Sprawl is associated with health risks posed by incomplete neighborhoods, less physical activity and social cohesion, and more overweight and obesity. **Plan Alternative C is the least healthy scenario, because the greatest proportion of new housing built between now and 2025 would be within incomplete neighborhoods with limited access to good and services.**

Caveats

- Residents preferring sprawl may not be concerned with the health benefits associated with density, such as driving less, less air pollution, and walking-distance access to shops and businesses.
- There may also be "NIMBY-ism": current residents may support residential density because it preserves the natural spaces around their own homes, but not want to move into dense areas themselves.
- Many residents are concerned about preserving the rural character of Humboldt County.

Recommended Health-Promoting Mitigations:

- Encourage policies that require or encourage complete neighborhood in non-urban areas.

Appendix: Table of job data.

Table HE.5. Healthy Economy Data By Industry[21]					
Industry	**Title**	**Entry Level Wage**	**Hourly Mean**	**2004-2014 % Employment Change**	**Education/Training**
Agriculture	Agricultural Workers, All Other	10.61	12.12	5.6	30-Day OJT (11)
	Farmworkers & Laborers, Crop, Nursery & Greenhouse	8.31	10.02	3.4	30-Day OJT (11)
	Agricultural Equipment Operators	9.96	11.44	3.8	1-12 Month OJT (10)
	Farmworkers, Farm and Ranch Animals	9.5	11.14	4	30-Day OJT (11)
	First-Line Supervisors/Managers of Farming, Fishing	14.52	20.02	12.2	Work Experience (8)
Timber	Forest and Conservation Technician	14.14	18.16	10	AA Degree (6)
	Foresters	29.23	34.19	N/A	N/A
	Logging Equipment Operators	14.52	18.80	2.9	1-12 Month OJT (10)
	Logging Workers, All Other	13.81	15.31	-8.3	N/A
Construction	Construction and Related Workers, All Other	12.13	16.95	N/A	1-12 Month OJT (10)
	Construction Laborers	11.93	17.67	9.9	1-12 Month OJT (10)

[21] California LaborMarketInfo. California Employment Development Department. Available at: http://www.labormarketinfo.edd.ca.gov/

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Table HE.5. Healthy Economy Data By Industry[21]					
Industry	**Title**	**Entry Level Wage**	**Hourly Mean**	**2004-2014 % Employment Change**	**Education/Training**
	Construction Managers	26.82	34.77	19	BA/BS Degree (5)
	Structural Iron and Steel Workers	18.15	20.79	N/A	1-12 Month OJT (10)
	Painters, Construction and Maintenance	13.27	17.06	19.1	1-12 Month OJT (10)
Road Construction/ Maintenance	Cement Masons and Concrete Finishers	15.74	19.32	24	12-Month OJT (9)
	Civil Engineers	22.34	31.36	10.3	BA/BS Degree (5)
Tourism: Restaurant	Cooks, Restaurant	8.52	9.76	10.4	12-Month OJT (9)
	First-Line Supervisors/ Managers of Food Prepreparation	9.61	12.36	11.4	Work Experience (8)
	Food Preparation Workers	7.85	9.08	16.7	30-Day OJT (11)
	Host and Hostess	7.52	9.14	13	30-Day OJT (11)
	Waiters and Waitresses	7.52	8.86	9.6	30-Day OJT (11)
Hotel	First-Line Supervisors/ Managers of Housekeeping	8.81	13.82	11.1	Work Experience (8)
	Hotel, Motel, and Resort Desk Clerks	8.05	9.55	13.6	30-Day OJT (11)
	Maids and Housekeeping Cleaners	7.71	8.96	12.8	30-Day OJT (11)
Outdoor	Recreation Workers	8.22	9.78	8	BA/BS Degree (5)

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Table HE.5. Healthy Economy Data By Industry[21]					
Industry	**Title**	**Entry Level Wage**	**Hourly Mean**	**2004-2014 % Employment Change**	**Education/Training**
	Amusement and Recreation Attendants	8	8.88	18.8	30-Day OJT (11)
	Receptionists and Information Clerks	9.54	11.38	6.7	30-Day OJT (11) (est)
Retail	First-Line Supervisor/Managers of Retail Sales Work	12.43	16.85	7.8	Work Experience (8)
	Retail Salespersons	8.19	10.80	21.9	30-Day OJT (11)
	Stock Clerks and Order Fillers	8.27	10.87	-3.7	30-Day OJT (11)
Restoration: Wetlands, Brownfields	Conservation Scientists	24.48	30.40	N/A	BA/BS Degree (5)
	Forest and Conservation Technicians	14.14	18.16	10	AA Degree (6)
High Technology	Computer Specialists, All Other	21.91	26.55	24.6	N/A
	Computer Support Specialists	14.25	18.46	28.6	AA Degree (6)
	Computer Systems Analysts	26.53	32.66	20	BA/BS Degree (5)
	Network Systems and Data Communications Analysts	16.05	23.80	40	BA/BS Degree (5)
Green Industry	Environmental Engineers	20.26	28.94	N/A	BA/BS Degree (5)

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Table HE.5. Healthy Economy Data By Industry[21]					
Industry	**Title**	**Entry Level Wage**	**Hourly Mean**	**2004-2014 % Employment Change**	**Education/Training**
(not mentioned specifically)	Environmental Science and Protection Technicians	12.95	14.85	N/A	N/A
	Occupational Health and Safety Specialists	27.13	31.03	N/A	N/A
Healthcare	Healthcare Support Workers, All Other	11.64	13.74	11.1	30-Day OJT (11)
	Health Technologists and Technicians	14.28	19.94	12.9	N/A
	Home Health Aides	8.12	9.49	25	30-Day OJT (11)
	Medical Transcriptionists	14.79	16.02	8.3	Post-Secondary Voc-Ed (7)
	Licensed Practical and Licensed Vocational Nurses	17.67	20.23	0	N/A
	Nursing Aides, Orderlies, and Attendants	9.2	10.77	0	30-Day OJT (11)
	Registered Nurses	25.67	31.08	22.5	AA Degree (6)
Education	Adult Literacy, Remedial Education, GED	16.44	23.46	14.3	BA/BS Degree (5)
	Clinical, Counseling, and School Psychologists	29.43	51.42	15.6	PhD Degree (2)
	Educational, Vocational, and School Counselors	19.71	25.98	12.9	MA/MS Degree (3)
	Health Educators	13.33	15.77	9.5	MA/MS Degree (3)
	Preschool Teachers	9.73	13.58	15.6	Post-Secondary Voc-Ed (7)
	Teacher Assistants	N/A	N/A	14.6	30-Day OJT (11)

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Table HE.5. Healthy Economy Data By Industry[21]					
Industry	**Title**	**Entry Level Wage**	**Hourly Mean**	**2004-2014 % Employment Change**	**Education/Training**
	Teachers and Instructors, All Others	N/A	N/A	28.2	BA/BS Degree (5)
	Elementary School Teachers	N/A	N/A	9.7	BA/BS Degree (5)
	Middle School Teachers	N/A	N/A	8.8	BA/BS Degree (5)
	Secondary School Teachers	N/A	N/A	1.2	BA/BS Degree (5)
	Vocational Education Teachers, Postsecondary	N/A	N/A	20	Post-Secondary Voc-Ed (7)
Government	Eligibility Interviewers, Government Programs	12.28	14.04	-13.3	1-12 Month OJT (10)
	Lawyers	24.9	33.90	12.2	LLD/MD Degree (1)
	Office Clerks, General	9.05	12.06	2.9	30-Day OJT (11)
	Social and Human Service Assistants	9.09	13.07	14	1-12 Month OJT (10)
Gaming	Gaming Dealers	7.91	10.17	33.3	Post-Secondary Voc-Ed (7)
	Gaming Service Workers, All Other	7.89	8.80	36.4	1-12 Month OJT (10)
	Gaming Change Persons and Booth Cashiers	8.82	10.47	12.5	30-Day OJT (11)
	Gaming Supervisor	18.56	22.24	15.4	Post-Secondary Voc-Ed (7)
	Slot Key Person	8.06	9.66	11.5	Post-Secondary Voc-Ed (7)

Legend

Title: Occupation specified by California Labor MarketInfo and represents jobs in Humbodlt County with pertinent information.

Hourly 25th Percentile: Represents hourly wage of lower 25% of employees in that occupation, thus can represent the entry level wage.

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Table HE.5. Healthy Economy Data By Industry[21]					
Industry	**Title**	**Entry Level Wage**	**Hourly Mean**	**2004-2014 % Employment Change**	**Education/Training**

Hourly Mean Wage: Wage as compared to living wage ($15.27 per hour) where red indicates below living wage. Education wage not calculated (N/A) due to seasonal work.

2004-2014 % Employment Change: Estimated projection of employment change from 2004-2014

Education & Training Levels:

(1) LLD/MD Degree=First Professional Degree
(2) PhD Degree=Doctoral Degree
(3) MA/MS Degree=Master's Degree
(4) BA/BS + Experience=Bachelor's Degree or Higher and Some Work Experience
(5) BA/BS Degree=Bachelor's Degree
(6) AA Degree=Associate Degree
(7) Post-Secondary Voc-Ed=Post-Secondary Vocational Education
(8) Work Experience=Work Experience in a Related Occupation
(9) 12-Month OJT=Long-Term On-the-Job Training
(10) 1-12 Month OJT=Moderate-Term On-the-Job Training
(11) 30-Day OJT=Short-Term On-the-Job Training

15

Healthy Economy Indicators

Note: Unlike other indicator sections, an analysis of Healthy Economy Indicators for each Plan Alternative was not possible as part of this Health Impact Assessment. Data on how each Plan Alternative would impact jobs and wages was not available. After discussing the Health-Based Rationale and Existing Conditions for each indicator, a broad analysis including the conclusions are given for how each Plan Alternative could impact jobs generally. Detailed jobs data is given in the Appendix.

HE.1.a Proportion of jobs paying a livable wage

Health-Based Rationale

The Humboldt County General Plan clearly recognizes the need for future policies to support economic development practices that "promote and sustain economic prosperity." This economic prosperity can be achieved with a living wage, which is defined as a wage needed to meet a minimum standard of living.[1] Job security and employment rates, along with health insurance provided by employers all significantly contribute to a healthy workforce and result in a stable and efficient economy.

Income is one of the strongest and most consistent predictors of health and disease in public health research literature. The strong relationship between income and health is not limited to a single illness or disease. In one study, individuals with an income of less than $20,000 for 4-5 years had a higher mortality risk than those who earned this income for fewer years, and a separate study in the New England Journal of Medicine[2] concluded that people who earned $15,000 annually were three times likely to die prematurely that those earning $70,000 annually.

Unemployment is associated with premature mortality[3], cardiovascular disease, hypertension, depression, and suicide.[4] [5] Those who self-reported job insecurity versus those with secured employment faced minor mental illness.[6] An estimated 6,000 excess deaths were reported as a result of 1% increase in unemployment in the United States.[7]

The adoption of a living wage is associated with a decrease in premature death from all causes for working adults. Among the offspring of low-wage workers, a living wage was associated with

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[1]Poverty in America: Living Wage Calculator. Pennsylvania State University Available at: http://www.livingwage.geog.psu.edu/index.php.

[2] Isaacs S, Schroeder S. Class—The Ignored Determinant of the Nation's Health. New England Journal of Medicine. 2004, 351(11): 1137-1142.

[3] Cornwall A, Gaventa J. 2001. From Users and Choosers to Makers and Shapers: Repositioning Participation in Social Policy. Working Paper 127 Sussex: Institute of Development Studies.

[4] Jin RL, Shah CP, Svoboda TJ. 1995 The impact of unemployment on health: a review of the evidence. The Journal of the Canadian Medical Association 153:529-540.

[5] Voss M, Nylén L, Floderus M, Diderichsen F, Terry P. Unemployment and Early Cause-Specific Mortality: A Study Based on the Swedish Twin. American Journal of Public Health. 2004;94(12):2155-2161.

[6] Ferrie JE, Shipley MJ, Newman K, Stansfeld SA, Marmot M. Self-reported job insecurity and health in the Whitehall II study: potential explanations of the relationship. Social Science & Medicine. 2005;60(7)1593-1602.

[7] Jin RL, Shah CP, Svoboda TJ. The impact of unemployment on health: a review of the evidence. The Journal of the Canadian Medical Association. 1995;153:529–540.

improved educational outcomes and a reduced risk of early childbirth.[8] Attainment of self-sufficiency income predicts better health, improved nutrition, and lower mortality.[9]

Existing Conditions

Data source. The main source of employment information for this Health Impact Assessment was the *California LaborMarketInfo*[10], an employment database provided by the State of California. Included in this analysis are occupations identified at the Humboldt County General Plan Update and Health focus groups and with the Humboldt County Public Health Department, but only those where there was sufficient information for Humboldt County, i.e., this analysis does not represent all occupations in each industry, but serves as a sample. Occupations were categorized based on the description as provided by *California LaborMarketInfo.*

General Plan Update Goals and Policies. Goals, policies, and implementation measures defined in the Humboldt County General Plan Update Chapter 11: Economic Development Element, which can be accessed on the Humboldt County website[11], reinforce the goal of creating a "healthy economy", here defined as maintaining a healthy, employed workforce with living wages and health insurance in relation to the analysis of the current economic conditions based on industry. Positive impacts of current goals, policies, investments and partnerships as stated in the Humboldt County General Plan Update in conjunction with current findings of this assessment are:

- Maintaining a diverse, stable, and growing local economy (ED-G1, ED-P19);
- Expanding internet access (ED-G2);
- Supporting education and training of the workforce (ED-G4, ED-P11, ED-P17, ED-P18, ED-IM4);
- Protecting timber lands (ED-G8);
- Revitalizing Brownfields (ED-G9, ED-P6, ED-P7);
- Encouraging partnerships between educational and training institution, employment centers and job searchers (ED-G10);
- Economic Development Assistance Programs for current and future workforce (ED-G11).

Living wage. Living wage calculations are based on a family scenario where one adult is the sole provider and working full-time (2080 hours per year or 40 hours per week). Poverty wage calculation is based on gross annual income and is converted to hourly wage for comparison. The table below compares living, minimum and poverty wages for different size families in Humboldt County. The living wage for a family of one adult and one child ($15.27 per hour) will be used for future comparison to hourly wage earned for each occupation.

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[8] Yen I, and Bhatia R. 2002. How Increasing the Minimum Wage Might Affect the Health Status of San Francisco Residents: A Discussion of the Links Between Income and Health, Working Paper, February 27, 2002.
Bhatia R, Katz M. 2001. Estimation of the health benefits from a living wage ordinance. Am J Public Health 91:1398-1402.

[9] National Academy of Sciences. 2006. Genes, Behavior, and the Social Environment: Moving Beyond the Nature/Nurture Debate. LM Hernandez and DG Blazer, eds. The National Academies Press. Accessed at: http://orsted.nap.edu/openbook.php?record_id=11693&page=25.

[10] California LaborMarketInfo, Employment Development Department State of California Available at: http://www.labormarketinfo.edd.ca.gov/cgi/databrowsing/localAreaProfileQSResults.asp?selectedarea=Humboldt+County&selectedindex=12&menuChoice=localAreaPro&state=true&geogArea=0604000023&countyName=

[11] Humboldt County General Plan Update. Available at: http://co.humboldt.ca.us/planning/gp/.

Table HE.1. Living, minimum and poverty wages by family type for Humboldt County.[12]					
	One Adult	**One Adult, One Child**	**Two Adults**	**Two Adults, One Child**	**Two Adults, Two Children**
Living Wage (per hour)	7.42	**15.27**	10.81	17.22	22.07
Minimum Wage (per hour)	7.50	7.50	7.50	7.50	7.50
Poverty Wage (per hour)	4.73	6.38	6.03	7.43	9.39

Employment by industry. Based on the California Labor Market Info, the following table details how Humboldt residents, ages 16 years old and older, are currently employed based on industry.

Table HE.2. Employment in Humboldt County by industry.		
	Total	**%**
Agriculture, forestry, fishing and hunting, and mining	2,743	4.9
Also includes logging and crop production		
Construction	3,239	5.8
Manufacturing	4,802	8.7
Wholesale trade	1,727	3.1
Retail trade	6,930	12.5
Includes automobile dealers, furniture, appliances, grocery stores, clothing, etc.		
Transportation and warehousing, and utilities	2,082	3.8
Information	1,061	1.9
Includes software publishing, data processing services		
Finance, insurance, real estate, and rental and leasing	2,812	5.1
Professional, scientific, management, administrative, waste management services	3,822	6.9
Includes legal services, computer systems design, travel services		
Educational, health and social services	14,748	26.6
Includes elementary thru university, and trade schools, hospitals, other health care offices		
Arts, entertainment, recreation, accommodation and food services	5,408	9.8
Includes artists, art institutions, gambling, traveler services, parks/camps, restaurants, bars		
Other services (except public administration)	2,870	5.2
Includes political organizations		
Public administration	3,182	5.7
Includes legislative offices, general government, justice, armed forces		
Total	**55,426**	**100**

Living wage by occupation. Occupations in Humboldt County that can provide a living wage (i.e., the hourly mean wage can support a family size of one adult and one child - $15.27) include:

- Timber;
- Construction;
- Road construction and maintenance;
- Restoration of lands;

[12] Amy K. Glasmeier. Poverty of America Living Wage Calculator. Pennsylvania State University. Available at: http://www.livingwage.geog.psu.edu.

- High technology industries.

Industries that did not always provide a living wage include:

- Agriculture, Ranching, Fishing;
- Tourism including restaurants, hotel, outdoor recreation;
- Retail;
- Government;
- Gaming.

Industries that sometimes provide a living wages include:

- Green industry;
- Healthcare.

Hourly mean wages for those employed in *education* could not be suitably estimated due to seasonal work period.

Industry growth. *California LaborMarketInfo* forecasts an increase in employment need in industries from 2004-2014. The growth industries often providing living wages include:

- High technology (20-40%);
- Registered nurses and some other health care professions (22.5%);
- Some construction occupations (19.1%).

These occupations educational/training perquisites range from an Associate's or Bachelor's Degree to on the job training.

Occupations with projected growth that do not often supply living wages:

- Gaming dealers and service workers (33% growth);
- Retail salespersons (21.9%);
- Recreation attendants in the outdoor tourism industry (18.8%);
- Preschool teachers (15.6%);
- Hotel clerks (13.6%).

Many of the occupations require a minimum of on the job training or vocational education.

Significant Employment Providers. The population employed in the industries mentioned above varies, but employment sectors providing the most jobs include:

- Educational institutions, health and social services (26.6%);
- Retail trade (12.5%).

Unemployment rates. Unemployment Rate and Labor Force not seasonally adjusted. Humboldt County's unemployment rate (6.5%) is slightly higher than the State of California (5.9%) and San Francisco County (4.5%).

4

HE.2.c Number of jobs available with appropriate educational requirements

Health-Based Rationale

One's education level plays an important role in determining the types of jobs and therefore the income one can expect. Level of educational attainment is a variable linked with economic advancement with the opportunities and accessibility to higher paying jobs. As income increases, funds can be used to amenities that contribute to good health including medical care.[13] As detailed above, income is one of the strongest and most consistent predictors of health and disease in public health research literature.

Existing Conditions

Education levels. As the table below shows, of the population in the County 25 years and older, approximately 74% have finished junior high but do not have more than an Associate's Degree.

HE.3 Education levels in Humboldt.[14]		
	Population	**Percent**
Population 25 years and over	**84,677**	**100**
Less than 9th grade	3,648	4.3
9 to 12th, no diploma	5,978	7.0
High School Graduate (Equivalency)	20,958	24.8
Some college, no degree	24,495	29.0
Associate's degree	7,468	8.8
Bachelor's degree	15,353	18.1
Graduate or professional degree	6,777	8.0
High School Graduate or higher	75,024	88.60
Bachelor's Degree or higher	22,101	26.10

Occupations by education level. This level of education qualifies Humboldt residents for several industries with living wages:

- Timber;
- Construction (excluding managerial);
- Healthcare;
- Some education occupations.

Many of these industries do require additional on the job training ranging from 30 day to one year training.

Occupations not often compensating employees with a living wage based on this educational attainment are (all excluding managerial or supervisor positions):

- Agriculture, Ranching, Fishing;

[13] Isaacs, Stephen and Steven A. Schroader. The Ignored Determinant of the Nation's Health. The New England Journal of Medicine. 2004: 351:11.
[14]Social Characteristics in the United States: 2006. U.S. Census Bureau American FactFinder. Available at: http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=05000US06023&-qr_name=ACS_2006_EST_G00_DP2&-ds_name=ACS_2006_EST_G00_&-_lang=en&-_sse=on

5

- Restaurants;
- Hotel;
- Outdoor tourism;
- Retail;
- Government;
- Gaming.

6

HE.2.a Proportion of jobs that provide health insurance benefits

Health-Based Rationale

Jobs that do not include health insurance contribute to poor health outcomes. Annually nationwide, 18,000 premature deaths are attributable to lack of health coverage.[15] Families with at least one full-time, full-year worker are more than twice as likely to have health insurance coverage, compared to families whose wage earners work as part-time employees (less than 35 hours per week), as contingent labor (e.g., on a seasonal or temporary basis, as employees of contractors, self-employed), or in which there is no wage earner.[16] Individuals without health insurance frequently forego timely health care, suffer more severe illness, and are more likely to die a premature death than their insured counterparts.[17] [18]

Existing Conditions

Information on health insurance benefits for industries is limited and not sufficiently categorized and unable to make conclusions based on this evidence.

Humboldt County's uninsured percentages for all ages and person under age of 18 are below that of the entire State of California (18.8, 15.5), but above that of San Francisco County (13.3, 10.6).[19]

Table HE.4. Number of Uninsured in Humboldt County.[20]

All Ages			Under Age 18		
Number insured	Number uninsured	Percent uninsured	Number insured	Number uninsured	Percent uninsured
102,605	21,154	17.1	25,539	3,975	13.5

[15] Institute of Medicine, 2004. Project on the Consequences of Uninsurance: An Overview. http://www.iom.edu/Object.File/Master/17/736/Fact%20sheet%20overview.pdf.
[16] Institute of Medicine. Committee on the Consequences of Uninsurance. Coverage Matters: Insurance and Health Care (2001), Chapter 3, Who Goes Without Health Insurance? Who Is Most Likely to Be Uninsured? Available at: http://www.nap.edu/html/coverage_matters/ch3.html.
[17] Institute of Medicine, 2004. Project on the Consequences of Uninsurance: An Overview. http://www.iom.edu/Object.File/Master/17/736/Fact%20sheet%20overview.pdf.
[18] http://www.nap.edu/html/coverage_matters/ch3.html.
[19] U.S. Census Bureau, Small Area Health Insurance Estimates Program Available at: http://www.census.gov/hhes/www/sahie/index.html.
[20] U.S. Census Bureau, Small Area Health Insurance Estimates Program Available at: http://www.census.gov/hhes/www/sahie/index.html.

7

Impacts of the Humboldt General Plan Update

Below is a limited analysis of the Plan Alternatives based on descriptions in the Humboldt General Plan Update. There will be exceptions in these alternatives based on various industry and economic circumstances and trends.

Description of Plan Alternatives

The Humboldt General Plan Update describes the Plan Alternatives as follows:

Plan Alternative A: Industrial reuse and protection of prime employment lands are key policies. Includes less robust economic development such as the expansion of road, rail, and airport, does not accommodate "big box" in unincorporated areas, and is more environmentally superior alternative.

Plan Alternative B: Consists of fairly robust economic development initiatives including expansion of road, rail, and airport and includes discretionary review of "big box" commercial uses. Industrial reuse and protection of prime employment lands are key policies.

Plan Alternative C: Higher capacity, less regulatory plan, some government programs left out and accommodates "big box" in unincorporated area.

Conclusions

Plan Alternative A

- With the protection of prime employment and industrial reuse, this land use alternative preserves and promotes some industries that provide employees with living wages and appropriate education requirements, such as timber.
- Construction jobs, which often can pay living wages, may also increase with infill housing development and with the development of walking trails and other green living construction.
- Some industries that often do not provide jobs with living wages would also remain relatively stable (e.g., tourism and agriculture) or grow slightly given the population growth (e.g., retail).
- Other industries that also infrequently provide living wages, such as big box retail, would be less likely given the limited development opportunities.
- There is also a possibility that the cost of living may decrease because general costs, such as those for housing, utilities and transportation may be reduced. See other indicator sections for more details.

Plan Alternative B

- This land use scenario would be slightly detrimental to some industries that can provide employees with living wages and appropriate education requirements, such as timber.
- Construction jobs, which also can pay living wages, may increase more in this Plan Alternative than in Plan Alternative A.
- Some industries that do not often provide jobs with living wages would also remain relatively stable (e.g., tourism) or grow given the higher population growth in this Plan Alternative (e.g., retail).
- Others industries that infrequently provide jobs with living wages would decrease (e.g., agriculture).
- Plan Alternative B is slightly more hospitable to other industries that also infrequently provide living wages, such as big box retail.

8

<u>Plan Alternative C</u>

- This land use alternative would be detrimental to some industries that can often provide employees with living wages and appropriate education requirements, such as timber.
- Construction jobs, which also can pay living wages, would increase most in this Plan Alternative.
- Some industries that do not often provide jobs with living wages would also remain relatively stable (e.g., tourism) or grow given the higher population growth in this Plan Alternative (e.g., retail).
- Other industries that infrequently provide for living wages would decrease (e.g., agriculture).
- This Plan Alternative is most likely to promote other industries that also infrequently provide living wages, such as big box retail.
- There is also a possibility that the cost of living may increase in this Alternative since, for example, people may be more dependent on owning a car, average electricity consumption could increase and housing prices may increase.

Recommended Health-Promoting Mitigations:

- Develop policies to attract and retain industries who:
    - Can provide a living wage;
    - Provide health insurance benefits;
    - Meet existing levels of workforce education.
- Develop policies to solidify collaborations that can provide employees the opportunity for advancement, possibly resulting in earning a living wage:
    - Educational institutions;
    - Labor training centers;
    - Other labor organizations.
- Ensure that a trained and qualified workforce is available to meet the needs of projected growing industries that can often provide living wages.

9

Public Safety and Social Cohesion Indicators

SC.2.a First responder response time, specifically Fire response times by zip code

Health-Based Rationale

The geographic distribution of fire stations throughout a county impacts the rate at which firefighters and emergency responders may respond to fires and medical emergencies at the neighborhood level. Rapid response by firefighters can influence severity of injury and number of deaths from a fire or emergency.

The National Fire Protection Association (NFPA) establishes codes and standards to minimize the possibility and effects of fire and other hazards. NFPA 1710 is a *voluntary* standard for fire station and emergency responders that states that the first arriving unit should respond within 5 minutes for 90% of all fire suppression incidents. Emergency medical responders should also respond within 5 minutes for 90% of all emergency medical incidents.[1]

An adequate number of fire stations geographically distributed can aid in ensuring rapid response and rescue. However, it is unclear exactly how important response times actually are. Based on *one* study that showed that survival rates are better if CPR is administered within 4 minutes of the cardiac arrest, all EMS services have adopted a < 8 minute response time as the standard for the industry.[2] A different study showed, though, that whether the first responders arrived before or after 8 minutes did not make a difference for survival rates for traumatic injury.[3] And a study done in Helsinki determined that out of 72,000 "Category C" emergency responses by ambulances, 33% of the 73 pre-hospital deaths were potentially avoidable if there had been faster ambulance response.[4] This is 0.0003 of the responses, i.e., a negligible amount, that could have been saved by faster response.

It is possible that a more useful measure might be how many Humboldt County paramedics are available vs. Emergency Medical Technicians (EMTs). A study looking at EMT vs. paramedic services in King County, WA, determined that while the annual incidence of heart attacks was similar in the EMT and paramedic areas, more lives of persons with heart attacks were saved in the paramedic area than in the EMT area. During this 17 month period, the reduction in community cardiac mortality was 8.4% in the paramedic area and 1.3% in the EMT area. These findings suggest that paramedic services have a small but measurable effect on community cardiac mortality.[5]

Insurance companies rate the risk of devastating fires to be lower in cities compared to unincorporated and less densely populated areas of the County. Fire insurance can cost up to twice as much in a high risk area. Recently, industry standards were changed so that structures more than 10 miles from a fires station are given the highest risk rating for insurance purposes.

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[1] Appendix B, Page 1, SF Controller"s Report: http://www.sfgov.org/site/controller_page.asp?id=24430.

[2] Eisenberg MS, Bergner L, Hallstrom A. 1979. Cardiac resuscitation in the community: Importance of rapid provision and implications for program planning. JAMA 241:1905-7.

[3] Pons PT, Mardovchick VJ. 2002. Eight minutes or less: Does the ambulance response time guideline impact trauma patient outcome? Journal of Emergency Medicine 23(1):43-8.

[4] Kuisma M, Holmstrom P, Repo J, Maatta T, Nousila-Wiik M, Boyd J. 2004. Prehospital mortality in an EMS system using medical priority dispatching: A community-based cohor study. Resuscitation 61(3):297-302.

[5] Eisenberg M, Bergner L, Hallstrom A. 1979. Am J Public Health 69(1):39-42.

Response times are just one aspect of overall fire risk in neighborhoods. Increased risk of fire increases the risk of fire-related injury or death. Between 1983 and 1990, an average of 74% of all fire deaths in the United States occurred in residential fires.[6] Heating fires are more common in single family homes, particularly those with fire places, than in apartment buildings where heating systems are professionally maintained. However a higher proportion of smoke alarms did not operate in apartments than in one- and two-family homes.

Fire prevention methods such as use of smoke detectors, sprinkler systems, building code enforcement, and flame-retardant mattresses and materials have decreased the risk of fire. Only 60% of households where a fire death occurred were equipped with smoke alarms; of those, 39% did not operate. Smoke alarms contribute to saving lives.[7]

Existing conditions

Fire protection services. Humboldt County's fire protection services provide protection to the approximately 126,518 citizens residing in the County. Fire protection forces consist of 69 career and 689 volunteer firefighters, 120 engines, 55 fire stations, 18 ambulances, and 2 rescue squads.[8] These are detailed in the table below.

Wildfire risk. Approximately 11% of Humboldt County residents live in areas that have been assessed as "high wildfire risk". These areas are broken down by "fire planning compartments" and they are: East Klamath, Trinity, Mattole-Lost Coast, and South Eel. These areas comprise most of South County and a large portion of the northeast.[9]

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[6] US Fire Administration. Fire in the United States. Available at http://www.usfa.dhs.gov/statistics/reports/fius.shtm. Accessed on February 2, 2008.

[7] FEMA. A Profile of Fire in the U.S.: 1992-2001. October 2004. Available at http://www.usfa.dhs.gov/downloads/pdf/publications/fa-293-508.pdf. Accessed online on February 2, 2008.

[8] Humboldt County Fire Safety Council. 2006. Humboldt County Master Fire Protection Plan. Chapter 4: Countywide Emergency Response. Available at http://co.humboldt.ca.us/planning/fire_safe_council/fsc_default.asp. Accessed on February 1, 2008.

[9] FSC. Chapter 3: Risk Assessment and Mitigation Strategies (RAMS) Modeling for Wildland Fires. Fire Safe Council Draft Master Fire Plan. Humboldt County Community Development Services Dept. Available at http://co.humboldt.ca.us/planning/fire_safe_council/fsc_default.asp. Accessed on February 18, 2008.

Table PS.1. Local Fire Department Staffing and Fire Engine and Station Capability.[10]

Arcata Fire Protection District	3	5	10	50
Beginnings Volunteer Fire Department	2	7	0	12
Blue Lake Fire Protection District	1	2	0	25
Carlotta Community Services District	2	4	0	14
County Service Area No. 4	1	1	6	0
Fieldbrook Community Services District	1	3	0	22
Eureka Fire Department	3	6	33	12
Ferndale Fire Protection District	1	3	0	34
Fortuna Fire Protection District	3	8	0	65
Fruitland Volunteer Fire Department	1	1	0	5
Garberville Fire Protection District	1	4	0	17
Honeydew Volunteer Fire Department	4	5	0	16
Hoopa Volunteer Fire Department	1	2	0	14
Humboldt Fire Protection District No. 1	2	4	18	14
Kneeland Fire Protection District	1	3	0	10
Korbel Fire Brigade	1	1	0	22
Loleta Fire Protection District	1	5	0	24
Maple Creek Volunteer Fire Department	1	1	0	9
Miranda Community Services District	1	2	0	10
Myers Flat Fire Protection District	1	2	0	6
Orick Community Services District	1	4	0	9
Orleans Volunteer Fire Department	1	4	0	8
Palo Verde Volunteer Fire Department	1	1	0	33
Petrolia Fire Protection District	1	4	0	10
Phillipsville Volunteer Fire Department	1	3	0	5
Prosper Ridge Volunteer Fire Department	0	1	0	9
Redcrest Volunteer Fire Department	1	1	0	2
Redway Fire Protection District	1	4	0	20
Rio Dell Fire Protection District	1	3	0	25
Salmon Creek Volunteer Fire Department	1	1	0	8
Samoa Fire Protection District	2	3	0	12
Scotia Volunteer Fire Department	1	3	0	30
Shelter Cove Fire Department	1	4	2	10
Sprowel Creek Volunteer Fire Department	2	2	0	30
Telegraph Ridge Fire Protection District	1	1	0	6
Trinidad Fire Department	1	0	0	14
Weott Community Services District	1	1	0	10
Westhaven Volunteer Fire Department	1	2	0	6
Whale Gulch Volunteer Fire Department	1	2	0	18
Whitethorn Fire Protection District	1	2	0	8
Willow Creek Fire Protection District	1	5	0	23
Yurok Volunteer Fire Department	2	2	0	12
Total	55	120	69	689

Response times. Rural fire departments in Humboldt County have:[11]

- Longer turn-out times (3.5-5.5 minutes or greater) due to more distant proximity of volunteers to fire stations;
- Longer response times (6-13+ minutes);

[10] FSC. Chapter 3: Risk Assessment and Mitigation Strategies (RAMS) Modeling for Wildland Fires. Fire Safe Council Draft Master Fire Plan. Humboldt County Community Development Services Dept. Available at http://co.humboldt.ca.us/planning/fire_safe_council/fsc_default.asp. Accessed on February 18, 2008.
[11] Humboldt County Fire Safety Council. 2006. Humboldt County Master Fire Protection Plan. Available at http://co.humboldt.ca.us/planning/fire_safe_council/fsc_default.asp. Accessed on February 1, 2008.

- Insurance Service Office (ISO) Public Protection Classification (PPC) ratings that are usually in the 8,9,10 rating range, indicating high risk;
- Almost 100% volunteer fire personnel, many of whom do not live in close proximity to the fire station(s).

Urban/semi-rural fire stations in Humboldt County generally have:

- Multiple-station coverage with smaller jurisdictions;
- Shorter response travel times (3-7 minutes);
- Shorter turn-out times (1.5 – 2.5 minutes);
- ISO PPC ratings that are in the low single digit range;
- Considerable amount of water supply and pressure;
- Either full-time paid or a mix of full-time paid and volunteers;
- Volunteers that reside in close proximity to the fire stations.

The average rural Community Structure Fire Response is the sum of the average turnout time (5 minutes), and the average travel time (6 minutes). Thus, average response time is 11 minutes. The average urban/semi-rural Community Structure Fire Response is the sum of average turn-out time (1.5 minutes) and the average travel time (4.3 minutes). Thus average response time is 7 minutes.

Medical emergency calls. Over 50% of the calls for fire organization services are related to medical aid, and they are also the fastest growing type of call. From 2000 to 2003, Fortuna experienced a 33% increase in medical aid and traffic collision call volume (3,088 calls in 2000 vs. 4,106 calls in 2003). Generally, when an emergency medical dispatch is requested, the local fire department responds and provides Basic Life Support until an ambulance which has Advanced Life Support capability arrives. The table below details Fortuna's Interagency Command Center's activity.

Table PS.2. Fortuna Interagency Command Center Recorded Activity.[12]

	Year						
Incident Type	*1998**	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
Public Assist	Un-recorded	156	223	331	313	257	143
Medical Aid	2567	2768	2846	2913	3329	3730	2341
Traffic Collisions	152	219	241	218	285	376	451
Structure Fire	92	99	96	102	92	100	81
Vehicle Fire	57	71	61	68	71	86	86
Wildland Fire	347	443	358	520	562	600	278
Referral to other agency	264	188	209	228	243	232	184
Other	595	781	647	919	1066	861	3045
Total	**4074**	**4725**	**4681**	**5299**	**5961**	**6242**	**6609**
Percent Change		+16%	-1%	+13%	+12%	+5%	+16%
Average Increase per year							+11%
Percent Increase (1998 to 2004)							+62%

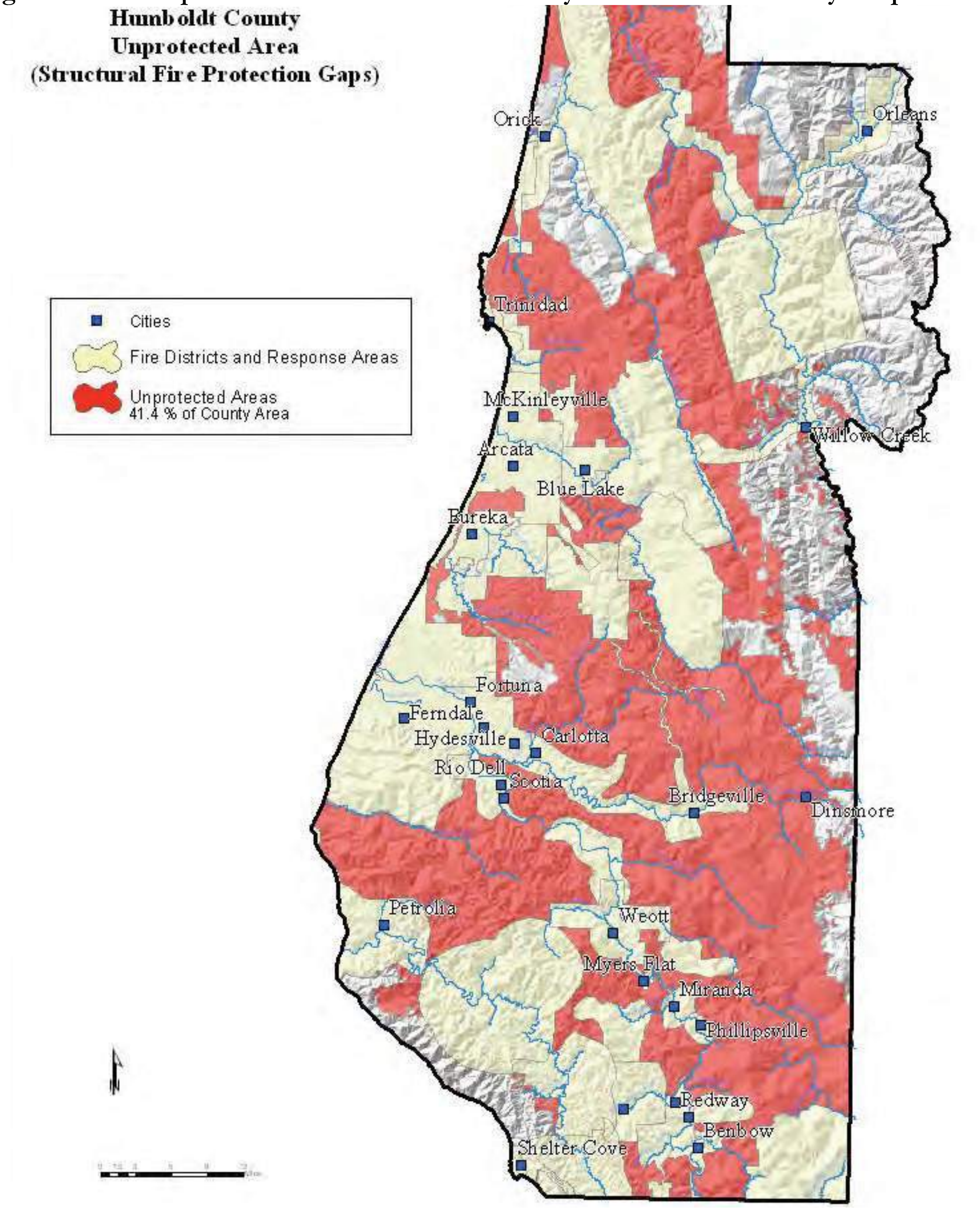
*Recorded activity for 1998 was not categorized by Public Assist incident type—these incidents are contained in other categories for that year.

[12] Humboldt County Fire Safety Council. 2006. Humboldt County Master Fire Protection Plan. Available at http://co.humboldt.ca.us/planning/fire_safe_council/fsc_default.asp. Accessed on February 1, 2008.

Areas Without Fire Protection. Similar to other Northern California counties with large rural areas, Humboldt has several areas that are without any dedicated, formal delivery of year-round structural fire protection and/or emergency response services. An analysis of the County fire protection coverage map, created using fire organization survey data, indicates that approximately 41.4% of Humboldt County falls into this category and is without year-round structural fire protection and other necessary emergency services (shown in the figure below). This represents approximately 2% of the housing units within Humboldt County.[13] These areas may receive a limited form of "good will" emergency response coverage from adjacent fire districts, CDF or other near-by agencies, but only on a seasonal or "as available" basis. These areas can have a response time of up to 45 minutes associated with them and the level of response greatly depends on the availability of resources. Additionally, a significant portion of the "unprotected" and "under protected" areas include State Highways and County Roads. Motorists involved in traffic collisions in these areas may experience long response times from first responders.

[13] This estimate is based on the 2000 Census, which indicates that the County contains 55,298 housing units of which 1,138 are located in the 41.4 % of the county area that is "unprotected".

Figure PS.1 A map of the areas of Humboldt County that are not covered by fire protection.



Analysis

Assumptions

- It is assumed that no new fire stations will be built and that staffing levels will remain the same.

Quantitative Analysis

Using information from the Fire Safe Council's Master Fire Protection Plan, the rural response time is 11 minutes, and the urban response time is 7 minutes. However, it is not yet clear whether new development in Plan Alternatives B and C would be in areas considered to be rural or just non-urban. Therefore, it is difficult to quantitatively assess the change in average response times for the County.

Qualitative Analysis

In focus groups with fire personnel held for the Master Fire Protection Plan, participants noted:

- On many occasions that a majority of their calls are medical. Incidence ranged from 56% - 95%, with most saying above 75%;
- Collaboration with forest service is vital to rural areas (however the fire service cannot enter structures by law);
- Insurance is difficult for volunteer firefighters due to it cost;
- Funding is a problem for most volunteer fire stations;
- Response times are long in rural areas;
- Semi-rural areas tend to have an ISO rating of 5 in hydrant areas and 8B in non-hydrant areas.

Disparities

In 1997, the Federal Emergency Management Agency (FEMA) conducted a review of socioeconomic factors and risk of fire. The review found that "virtually every study of socioeconomic characteristics has shown that lower levels of income are either directly or indirectly tied to an increased risk of fire."[14] One study in Dallas, Texas found that there was a 20-fold difference in risk of fire between persons with highest incomes and lowest incomes.[15] The review also found that African American and American Indian children are nearly twice as likely to die in a fire as white or Asian children. Children under age 5 are 40% more likely to die in a fire than the general population.[16]

Older adults are also particularly at risk in the event of a fire. Nationally in 2001, the elderly represented 12% of the US population but suffered more than 30% of all fire deaths. This is due to a combination of factors: mental and physical frailties, higher alcohol usage, greater use of medications, higher smoking incidence, and elevated likelihood of living in a poverty situation. The relative risk of an older adult dying in a fire is 2.5 times greater than the general population.[17]

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[14] FEMA. Socioeconomic Factors and the Incidence of Fire. June 1997. Available at http://www.usfa.dhs.gov/statistics/reports/socio.shtm. Accessed online on February 2, 2008.

[15] Istre, GR, etal. NEJM 2001;344:1911-6.

[16] USFA. A Profile of Fire in the U.S.: 1992-2001. October 2004. Available at http://www.usfa.dhs.gov/downloads/pdf/publications/fa-293-508.pdf. Accessed on February 2, 2008.

[17] US Fire Administration/National Fire Data Center. 2004. The Fire Risk to Older Adults. Topical Fire Research Series 4(9):1-8.

Conclusions

A) Plan Alternative A would encourage concentration of population in areas that are already better served by fire departments with a higher percentage of career firefighters. Thus, **response times will be faster in Plan A**. In addition, there are more paramedics and EMTs in the urban areas of Humboldt County (vs. First Responders with Basic Life Support skills and equipment), which have an impact on mortality and morbidity.

B) Plan Alternative B would encourage population in both urban and non-urban areas, and thus would not a have a large impact on response times.

C) Plan Alternative C would encourage a greater amount of population growth in rural areas that are served more often by volunteer firefighters with slower response times. As such, **Plan Alternative C would lead to lower average response times**. Negative health outcomes could include increased injuries and deaths from fires and potentially increased harm in medical emergencies.

Recommended Health-Promoting Mitigations:

- Support clustered development in regions where water supply is adequate.
- Establish a uniform measurement system county-wide to track response times.
- Encourage currently trained EMTs to gain paramedic training.

SC.2.b Emergency preparedness training for citizens

Health-Based Rationale

As population density and settlement in high-risk areas continue to rise, natural disasters are expected to increase in frequency and severity. Thus, mass casualties are a likely consequence of such events. In the last 25 years, the United States has been subject to 442 natural disasters. During the last century, more than 16,500 people died and almost 2.5 million people were affected as a result of the top ten natural disasters registered in the US alone.[18] And the occurrence of natural disasters is increasing; in the 1960's disaster totals numbered only 89 a year – in the 1990's it was 392.[19]

Studies of injuries after many types of natural disasters (floods, earthquakes, hurricanes, tornados) show that the most common type of injuries are soft tissue injuries, i.e., cuts, lacerations, and puncture wounds; or musculoskeletal injuries like fractures, sprains and closed head injures. Members of the lay public are often the actual 'first responders' in many disaster events.[20] In California, the state government expects residents to be self-sufficient for the first 72 hours after an earthquake.[21]

In a study done in Los Angeles after the Northridge earthquake, 54% of the residents surveyed said they had received first aid training; this is similar to other studies with regard to prevalence of first aid training. Of those, 45% had received it in the last five years. Respondents who had first aid training were 2.4 times more likely to help their family and 2.1 times more likely to help a stranger than those without first aid training. People who had first aid training (treating shock, controlling bleeding, putting on a splint, mouth to mouth resuscitation, CPR) were almost 2 ½ times more likely to use first aid skills.[22]

The Multihazard Mitigation Council studied the effectiveness of FEMA grants to mitigate the effects of floods, hurricanes, and earthquakes. They concluded that the mitigations (which include everything from emergency preparedness programs for citizens, hospitals, public health departments to infrastructure support and maintenance) set in place during 1993 – 2003 nationally will save 220 lives and prevent almost 4,700 injuries over the next 50 years. Additionally, they estimate that every $1 spent on hazard mitigation (actions to reduce disaster losses) provides the nation $3.65 in future benefits.[23]

Existing conditions

In 2006-2007, Humboldt County's chapter of the American Red Cross trained approximately 9,000 people in Health & Safety trainings and 13,000 people attended disaster preparedness trainings or

[18] Bissell RA, Pinet L, Nelson M, Levy M. 2004. Evidence of the effectiveness of health sector preparedness in disaster response: The example of four earthquakes. Fam Community Health 27(3):193-203.
[19] WHO. Experts meet in Kobe to discuss earthquakes and health. Press release, January 24, 1997. Available at www.int/archives/inf-pr-1997/en/pr97-08.html.
[20] Auf der Heide E. 2003. Convergence behavior in disasters. Annals of Emergency Medicine 41:463-6.
[21] California Governor's Office of Emergency Preparedness.
[22] Kano M, Siegel JM, Hyg MS, Bourque LB. 2005. First-aid training and capabilities of the lay public: a potential alternative source of emergency medical assistance following a natural disaster. Disasters 29(1):58-74.
[23] Multihazard Mitigation Council. 2005. Natural Hazards Mitigation Save: An indpendent study to assess the future savings from mitigation activities. National Institutes of Building Sciences. Washington, DC.

workshops.[24] However, the trainings that people received could range from a ½ hour presentation to a 2-3 hour focused training. Currently, there is no exact count of the number of citizens who are prepared in case of an emergency.[25] [26] Barbara Caldwell, Executive Director of Humboldt Red Cross, indicated that the sites that the Red Cross concentrates on, and thus where most people are trained, are on the coast, given that the coastal region is at greatest risk of earthquake and tsunami.

All county employees (2000 people) are required to have disaster preparedness training. In the Public Health Department, all 200 employees received some training and emergency home kits.[27] The Emergency Operations Plan of the Office of Emergency Services designates public employees as Disaster Service Workers, and may be required by their employer to carry out disaster-related activities.[28] Also, all local government employees in incorporated areas are required to be trained.[29] All public schools are required to have a disaster emergency plan.

Each state has a Governor's Office of Emergency Services to manage state-level organization and response efforts. Within the states, each county is its own Operational Area (OA). Humboldt County Ordinance 2203 established the Humboldt OA and identified the Sheriff as Director of Emergency Services for the County. The Sheriff's Department has an Emergency Operations Plan, which identifies the chain of command, lays out the existing conditions with regard to threat from earthquake, tsunami, flooding, and civil disobedience. Additionally the Emergency Operations Plan details systems that could be affected during a natural disaster (transportation, communications, potable water, electrical power, medical facilities, sanitation systems, natural gas lines, hazardous materials storage, and dam failure). Evacuation areas are laid out.

The figure below shows which areas in Humboldt County will be most affected by earthquakes.

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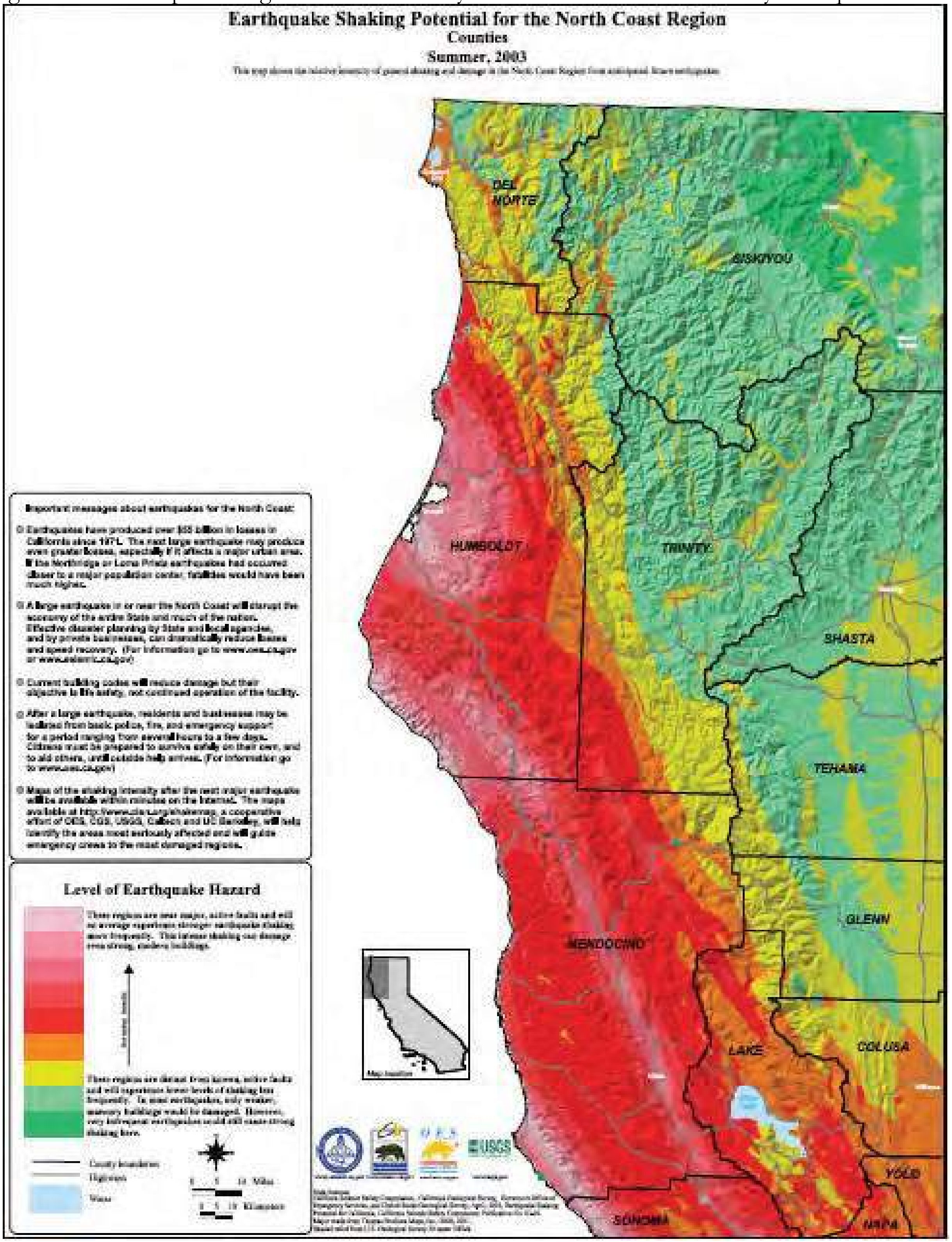
[24] Humboldt Red Cross. Annual Report 2006-007. Available at http://humboldtredcross.org/media/annual_report.pdf. Accessed on January 30, 2008.
[25] Phone conversation with Barbara Caldwell, Executive Director of Humboldt Red Cross, January 30, 2008.
[26] Phone conversation with Charlene Pellatze, Emergency Preparedness Coordinator with Humboldt County Public Health Department. February 1, 2008.
[27] Phone conversation with Charlene Pellatze, Emergency Preparedness Coordinator with Humboldt County Public Health Department. February 1, 2008.
[28] Humboldt County Sheriff's Department. 2002. Humboldt County Emergency Operations Plan. Part 1: General Information. Available at http://co.humboldt.ca.us/sheriff/OES/EOP/pdf/part1.pdf. Accessed on February 2, 2008.
[29] Phone conversation with Dan Larkin.

Figure PS.2. A map showing areas of the County that would be most affected by earthquakes.[30]



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[30] California's Seismic Safety Commission. Available at: www.seismic.ca.gov/pub/intensitymaps/ncoast_county_print.pdf .

Analysis

Assumptions

- Earthquake, tsunami, flooding, wildland fire, and drought conditions will worsen with climate change over the next 25 years.

Quantitative Analysis

Data about current levels of emergency training does not exist. Sources stated that those kinds of numbers are not kept and it would be difficult to extract exactly how many people are trained. Given that, quantitative analysis is not possible.

Qualitative Analysis

Public comments on the Safety Element do not specifically address the County's level and capacity for training it's citizenry in emergency preparedness. However, there are comments that reflect a concern for the increase in threats due to an increase in natural disasters as a result of global warming. One comment raises the concern that Humboldt County's own future flood maps points out that the area north and south of Eureka/Arcata will be under water in the future, that Rt. 299 to Redway will also be cut off, and that this could happen sooner rather than later – and abruptly - if ice masses in Greenland and Antartica slip off. For a map of the 100 and 500 year flood risks, see http://co.humboldt.ca.us/planning/gp/PrelimHearingDraft/Group3/Maps/base2flood.pdf. There were also flooding concerns due to upstream timber production policies.[31]

Conclusions

A) **Plan Alternative A focuses growth in areas of the County where the Red Cross concentrates its trainings**. The Red Cross is the primary agency responsible for citizen emergency preparedness training on a county level.
B) **Plan Alternative B is likely to bring about an increase in the numbers of people trained in emergency preparedness but no change in the proportion of Humboldt County residents trained in urban vs. non-urban settings**.
C) **Plan Alternative is likely to bring about an increase in the numbers of people trained due to the increase in population in the urban areas, however, this is the least likely Alternative to bring about a proportional increase in rural residents trained**.

Recommended Health-Promoting Mitigations:

- Increase the importance of emergency preparedness in the General Plan. The Draft Safety Element of the GPU does not cover improving emergency preparedness among Humboldt County's citizenry beyond implementing the Emergency Operations Plan, which also does not cover this topic in detail. Have schools communicate their Emergency Operations Plans to parents.
- Set benchmarks on how many citizens are trained in each area. Designate a public agency responsible.

[31] Written Comments: Group 3 – Noise and Safety Element. Humboldt GPU Update. Available at http://co.humboldt.ca.us/planning/gp/PrelimHearingDraft/CommentList2.htm#group3. Accessed on February 3, 2008.

- Support the Humboldt Red Cross in outreach efforts to bring people into their CERT training (Community Emergency Response Team).
- Have schools communicate their Emergency Operations Plans to parents.
- Expand funding for trainings and awareness raising about emergency preparedness.
- Set up a Rural Emergency Preparedness outreach team to specifically address the readiness and concerns of rural residents in case of emergency.

SC.1.c Driving Under the Influence (DUI)

Health-Based Rationale

Drinking and driving is a common occurrence. The main health concerns are death and injury due to motor vehicle accidents (MVA). During 2005, 16,885 people in the U.S. died in alcohol-related motor vehicle crashes, representing 39% of all traffic-related deaths.[32] Also in 2005, nearly 1.4 million drivers were arrested for driving under the influence of alcohol or narcotics.[33] However, that's less than 1 percent of the 159 million self-reported episodes of alcohol–impaired driving among U.S. adults each year.[34] Drugs other than alcohol are involved in about 18% of motor vehicle driver deaths. These other drugs are generally used in combination with alcohol.[35]

More than half of the 414 child (ages 14 and younger) passengers who died in alcohol-related crashes during 2005 were riding with the drinking driver. Of the 1,946 traffic fatalities among children ages 0 to 14 years in 2005, 21% involved alcohol. In 2005, 16% of drivers ages 16 to 20 who died in motor vehicle crashes had been drinking alcohol.[36]

Among motorcycle drivers killed in fatal crashes, 30% have blood alcohol concentrations (BACs) of 0.08% or greater. Motorcyclists ages 40 to 44 years have the highest percentage of fatalities with BACs of 0.08% or greater.[37]

Among drivers involved in fatal crashes, those with BAC levels of 0.08% or higher were nine times more likely to have a prior conviction for driving while impaired (DWI) than were drivers who had not consumed alcohol.[38]

Urban counties have a higher *number* of alcohol-involved fatal crashes because they have more people, however, rural counties have higher crashes per capita *rates* for alcohol-related motor vehicle collisions.[39] While 17% of the US population is classified as rural, 58% of all fatal crashes and 60% of traffic fatalities were recorded in rural regions of the US between 1993-2004.[40] Fatal crashes and traffic fatalities in rural areas are 3.5 times more prevalent than expected on the basis of the

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[32] NHTSA. 2006. Traffic Safety Facts 2005: Alcohol. Dept. of Transportation. National Highway Traffic Safety Administration. Available at http://www-nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/TSF2005/AlcoholTSF05.pdf. Accessed on January 27, 2008.

[33] Department of Justice (US), Federal Bureau of Investigation (FBI). Crime in the United States 2005: Uniform Crime Reports. Washington (DC): FBI; 2005. Available from URL: http://www.fbi.gov/ucr/05cius/index.html.

[34] Quinlan KP, Brewer RD, Siegel P, Sleet DA, Mokdad AH, Shults RA, Flowers N. Alcohol-impaired driving among U.S. adults, 1993-2002. American Journal of Preventive Medicine 2005;28(4):345-350.

[35] Jones RK, Shinar D, Walsh JM. State of knowledge of drug-impaired driving. Dept of Transportation (US), National Highway Traffic Safety Administration (NHTSA); 2003. Report DOT HS 809 642.

[36] NHTSA 2006.

[37] Paulozzi L, Patel R. 2004. Trends in motorcycle fatalities associated with alcohol-impaired driving: United States 1983-2003. Morb Mortal Wkly Rep 53:1103-6. Available at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5347a2.htm.

[38] NHTSA. 2006, ibid.

[39] Traffic Safety Center. Winter 2005-2006. Zeroing in on Drinking-Driving, Mapping, Data Analysis, and Surveys to Help Highlight Problems and Reduce Risks. TSC Newsletter 3(1).

[40] Burgess M. 2005. Contrasting rural and urban fatal crashes 1993-2004. Dept. of Transportation. Washington DC. National Center for Statistics and Analysis.

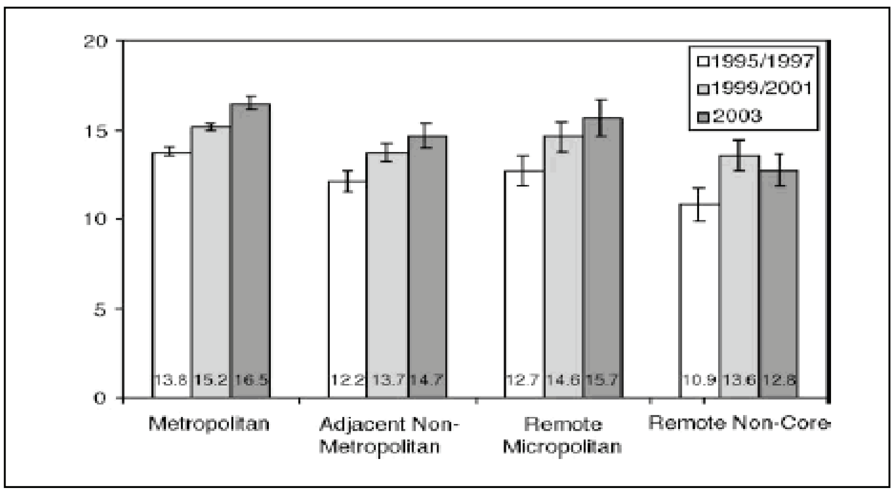
percentage of total population, and the risk that the driver behavior, such as DUI and not wearing seat belts, is attributed to a fatal crash is 10% higher in rural areas than urban.[41]

Higher mortality in rural crashes has been attributed in various research to delayed time to medical response, limited access to trauma resources, higher speed limits, an increased rate of alcohol use, and a lower rate of seat belt use in rural locations. However, much research shows the same rate of drinking while driving in urban and rural.[42]

In a report detailing US-wide rates of motor vehicle accident fatalities comparing rural and urban factors, the distribution of BAC levels was similar for urban and rural drivers at BAC levels of 0.10 or lower. However, for all levels of BAC above 0.10, the percentage of rural drivers with a given BAC exceeded the percentage of urban drivers with that same BAC, i.e., there was a higher percentage of rural drivers with a BAC of 0.11, 0.12, 0.13, etc.[43]

As the figure below shows, the proportion of adults in the US aged 18-49 who consumed 5 or more drinks in one day in the last year varied little with regard to urban vs. rural.

Figure PS.3. Adjusted percentage (95% confidence intervals) binge drinkers by type of county.[44]



Existing conditions

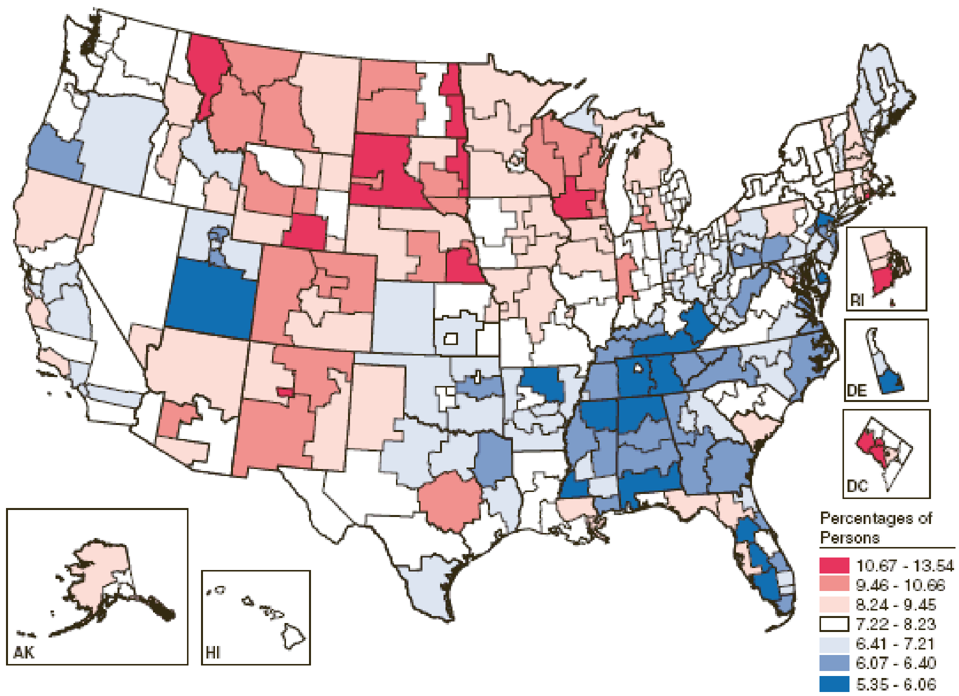
California. In 2004, 4,120 people in California were killed in traffic crashes. About 40% of all traffic fatalities in the state were the result of alcohol use. The average age of an arrested DUI offender in 2004 was 33.2 years, but the highest percentage of drivers with BAC levels of 0.08 or greater was for

[41] Raskaukas M. 2007. The culture of traffic safety in rural America. Intelligent Transportation Systems. University of Minnesota Center for Transportation Studies. Available at http://www.its.umn.edu/Publications/ResearchReports/reportdetail.html?id=1270. Accessed on February 13, 2008.
[42] Donaldson AE, Cook LJ, Hutchings CB, Dean JM. 2006. Crossing county lines: The impact of crash location and driver's residence on motor vehicle crash fatality. Accident Analysis and Prevention 38:723-7.
[43] NHTSA. 2006. Contrasting Rural and Urban Fatal Crashes 1994-2003. US Dept. of Transportation. Available at http://www-nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/Rpts/2005/809896.pdf. Accessed on February 14, 2008.
[44] Jackson JE, Doeschera MP, and Harta LG. Problem drinking: Rural and urban trends in America, 1995/1997 to 2003. Preventive Medicine. (2006) 43;122-124.

drivers ages 21-24 (32%). Drivers under the age of 21 who are drinking are twice as likely to be involved in fatal crashes as those who are older than 21. Even so, alcohol-related motor vehicle fatalities for ages 15-20 has declined 59% since 1982. Nearly ¾ of the drivers convicted of driving while impaired are either frequent heavy drinkers or alcoholics.[45]

Underage drinking among youth aged 12-17 was higher in rural than non-rural areas. Binge drinking (5 or more drinks on the same occasion at least one day in past month) is also higher among rural youth age 12-17 (4.1%) than non-rural (1.6%). Both of these measures were not higher in rural areas for the age group 18-20.[46] Three years of Substance Abuse and Mental Health Services Administration data from the National Survey on Drug Use and Health (2002-2004), found that of the 15 sub-state areas with the highest rates of past year alcohol dependence or abuse, most were in the northern West or Midwest of the country.

Figure PS.4. Alcohol dependence or abuse in the past year among persons aged 12 or older by sub-state region: percentages, annual averages based on 2002, 2003 and 2004 NSDUH data.[47]



Humboldt County. In Humboldt, the rate of alcohol dependence is higher than in the urban Bay area, with 8.2-9.5% of people reporting alcohol dependence or abuse in the last 12 months.

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[45] Source: CA Dept of Alcohol & Drug Programs. Fact Sheet: Driving Under-the-Influence (DUI) Statistics. March 2006. Available at http://www.adp.ca.gov/FactSheets/Driving_Under_the_Influence_Statistics.pdf. Accessed on January 27, 2008.

[46] SAMHSA. 2004. The National Survey on Drug Use and Health Report: Underage Drinking in Rural Areas. Substance Abuse and Mental Health Services Administration. Available at http://www.oas.samhsa.gov/2k4/ruralYouthAlc/ruralYouthAlc.htm.

[47] National Survey on Drug Use and Health. 2006. The NSDUH Report. Issue 25: Alcohol Dependence or Abuse in Substate Areas. SAMHSA. Available at http://www.oas.samhsa.gov/2k6/subStateAlc/subStateAlc.htm.

Humboldt County has one of the highest rates of deaths due to alcohol and drug use in California.[48] In some areas, DUI citations are increasing. For example, there were 336 DUIs in Arcata in 2001, 442 DUIs in 2005.[49] This increase is not unexpected; research from 2005 at the Traffic Safety Center at University of California at Berkeley forecast that alcohol-related motor vehicle accidents will increase by 10% by 2008. This research involved looking throughout California at transportation zones and corridors and found that rural counties have the highest rates of DUI crashes.[50]

Adult arrests for DUI. In 2001, there were 15.2 adults arrested for DUI in Humboldt per 1,000 (1316 total). This is much higher than state's rates, which were 8.4 per 1000. Humboldt is ranked near the bottom (47th out of 52) of counties in the state in terms of its DUI arrest rates. From 1996 – 2001, Humboldt County was consistently higher than California.[51]

Adult arrests for alcohol violations. 18.9 per 1,000 people in Humboldt were arrested for alcohol violotions in 2001. This is more than triple the state's rate of 5.5 per 1,000. Again, from 1996 – 2001, Humboldt County rate was consistently much higher than the state's.[52]

Alcohol-involved motor vehicle accidents. In 2000, there were 140 total alcohol involved motor vehicle accidents with a rate of 153.5 per 100,000 licensed drivers in Humboldt. This is much higher than state's rates, which were 98.1 per 100,000. Again, from 1996 – 2001, Humboldt County's rate was consistently much higher than California's.[53]

Binge drinking. Binge drinking is a significant public health problem in Humboldt County. The area comprised of Humboldt and Del Norte counties has the highest rate of binge drinking in California for persons aged 18-34, and the fourth highest rate of binge drinking among adults in the state.[54]

Binge drinking rates among youth in Humboldt County are also alarmingly high. 56 percent of 11th- grade students report being drunk or sick after drinking alcohol in their lifetime. Additionally, 6 percent of seventh-grade students reported drinking five or more drinks in a couple of hours during the past 30 days. By 11th grade, 33 percent of female students and 43 percent of male students reported drinking five or more drinks in a couple of hours during the past 30 days.[55]

Analysis

Assumptions

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[48] 2004 Community Indicators of Alcohol and Drug Abuse/Risk.
[49] Weaver B. The LumberJack – student newspaper of Humboldt State University. Arcata increases drunk driving enforcement. 9/19/07. Available at http://media.www.thejackonline.org/media/storage/paper1142/news/2007/09/19/News/Arcata.Increases.Drunk.Driving.Enforcement-2970516.shtml.
[50] TSC. 2006. Using GIS to Identify Clusters of DUI Crashes. University of California – Berkeley. Traffic Safety Center. Available at http://www.tsc.berkeley.edu/research/dui.html. Accessed on February 3, 2008.
[51] CARS, Inc. 2004. Community Health Indicators of Alcohol & Drug Abuse Risk: Humboldt County 2004. Center for Applied Research Solutions. Available at http://www.ca-cpi.org/Publications/Community_Indicators/County_Data_Files/Humboldt_04.pdf. Accessed on February 3, 2008.
[52] CARS, Inc. 2004, ibid.
[53] CARS, Inc. 2004, ibid.
[54] California Department of Health Services Center for Health Statistics May 2004, based on the 2001 California Health Interview Survey.
[55] 2004-2006 California Healthy Kids Survey results for Humboldt County.

- Enforcement, prevention, and deterrence interventions to decrease drunk driving will remain the same.

<u>Quantitative Analysis</u>
Quantitative analysis was not possible due to data limitations; the DUI rates were not separated by location (urban vs. non-urban).

<u>Qualitative Analysis</u>
The Humboldt County Health and GPU focus groups identified driving under the influence as a cause for great concern. In the GPU and Health focus groups, participants felt that alcohol dependency and DUI are a threat to public health and wanted to see an analysis included in the HIA. Additionally, comments on the Draft Safety Element included this by a Humboldt County resident:[56]

> The Safety Element is supposed to protect Humboldt County citizens from risk of death, injuries and property damage and economic and social dislocation resulting from fire, earthquake, flood and other hazards. The elephant in the room is that one of the other hazards is risk of death from auto accidents. That risk of death is more than twenty times higher than the risks from earthquake, fire and flood combined. And yet there is no mention of the best ways to go about reducing this huge threat to our physical safety.

Conclusions

A) **With Plan Alternative A, in which all population growth is accommodated in urban areas, fatality rates from driving under the influence of alcohol would likely decrease while accident and injury from DUI accidents would likely increase.** Urban and rural rates of drinking are similar in the existing literature about DUI, but prevalence statistics show higher rates of arrest for driving while intoxicated and fatality as well as use of substance abuse treatment in Humboldt County. While it is unclear if a causal relationship between alcohol intake and living in a rural area is implicated, fatality from DUI would likely decrease due to lower speed limits and less dangerous conditions (such as curved roads, cliffs, poorly lit roads).

B) **Plan Alternative B would likely result in the same rates of DUI** and thus a similar rate of incidence of injury and death due to DUI. An increase in population generally, though, would result in more DUI accidents.

C) **Plan Alternative C may** or may not affect the rates at which residents are driving impaired; however it **would likely increase the rate at which people are die due to driving under the influence**, given that road conditions and speed make all fatalities more likely in rural areas and thus more difficult to navigate while drunk.

Recommended Health-Promoting Mitigations:

- Implement evidence-based interventions and policies against alcohol-impaired driving:

[56] Humboldt General Plan Update. Public comments. Available at http://co.humboldt.ca.us/planning/gp/PrelimHearingDraft/CommentList2.htm#group3. Accessed on January 28, 2008.

- Implement 0.08% blood alcohol concentration (BAC) laws. These are state laws that lower the illegal BAC for drivers from 0.10% to 0.08%. These have been shown to reduce alcohol-related fatalities by a median of 7 percent;
- Implement minimum legal drinking age laws and lower BAC laws specific to young or inexperienced drivers (zero tolerance laws);
- Increase the use of sobriety checkpoints;
- Fund mass media campaigns to educate the population about the dangers of drunk driving;
- Increase school-based education programs to educate students about the dangers of drunk driving and of riding with a drinking driver;
- Train alcohol servers on intervening with people who have been drinking and intend to drive;
- Decrease alcohol outlets and their hours of operation.

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SC.4.a Isolation index

Health-Based Rationale
GPU and Health focus group participants felt very strongly that a health challenge of rural life was being socially isolated. In fact, there is a broad literature base that demonstrate this. Those who feel socially isolated also feel higher levels of anxiety, negative mood, hostility, stress, as well as less optimism, happiness and life satisfaction.[57] Social isolation has been shown to weaken the body's ability to repair and maintain its systems.[58] Studies show that adults who report social isolation also report poorer sleep quality.[59]

Higher rates of social connectedness or support are associated with lower resting blood pressure, better immune system function, and lower amounts of stress hormones.[60] One study showed that in patients recovering from heart surgery, ratings of the statement "I feel lonely" predicted survival at 30 days and five years after surgery, even after controlling for preoperative conditions known to increase mortality.[61] A study in Australia showed that higher levels of social integration as measured by almost all indicators were associated with lower mortality rates.[62]

Social connectedness can be of great use during times of stress. Those who consider themselves socially connected are more likely to actively cope (e.g., problem solve) with stressful tasks and situations. Active coping has been associated with a biomarker signifying a healthier cardiac response.[63] Studies consistently find an inverse relationship between levels of social connection (defined as "social capital") and mental health issues: the higher the level of trust and connectivity in an area, the lower the levels of mental illness.[64]

Theory behind why social connection has such an impact on health commonly cites three pathways:[65]

1. Ease of diffusion of information;
2. Psychosocial support;
3. Political organizing which can bring resources into an area.

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[57] Cacioppo JT, et al. 2000. Lonely traits and concomitant phsyciological processes: The MacArthur Social Neuroscience Studies. Int J Psychophysiol 35:143-54.
[58] Cacioppo JT. 2002. Loneliness and health: Potential mechanisms. Psychosom Med 64:407-17.
[59] Buysse DJ, et al. 1989. The Pittsburg Sleep Quality Index: A new instrument for psychiatric practice and research. Psychiatry Res 28:193-213.
[60] Uchino BN, Cacioppo JT, Kiecolt-Glaser JK. 1996. The relationship between social support and physiological processes: A review with emphasis on underlying mechanisms and implications for health. Psycho Bull 119:488-531.
[61] Herlitz J, et al. 1998. The feeling of loneliness prior to coronary artery bypass grafting might be a predictor of short- and long-term postoperative mortality. Eur J Vasc Endovasc Surg 16:120-5.
[62] Siahpush M, Singh GK. 1999. Social integration and mortality in Australia. Aust N Z J Public Health 23(6):571-7.
[63] Cacioppo JT, Hawkley LC. Summer 2003. Social isolation and health, with an emphasis on the underlying mechanisms. Perspectives in Biology and Medicine 46(3 supplement):S39-S52. Available at http://muse.jhu.edu/journals/perspectives_in_biology_and_medicine/v046/46.3xcacioppo.pdf. Accessed on February 17, 2008.
[64] Scheffler RM, Brown TT, Rice JK. 2007. The role of social capital in reducing non-specific psychological distress: The importance of controlling for omitted variable bias. Soc Sci & Med 65:842-854.
[65] Kawachi, I., Berkman, L. (2000). Social cohesion, social capital, and health. In I. Kawachi and L.F. Berkman (Eds). *Social Epidemiology*. New York: Oxford University Press.

Isolation is difficult to measure, but there are proxy measures. There is a vast literature on social cohesion in public health as well as other fields, and making the assumption that social isolation was the opposite of social cohesion helped to define indicators. The Organization for Economic Cooperation and Development, in their Society at a Glance 2003 Social Indicators, chose the following as their "social cohesion" indicators:[66]

- CO1. Subjective well-being
- CO2. Social isolation
- CO3. Group membership
- CO4. Teenage births
- CO5. Drug use and related deaths
- CO6. Suicides

Here, the rates of the following will be examined:

- Psychological distress and mental well-being;
- Treatment for mental health and substance abuse;
- Depression and suicide;
- Crime;
- Volunteerism and civic engagement.

Existing conditions

Psychological distress and mental well-being. In Humboldt County:[67]

- 53% of residents said they spent 0 days in poor mental health in the last month;
- In 2005, 10.2%, or 1 out of every 10 people, stated they had spent between 10 – 20 days in the last month in poor mental health;
- 21% of the people polled did not do their usual work due to emotional problems in 2001;
- In 2001 less than 500 people in the county felt down most of the time, 16.5% felt down some of the time, 21% felt down a little of the time, and almost 60% felt down not at all
- 4.8% of respondents said they have psychological distress;
- In 2005, 11.2% saw a health professional for emotional problems;
- In 2005, 20.3% felt that they needed help for an emotional/mental problem.

Depression/suicide. Depression and suicidal intent is linked to social isolation. One study showed that in people who consider themselves to be socially isolated, some level of depression was 8 times more likely, and major depression was 21 times more likely.[68] Social isolation is also linked to suicidal intent.[69] [70] In adolescents, social isolation was associated with an increased risk for depressive symptoms, suicide attempts, and low self-esteem.[71]

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[66] OECD. 2006. Society at a Glance: Social Indicators: 2006 Edition. Organization for Economic Development. Available at http://www.oecd.org/document/24/0,2340,en_2649_33729_2671576_1_1_1_1,00.html. Accessed on February 17, 2008.

[67] California Health Information Survey. Available at http://www.chis.ucla.edu/.

[68] Hawthorne G. 2008. Perceived social isolation in a community sample: its prevalence and correlates with aspects of peoples' lives. Soc Psychiatry Psychiatr Epidemiol 43:140-50.

[69] Haw C, Hawton K. 2008. Life problems and deliberate self-harm: Associations with gender, age, suicidal intent and psychiatric and personality disorder. J Affect Disord. Epub ahead of print.

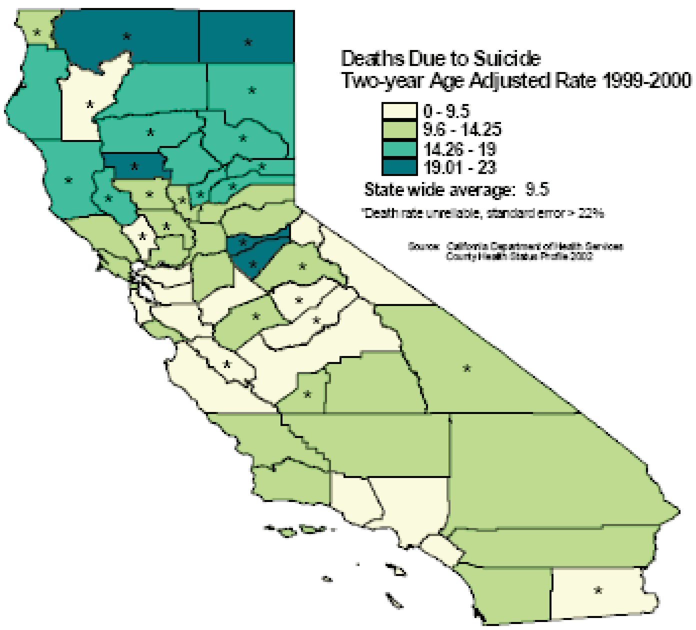
[70] Hokans KD, Lester D. 2007. Motives for suicide in adolescents: A preliminary study. Psychol Rep 101(3 Pt 1):778.

[71] Hall-Lande JA, Eisenberg ME, Christenson SL, Neumark-Sztainer D. Social isolation, psychological health, and protective factors in adolescense. Adolescence 42(166):265-86.

Suicide rates are higher in rural areas. The Centers for Disease Control compared suicide rates in urban and rural counties and found that men in urban counties committed suicide at a rate of 21-22 per 100,000; in rural counties male suicide rate was 31 per 100,000. Men tend to have *rates* of suicide 4- 6 times higher than females because they use more reliably lethal methods. However, suicide *attempts* are higher for females.[72] Some posit that ease of accessing firearms may play a part in the higher rate in rural areas, as firearms suicides count for 62% of suicides, and in fact, rural counties had 54% more firearm suicides.[73] For both men and women, suicide rates in rural counties of the West were higher than those in any other region of the US. Lower treatment rates for depression in rural areas may also contribute to higher suicide rates.[74]

In Humboldt County, 34 people committed suicide in 2007, the highest total since 1990, and a 60 percent increase over 2006.[75] In the three year period from 2001-2004, Humboldt County's rough suicide rate was 22.3 per 100,000, over three times Los Angeles's rate of 7.1 per 100,000. The most recent statistic for California is 9.4 per 100,000.[76] The figure below shows these rates for the state.

Figure PS.5. Two year age adjusted suicide rates in California, 1999-2000.[77]



[72] Eberhardt MS, Ingram DD, Makuc DM, et al. 2001. Health, United States, 2001. Urban and Rural Health Chartbook. National Center for Health Statistics. Available at http://www.cdc.gov/nchs/data/hus/hus01.pdf. Accessed on February 16, 2008.

[73] Branas CC, Nance ML, Elliott MR, Richmond TS, Schwab CW. 2004. Urban-rural shifts in intentional firearm death: different causes, same results. Am J Public Health 94(10):1750-5.

[74] Eberhardt MS, Ingram DD, Makuc DM, et al. 2001. Health, United States, 2001. Urban and Rural Health Chartbook. National Center for Health Statistics. Available at http://www.cdc.gov/nchs/data/hus/hus01.pdf. Accessed on February 16, 2008.

[75] Humboldt County Coroner's Office.

[76] Harrison C. Jan. 3, 2008. County posts highest suicide total in 18 years. The Eureka Reporter. Available at http://eurekareporter.com/article/080103-county-posts-highest-suicide-total-in-18-years.

[77] Avram S. 2002. North State Rural Mental Health Summit: Review of Relevant Data. Northern Sierra Rural Health Network.

Mental health treatment. Humboldt has served a fairly consistent amount of mental health clients per year. From 1990–1998, there were between 2,000–3,000 clients per year, going up and down but with no consistent trend.[78] There were 3,504 clients in 2000-2001, the most recent year for which there is data.[79] Unfortunately, the state Dept of Mental Health does not do a comparison analysis of mental health clients in rural vs. urban areas of the county. However, it is of note that Humboldt County only has 16 licensed mental health professionals per 10,000 residents. Marin County has 63 per 10,000. [80]

In Humboldt County, 11.2% of those polled had seen a mental health professional, and 11.8% said they had difficulty or delays in getting mental health care.[81]

In treating depression, travel time to the preferred provider was significantly associated with making fewer visits and having a lower likelihood of receiving care in accordance with guidelines.[82]

According to the Office of Statewide Health Planning and Development (OSHPD) hospital utilization data, there are only six hospitals in Humboldt County. None of them have chemical dependency beds, and only one of them takes psychiatrics admissions (Semper Virens PHF in Eureka). Thus, all hospital admissions for psychiatric illnesses were located in Eureka, and there were 5840 licensed bed days, 473 discharges, and 4014 patient days. There is no psych ER listed in the County. As such, data that is kept on emotional and mental health issues at the hospital level is limited and it is not possible to disaggregate between rural and urban admissions.[83]

Rates of substance abuse and substance abuse treatment. For the years from 1997 to 2002, Humboldt's rates of admission for alcohol and drug treatment programs was higher than the state's. In 2002, Humboldt's rate was 14.2 per 1000, while California's was 8.7 per 1000.[84]

With regard to deaths due to alcohol and drug use, for the years 1996 to 2000, Humboldt's rates were substantially higher than the state's. In 2001, the rate in Humboldt (39.5 per 100,000) were more than double the states' (18.0 per 100,000). [85]

As the figure below shows, trends in US substance abuse treatment statistics show that rates of alcohol admission rise precipitously with increasing rural-ness, peaking in rural areas with a city with

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[78] California Health and Human Services Agency, Dept. of Mental Health. Table 9A: Number of unduplicated clients Fiscal Years 1991-1992 through 1997-1998. Available at http://www.dmh.cahwnet.gov/Statistics_and_Data_Analysis/County_Mental_Hospital_Data.asp. Accessed February 16, 2008.

[79] 2002. North State Rural Primary Care – Mental Health Summit: Collaborating for Care. Final Report. California Institute for Mental Health. Available at http://cimh.org/downloads/FinalReport.pdf. Accessed on February 15, 2008.)

[80] 2002. North State Rural Primary Care – Mental Health Summit: Collaborating for Care, ibid.

[81] California Health Information Survey. Available at http://www.chis.ucla.edu/.

[82] Fortney J, Rost K, Zhang M, Warren J. 1999. The impact of geographic accessibility on the intensity and quality of depression treatment. Med Care 37(9):884-93.

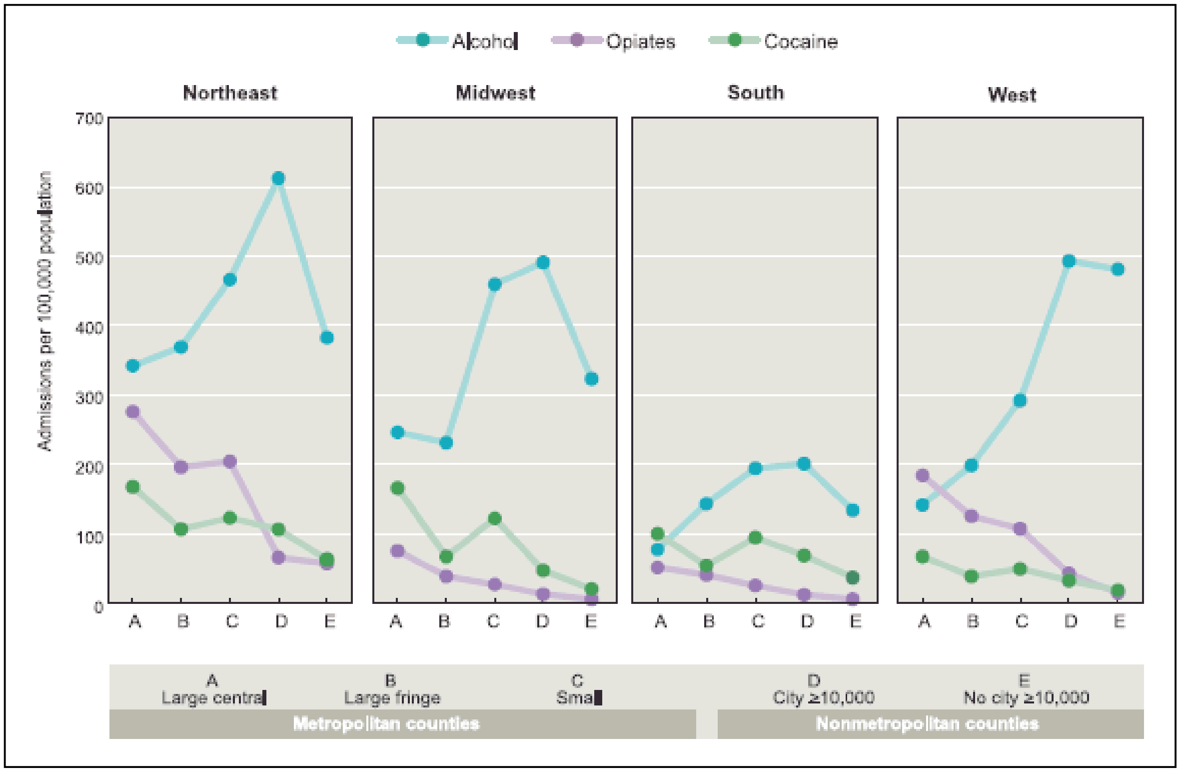
[83] OSPHD http://www.oshpd.ca.gov/HID/DataFlow/HospData.html

[84] CARS. 2004. Community Indicators of Alcohol and Drug Abuse. Humboldt County 2004. Center for Applied Research Solutions. CA Dept of Alcohol and Drug Programs.

[85] CARS. 2004, ibid.

greater than 10,000 people then declining in completely rural areas. Admissions for opiates and cocaine continuously decline further from urban areas.

Figure PS.6. Substance abuse treatment admission rates by primary substance, region an urbanization level in the United States.[86]



Crime statistics. Overall levels of crime in Humboldt County as reported to the Federal Bureau of Investigation are shown in the table below.

Table PS.3. Crime rates in Humboldt County in 2000 and 2005.[87]

Year	2000	2005
Crime Total	5,570	
Murder	4	3
Rape	65	54
Robbery	85	98
Aggravated assault	273	239
Burglary	1,134	1,334
Larceny – theft	3,530	2,753
Motor vehicle thefts	420	733

[86] Eberhardt MS, Ingram DD, Makuc DM, et al.. 2001. Health, United States, 2001. Urban and Rural Health Chartbook. National Center for Health Statistics. Available at http://www.cdc.gov/nchs/data/hus/hus01.pdf. Accessed on February 16, 2008.
[87] Crime, Humboldt County, 2000 – Federal Bureau of Investigation, National Archive of Criminal Justice, University of Michigan. Available at http://www.fedstats.gov/mapstats/crime/county/06023.html. Accessed on February 17, 2008.

The table below shows rates of crime in the unincorporated areas of Humboldt County vs. the incorporated areas.

Table PS.4. 2005 crime rates by location in Humboldt County.[88]

Jurisdiction	Violent crimes					Property crimes				Larceny-theft			
	Total	Homicide	Forcible rape	Robbery	Aggravated assault	Total	Burglary	Motor vehicle theft	Larceny-theft over $400	Total	Over $400	$400 and under	Arson
County total	394	3	54	98	239	2,593	1,334	733	526	2,753	526	2,227	37
Sheriff's Department	124	2	9	21	92	574	354	17	203	569	203	366	4
Unincorporated	124	2	9	21	92	574	354	17	203	569	203	366	4
Arcata	48	0	6	11	31	398	252	83	63	519	63	456	4
Blue Lake	6	0	2	1	3	47	29	15	3	50	3	47	0
Eureka	170	1	25	63	81	1,037	503	348	186	1,000	186	814	18
Ferndale	0	0	0	0	0	14	12	0	2	10	2	8	3
Fortuna	21	0	7	2	12	166	95	42	29	316	29	287	4
Rio Dell	18	0	2	0	16	27	16	7	4	50	4	46	0
Trinidad	0	0	0	0	0	21	10	3	8	33	8	25	1
CSU Humboldt	5	0	3	0	2	33	10	1	22	158	22	136	3
North Coast Redwoods DPR	1	0	0	0	1	53	48	0	5	27	5	22	0
Union Pacific Railroad	0	0	0	0	0	0	0	0	0	0	0	0	0
CA Highway Patrol	1	0	0	0	1	223	5	217	1	21	1	20	0

In a report from the California State District Attorney's office comparing urban and rural rates of crime, 97% of California's population is urban and 98% of crime takes place in urban counties. The table below shows rates of each type of crime per 100,000 people in urban and rural areas of California. In all categories except burglary, rates of crime are lower in rural areas of California; specifically rural violent crime comprises 1/3 of violent crime incidence even though approximately ½ of the population lives in rural areas.

Table PS.5. Rates of crime per 100,000 people in urban and rural areas.[89]

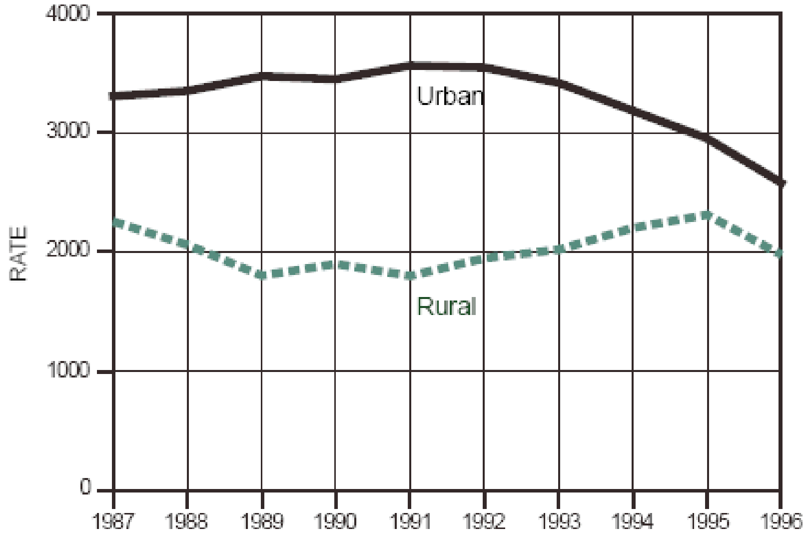
		Total	Violent crimes	Willful homi-icide	For-cible rape	Rob-bery	Aggra-vated assault	Property crimes	Burglary	Motor vehicle theft
1996	Urban	2,578.9	857.8	9.1	31.7	298.5	518.5	1,721.1	958.3	762.8
	Rural	1,974.4	567.8	4.5	30.4	63.7	469.2	1,406.6	1,093.0	313.6

Between 1987 and 1996 (the last year this comparison was done in the report), crime decreased 22% in urban areas and 12.5% in rural areas, but from 1991-96, crime in rural areas has increased (see chart below).

[88] California Department of Justice. Table 1: Crimes and Crime Rates by category and crime. Humboldt County. Available at http://stats.doj.ca.gov/cjsc_stats/prof05/12/1.htm. Accessed on February 17, 2008.

[89] Criminal Justice Statistics Center. 1997. Outlook: Crime in urban and rural California. Office of the Attorney General, California. Available at http://ag.ca.gov/cjsc/publications/misc/urbrurt.pdf. Accessed on February 17, 2008.

Figure PS.7. California crime rates (1987-1996) in urban and rural areas per 100,000 people.[90]



Crime rates per 1,000 people in Humboldt were slightly higher than the state's for the years 1996 to 2001. In 2001, Humboldt's rate was 46.3 crimes per 1,000 people, while the state's was 39.4.[91]

Group Membership/Civic Engagement. Humboldt County has higher participation and registration rates than California as a whole. The County has between 5-11 percent higher voter registration rates than California since 1996. In 2000, 73% of those registered cast a ballot, slightly higher than California's rate of 71%. Also, 59% of the electorate turned out to vote in 1996 and 2000, which is 7% higher than California.

53% of all adults volunteer in their communities every year. 62% of Humboldt County residents volunteered at least one hour per month in a survey generated by the Humboldt County Board of Supervisors during National Volunteer Week (4.11.00).[92]

<u>Analysis</u>

Quantitative Analysis
A quantitative analysis is not possible with existing data.

Qualitative Analysis
GPU and Health focus group participants felt very strongly that a health challenge of rural life was being socially isolated.

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[90] Criminal Justice Statistics Center. 1997. Outlook: Crime in urban and rural California. Office of the Attorney General, California. Available at http://ag.ca.gov/cjsc/publications/misc/urbrurt.pdf. Accessed on February 17, 2008.
[91] CARS. 2004. Community Indicators of Alcohol and Drug Abuse. Humboldt County 2004. Center for Applied Research Solutions. CA Dept of Alcohol and Drug Programs.
[92] 2001. Humboldt County Social and Wealth Indicators Project 2001. Available at http://www.humboldt.edu/~envecon/Indicators/. Accessed on February 18, 2008.

Conclusions

A) Given that Alternative Plan A concentrates residents in a smaller area, people are more likely to have unintentional contact. Also, because more civic organizations are located in urban areas, rates of civic engagement will likely increase, resulting in more social cohesion, greater ability to advocate for resources which can aid in healthy living. The greater opportunities for social connection **may result in decrease in isolation** and thus decreased rates of suicide, depression, and substance abuse treatment.

B) **Plan Alternative B, due to an increase in residents, will probably bring a decrease in social isolation.** However, the gains brought about by simple population increase will be tempered by the fact that half of the increase will be located in non-urban areas with less opportunity for social cohesion. Thus, while some of the health benefits such as increased access to resources due to social networks and civic activism may result as well as a decrease in mental health issues, the effect would be less pronounced than with Plan Alternative A.

C) **Plan Alternative C is likely to bring about an increase in social isolation due to locating more people in the non-urban areas** of the County where there are fewer organizations and less opportunities for casual contact. Subsequently, Plan Alternative C is the least healthy option with regard to social connection.

Recommended Health-Promoting Mitigations:

- Incentivize employers to encourage volunteering and voting.
- Require construction or renovation of community centers with funding for staff and programs with large rural or urban development projects.
- As part of a community benefits package, require developers to fund programs to engage the community, such as community concerts, parades, festivals.
- Expand outreach for Citizen Advisory Committees on various types of municipal projects.
- Support programming to build retiree/ student partnerships or other mentoring relationships.
- Measure isolation and social cohesion in Humboldt County using a validated tool such as the Saguaro Index[93] or the Petris Scale[94] in order to have an indicator to measure.
- Support community building activities such as parades and events that showcase local artisans.

[93] http://www.ksg.harvard.edu/saguaro/communitysurvey/.
[94] http://www.petris.org/.

Environmental Stewardship Priority Indicators

ES.3.a Proportion of County land area retained for active farming uses

Health-Based Rationale

Agriculture is an important part of the economic base of Humboldt County, including many small producers and self-employed. Productive farming land is part of what many local residents value about the County.

Consumption of locally produced foods can reduce consumption of fossil fuels and reduce potential for pollution and for global warming.[1] It may also increase consumption of fruits and vegetables and reduce the consumption of processed foods by improving the freshness, and therefore the taste, of produce In addition, consumption of locally grown produce can have economic benefits. First, farmers who direct market their food receive a higher percentage of the sales price; when they do not, they only receive between 4 and 19 cents of every dollar spent on food while the remaining portion goes to marketers[2], processors, distributors, retailers, wholesalers, and goods movement. Second, money paid to local farmers is more likely to stay in the community. Every dollar spent on locally grown produce circulates 2.5 times in the local community, as compared to 1.4 times for dollars spent on conventionally grown food in a supermarket.[3]

Due to the rural nature and geographic location of the area, transportation of agricultural and industrial products to larger marketing areas within and outside of California is difficult and expensive, since most goods must be shipped over a mountainous or coastal highway to reach a major market area. Getting the crop from seed to harvest takes only one-fifth of the total oil used for our food. Most oil is consumed transporting food from the point of production to the point of consumption.[4] 16% of total US energy consumption goes into food production, processing, packaging, distribution and marketing.[5]

Importing food from other countries exposes the consumer to food produced under regulations concerning pesticides and production that may not be as vigorous as standards in this country.
Large commercial farming operations are the exception rather than the norm with smaller family farms making up the majority of agricultural operations in the area. Livestock related operations, including the dairy industry and beef cattle operations, are the most significant agricultural contributors to the local economies within the region. Other significant agricultural operations are nursery crops that include lily bulbs and woody ornamentals, pasture and hay land crops, and to a lesser extent, vegetable row crops, orchards and vineyards. Small family farm operators are finding it difficult to stay competitive[6] due to several limiting factors, not the least of which include higher operating and transportation costs to sell their products regionally or having to ship their products to larger market areas within or outside of California. Small farm operators are looking for ways to diversify their product lines and simplify marketing methods in order to offset their escalating operating costs, and health-conscious consumers are looking for ways to

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[1] La Trobe, H. Farmers' markets: consuming local rural produce. International Journal of Consumer Studies. 2001; 25;(3): 181-192.
[2] Elitzak H. Food Marketing Costs: A 1990's Retrospective. United States Department of Agriculture Economic Research Service. September-December 2000. Available at http://www.ers.usda.gov/publications/foodreview/septdec00/FRsept00e.pdf.
[3] Seyfang G. Local Organic Food: The Social Implications of Sustainable Consumption. CSERGE (Center for Social and Economic Research on the Global Environment) Working Paper EDM 04-09. University of East Anglia, Norwich, UK. 2004.
[4] Kingsolver, B. Animal, Vegetable, Miracle, Harper Collins Publishers, 2007, p. 5.
[5] Pirog R. Food, Fuel, and Freeways: An Iowa Perspective on How Far Food Travels, Fuel Usage, and Greenhouse Gas Emissions. Ames, Iowa. Leopold Center for Sustainable Agriculture. Iowa State University. 2001.
[6] Humboldt 2025 General Plan Update Agricultural Resources and Policies report available at http://co.humboldt.ca.us/planning/gp/pdf/agrprt_2.pdf.

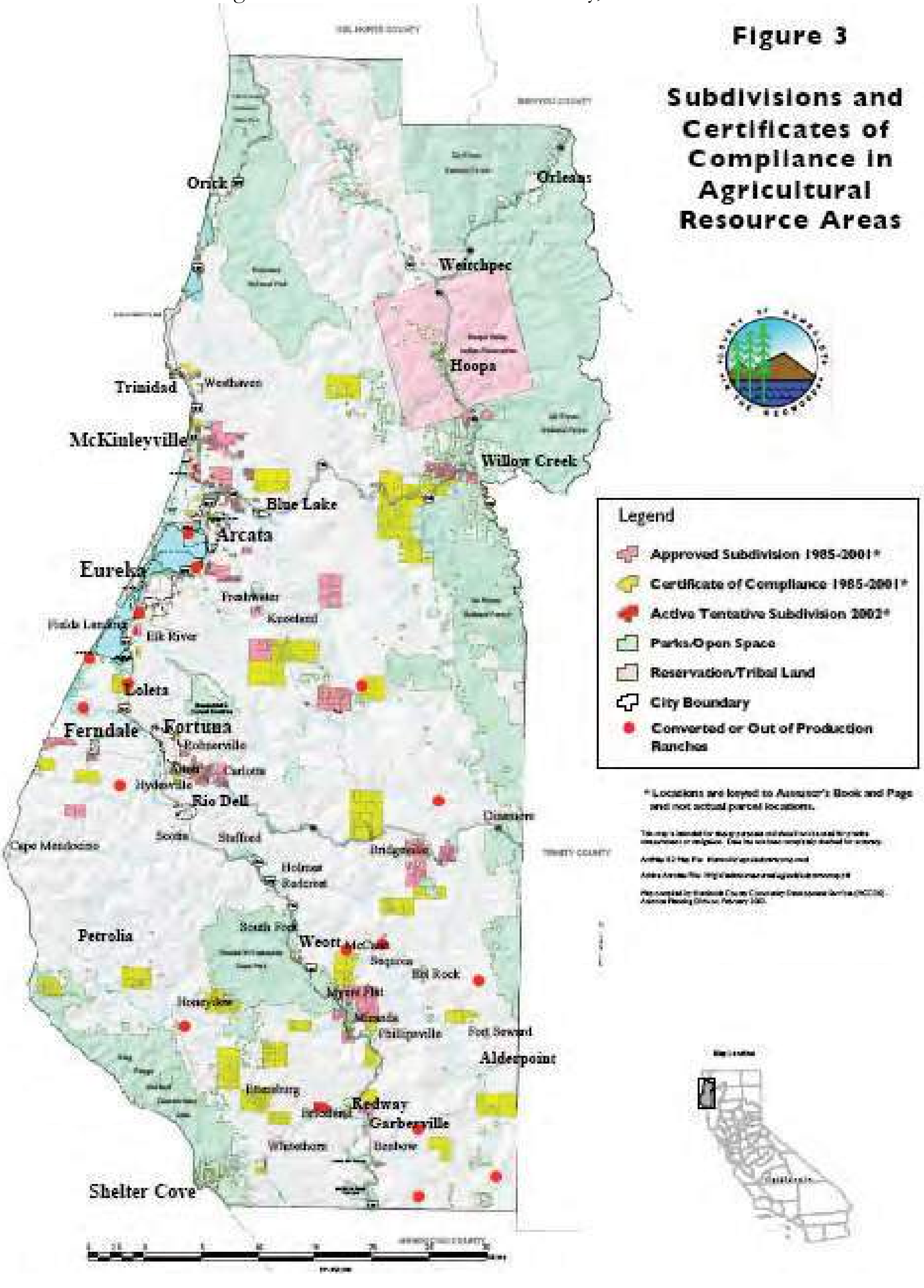
access locally-grown, environmentally-friendly foods. Direct farmer-to-consumer marketing methods have potential for growth and success.

Existing conditions
Amount and conversion of farmlands: In 2002 there were 633,931 acres of farm land, accounting for 28% of Humboldt acreage. Cattle accounted for 17%, Milk Products for 36%, Nursery Products for 30% and miscellaneous crops for 17%. As of August 2007 there were 17,879 acres certified as organic (15,479 prime farm land and 2400 acres range land)[7].

Humboldt 2025 General Plan Update Agricultural Resources and Policies report available at http://co.humboldt.ca.us/planning/gp/pdf/agrprt_2.pdf is a valuable resource for those interested in agricultural lands in the County. It contains a detailed breakdown of these lands by location and use as well as a detailed economic analysis. The report states that Humboldt ranked 36th in the state for gross value of agricultural production (excluding timber). The crops that produced the most value were: milk and diary products ($43 million), nursery stock (i.e., flowers and trees for sale to nurseries) ($34 million), livestock ($23 million), and field crops ($8 million). The report also includes information on farm size and agricultural land conversion. Based on the work of Smith and Giraud[8], it estimates that 60,500 acres of agricultural land was converted to other uses between 1985 and 2001. That land was used for subdivisions, was rezoned, or was used for other purposes. The figure below is a map from the report that shows the lands that were converted and for what purposes.[9]

[7] Northwest California Resource Conservation and Development Council Area Plan 2008-2013
[8] Michael Smith & Deborah Giraud; Traditional Land Use Planning Regulations and Agricultural Land Conversion, 2001.
[9] Humboldt 2025 General Plan Update Agricultural Resources and Policies report available at http://co.humboldt.ca.us/planning/gp/pdf/agrprt_2.pdf.

Figure ES.1. Conversion of agricultural lands in Humboldt County, 1985-2001.[10]



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10 Humboldt 2025 General Plan Update Agricultural Resources and Policies report available at http://co.humboldt.ca.us/planning/gp/pdf/agrprt_2.pdf.

Analysis

Assumptions

- Lands not currently designated as agriculture lands will be converted to that use.
- There will be a continued market for agricultural products.
- With escalating transportation costs and consciousness about global warming local consumer interest in local products will grow.

Logic

- Agricultural acreage has been declining in recent history.
- There is a recent increase in interest in purchase of locally produced foods.
- Getting crops from seed to harvest takes only one-fifth of the total oil used for our food. Most in consumed transporting food from the point of production to the point of consumption.
- Only certain areas in the County have soils suitable for farming; zoning should be preserved when possible.

Quantitative Analysis

As part of the Environmental Impact Assessment process the County is currently preparing land use maps that will analyze how many acres of agricultural land would be converted to other uses for each Plan Alternative. No quantitative analysis is possible without that data.

Qualitative Analysis

Attendees from community meetings favored maintaining the rural character of the county and maintaining and supporting local agricultural production. Food miles traveled was discussed, as was supporting the local economy. Having local food was also considered a security issue.

During the public scoping meetings for the General Plan Update, protection of agricultural resources was raised as a key concern. Some of the recommendations were documented in the Critical Choices Report[11] and included:

- Developing County programs to provided incentives for preservation (e.g., conservation easements, TDR's, economic incentives);
- Developing programs that recognize and encourage smaller agriculture operations(intensive uses, organic and micro-agriculture) and allow smaller parcels in the Williamson Act;
- Implementing County-wide protection policies through Plan and zone map changes.

Conclusions

A) **Plan Alternative A will preserve the greatest amount of agricultural land** since it limits new development to urban areas. This would improve help by preserving jobs and maintaining the availability of locally produced foods, the transportation of which would not be as far and would therefore not contribute as much toward climate change and its associated health impacts.

B) **Plan Alternative B would reduce the acreage of land area retained for active farming uses** due to real estate pressures raising land prices and nuisance claims (despite the "right to farm ordinance" protecting farmers from unwarranted nuisance claims). Farming land close to urban centers has the particular value of reducing transportation costs and time for the farmer. Local jobs may suffer and more food would need to transported to Humboldt than in Plan Alternative A.

[11] Available at: http://co.humboldt.ca.us/planning/gp/meetings/critical/CCreport.asp.

C) Since it allows for the most development outside of the current urban areas, **Plan Alternative C would reduce the acreage of land area retained for active farming uses most**. This would lead to a decrease in jobs and an increase in the amount of food shipped into Humboldt. Food transportation is a source of vehicle emissions that leads to climate change, which will impact health.

Alternative Health Promoting Mitigations:

- Selectively preserve agricultural land under Scenario C.
- Restrict housing placement to the periphery of agriculturally zoned land to maintain contiguous acreage for future farming use.
- See the Humboldt 2025 General Plan Update Agricultural Resources and Policies report available at http://co.humboldt.ca.us/planning/gp/pdf/agrprt_2.pdf for further mitigations.

ES.3.b Proportion of County land area retained for timber production

Health-Based Rationale

Timberland preservation is important for long-term economic utilization and to actively enhance and increase County timber production capabilities. Further declines in timber production reduce the viability of the local forest industry, diminish economic productivity and result in job losses. Forestland fragmented into small parcels cannot economically sustain timber production as the primary use. Property improvements for residential purposes can increase the market value of the land so that it is cost prohibitive for use as commercially viable forest land. Residential uses can reduce the long-term productivity of adjacent timberlands when increased regulatory restrictions are imposed on harvesting to moderate impacts to residential users.[12] Timberlands may contain wildlife habitats, sensitive watersheds or critical water supply areas.

From a health perspective, the loss of timberlands has several consequences. First, loss of timber-related jobs could result in increased unemployment in the County. Unemployment and underemployment lead to hypertension, depression, reduced life expectancy, and a tendency toward alcohol and drug abuse (see the Healthy Economy Indicators section for details). Good paying timber jobs may be replaced with poorly paying service jobs which often do not come with benefits such as health insurance.

Loss of timberlands can also negatively impact watersheds, which are needed for maintaining adequate supplies of clean water. See the Total Impervious Area indicator below for more details about the health impacts of loss of watersheds.

Other health related impacts of loss of timber land include a potential degradation of air quality as a result of losing trees that can filter particulate matter from air and potential loss of lands that are culturally significant.

Existing conditions

Amount and conversion of timberlands: Humboldt 2025 General Plan Forest Resources and Policies report available at http://co.humboldt.ca.us/planning/gp/pdf/forest2.pdf[13] is a valuable resource for those interested in timberlands in the County. Some of its findings include:

- There are 1,900,000 acres of forestland in Humboldt, 1,700,000 of which are suitable for production.
- Timber harvest in the County is a substantial percent of the state's, consistently over 20%.
- About 1000 acres of timberland have been converted to other uses since 1985.

The report also includes a classification of timberland sites by tree height and value and by type of tree, an economic analysis, an analysis of land ownership and an analysis of potential land use conflicts.

According to the California Department of Forestry and Fire Protection, in 1996 Humboldt County had 1,487,000 acres of forest land, 65% of total acreage: 262,000 were National forests, 15,000 other public lands, 608,000 forest industry, 602 farmer and other private land. In 1967 there were 1,850,000 acres of forested land. Over almost 30 years there was close to a 20% reduction of forested land.[14]

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[12] Fire and Resource Assessment Program – California Dept of Forestry and Fire Protection.
Preliminary Timber Resource State for Humboldt County California, Daniel Oswald, SFS Resource Bulletin PNW-23, 1968.
[13] Humboldt 2025 General Plan Forest Resources and Policies report available at http://co.humboldt.ca.us/planning/gp/pdf/forest2.pdf.
[14] Fire and Resource Assessment Program – California Dept of Forestry and Fire Protection.

Analysis

Assumptions

- Lands not currently designated as timberland will be converted to that use.

Logic

- Expansion of residential areas into existing timberland or land near existing timberland will affect the economic viability of those lands and impact associated jobs.

Quantitative Analysis

As part of the Environmental Impact Assessment process the County is currently preparing land use maps that will analyze how many acres of timberland would be converted to other uses for each Plan Alternative. No quantitative analysis is possible without that data.

Qualitative Analysis

At community focus groups, participants expressed interest in maintaining the rural character of the county by preserving open space. Timber production was recognized as an important economic force in the County, offering relatively well-paid jobs with benefits. Interest was expressed in preservation of habitats of threatened and endangered species which could be relatively preserved by responsible logging practices compared to residential development. There was discussion of the cultural importance of the forest lands among some populations.

When discussing timber the following issues were raised: forest fires, erosion (associated with water quality and fish), recreation, logging and forest roads, cultural/ceremonial places, sustainable harvests, globalization, preservation of biodiversity, and economic sustainability.

During the public scoping meetings for the General Plan Update, protection of timberlands was raised as a key concern. Some of the recommendations were documented in the Critical Choices Report[15] and included:

- Developing updated County-wide policies for timber resource protection and management and include consideration of economic, social and environmental affects of harvesting;
- Implementing these policies in specific areas through Plan and zone modifications, other areas of County jurisdiction (e.g., roads) and policy input to state and federal agencies.

Conclusions

A) **Plan Alternative A will preserve the greatest amount of timberland** since it limits new development to urban areas. This would improve help by preserving jobs and maintaining watersheds.

B) **Plan Alternative B would slightly reduce the acreage of land area retained for timber harvest** due to real estate pressures raising land prices. Local jobs may suffer as would watersheds.

C) Since it allows for the most development outside of the current urban areas, **Plan Alternative C would reduce the acreage of timberland most**. This would lead to a decrease in jobs associated with timber and could harm watersheds.

Caveats

[15] Available at: http://co.humboldt.ca.us/planning/gp/meetings/critical/CCreport.asp.

There is considerable variation in logging practices which influence the impact of the timber industry on long-term viability, rural character of the County, and sensitive habitats.

Alternative Health Promoting Mitigations

- Selectively preserve timberland tracts under scenario C.
- Humboldt 2025 General Plan Forest Resources and Policies report available at http://co.humboldt.ca.us/planning/gp/pdf/forest2.pdf for further mitigations.

ES.2.a Acres of public open space per 1,000 population in Urban areas

Health-Based Rationale

Many residents of Humboldt County value the open space available. Parks and natural open space areas promote physical activity and social interaction. Areas with natural vegetation also have direct effects on physical and mental health. For example:

- One review of studies showed that access to places for physical activity combined with outreach and education can produce a 48% increase in the frequency of physical activity;[16]
- Living in proximity to green space is associated with reduced self-reported health symptoms, better self-rated health, and higher scores on general health questionnaires;[17]
- People dissatisfied with their available green spaces have 2.4 times higher risk for mental health issues;[18]
- Parks increase neighborly interaction and socialization.[19] Social networks and interaction have been linked to improvements in physical and mental health.

Existing conditions

National Standard: The National Recreation and Park Association's Standard of Excellence is 6 acres or more of park land per 1000 people. Most urban areas do not achieve this standard.

Eureka: There are a total of more than 113.67 acres of parks in Eureka including: Carson Park (3.22 acres), Clara Mae Berry Park (0.5 acres), Cooper Gluch (33 acres), Hammond Park (1.4 acres), Halvorsen Park (3 acres), Lundbar Hills Park (1.25 acres), Ross Park (1.5 acres), Sequoia Park (67 acres+), 20/30 Park (2.8 acres), and some other facilities and ball fields.[20] The population in Eureka was 25,435 in 2006. Using these numbers, one can calculate that there are more than 4.47 acres of park per 1000 people in Eureka.

Arcata: There are over 104 acres of Park in Arcata[21]. In 2006, there were 16,888 people in the city and therefore there were over 6.16 acres of park per 1000 people.

Fortuna: There are 2 main parks in Fortuna: Rohner Park (55 acres) and Newburg Park (18 acres). The city's population in 2006 was 11,208. Therefore, there were over 6.5 acres of parks per 1000 people in Fortuna.

Analysis

Assumptions

- Few parks, and no large parks, will be built in urban areas of Humboldt County in the coming years.

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[16] Kahn EB. The effectiveness of interventions to increase physical activity. Am J Prev Med. 2002;22(4):73-107.

[17] Vries S, de Verheij RA, Groenewegen PP, Spreeuwenberg P. Natural environments - healthy environments? An exploratory analysis of the relationship between green space and health. Environment and Planning A. 2003;35(10):1717-1731.

[18] Guite HF, Clark C, Ackrill G. 2006. The impact of physical and urban environment on mental well-being. Public Health 120:1117-1126.

[19] Sullivan WC, Kuo FE, DePooter Sf. 2004. The fruit of urban nature: Vital neighborhood spaces. Environment and Behavior 36(5):678-700.

[20] Eureka Parks and Playgrounds Brochure, City of Eureka Public Works Department, Parks Division. Available at: http://www.ci.eureka.ca.gov/depts/pw/parks/park_facilities_and_map.asp.

[21] City of Arcata, Economic Development Strategic Plan, Technical Appendices, Appendix E Economic Development Assets. Available at: http://www.cityofarcata.com/images/stories/Economic_Development_Plan/AppendixE.pdf.

Logic

- Bringing more people into urban areas may reduce the acreage of parks available per 1000 people if more parks are not built.

Quantitative Analysis

In all three Plan Alternatives, approximately 14,400 people would come to urban areas over the next 25 years. Currently, using the information above, one can calculate that the average acres of park per 1000 residents for all three cities combined is approximately 5.5 (291 acres and 53531 people). With an additional 14,400 people, this will be reduced to 4.3 acres of parks per 1000 residents.

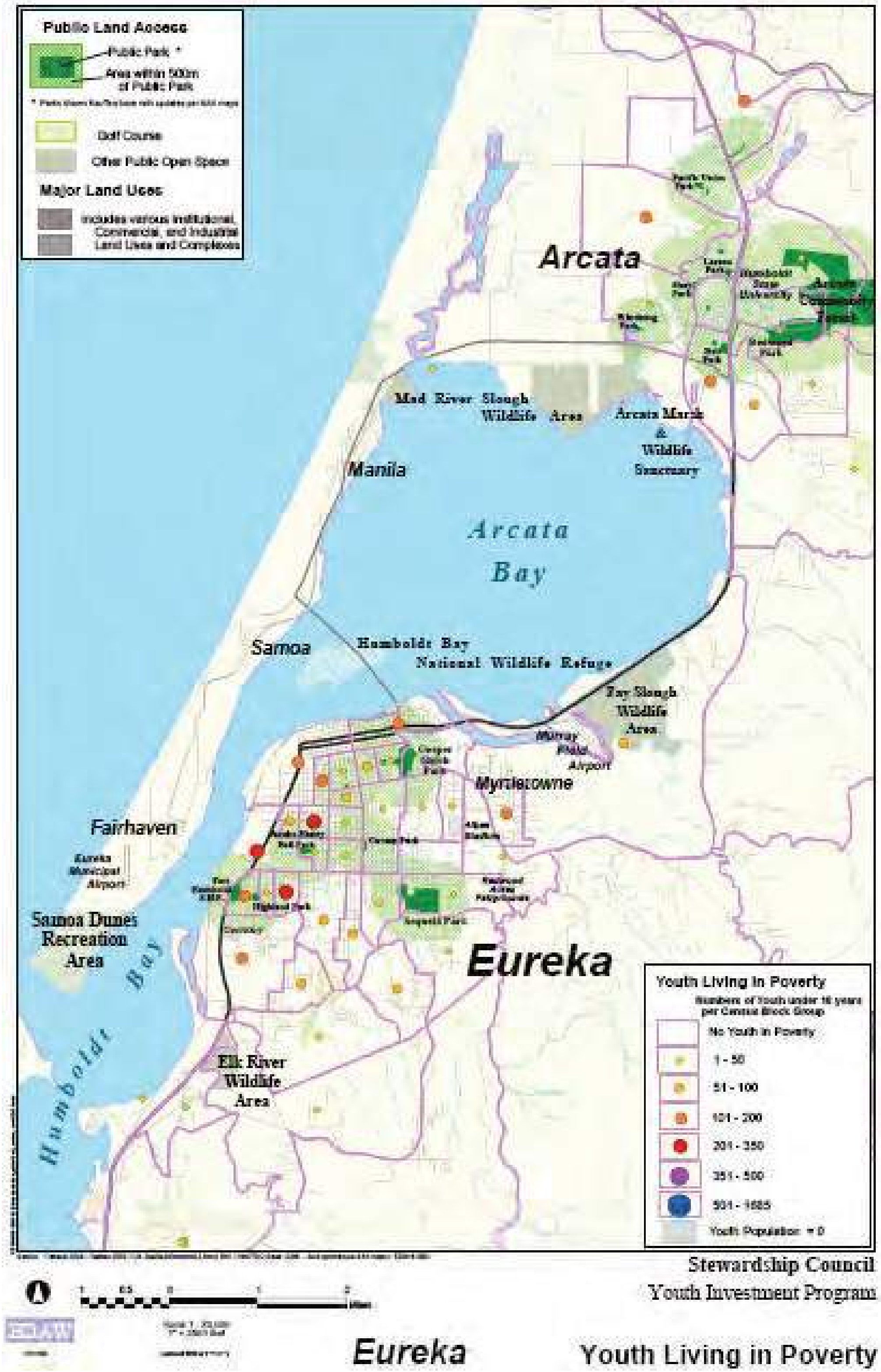
Qualitative Analysis

People want to retain Humboldt's outdoor space and rural character, so ensuring parks are available is important. Publicly accessible parks (not just urban parks) were recognized for their importance to the economy (tourism and others), physical activity, and mental health.

Disparities

People without access to cars (low income residents, seniors, children) need to be able to access parks by walking or biking. Often, areas in which low income residents live have fewer parks, as the figure below shows.

Figure ES.2. A map overlaying parks with areas of poverty in Eureka and Arcata.[22]



22 http://www.stewardshipcouncil.org/youth_investment/gis_maps/Loc-Eureka_youth-povdot_22x34.pdf.

Conclusions
In all Plan Alternatives, 14,400 new people will be moving to urban areas of Humboldt. **Without the construction of additional parks, the acreage of parks per 1000 residents will decrease.**

Caveats
In Plan Alternatives B and C, people in non-urban housing will probably not be close to parks and playgrounds.. This indicator evaluates urban centers and does not address people in those areas. Given that they will not be close to parks, there will be associated health issues – lack of exercise, lack of social interaction, etc. More research would need to be carried out to understand if the open space in the non-urban areas is used in the same way parks would be in urban areas.

Alternative Health-Promoting Mitigations:
- Ensure funding for parks is maintained.
- Ensure schoolyards are available in off hours for community use.
- Ensure that forests, parks and wetlands in the County are not being converted to other uses.
- Specifically, build parks in Eureka to increase acreage of parks available to the largest population in the county.

ES.5.c Percent of households using municipal water system

Health-Based Rationale

Water resources and water quality have been greatly affected by development. Watersheds (regions of land within which water flows down into rivers, lakes, or ocean; drainage basins) have been developed, stormwater runoff has increased, and pollution levels in water has increased. Among other environmental effects, the increase in impervious areas (most notably, roads and parking lots) leads to loss of groundwater recharge (the process by which ground water is replenished), which can reduce both residential and municipal water supplies and to increased flooding. Stormwater is often polluted by pesticides and fertilizers from homes and farms, and from oil, lead, heavy metals, and other pollutants from industry and transportation. In some parts of the California, pesticides in drinking water because of industrial agriculture is so great that by the age of 10, children have been exposed to the maximum allowable "life doses".[23] Water can also contain fecal coliform bacteria. This water can make its way into our drinking water supply, into the water used for recreation, and into the water in which we fish. Additionally, excess nutrients in water resources due to sewage and fertilizer runoff and other sources is harmful due to the resulting increase in plant growth (e.g., algae) and due to oxygen depletion, which can harm fish.

Water quality in many rivers, lakes and estuaries in the country is degraded and water can no longer be used for drinking, swimming or fishing. The EPA's 1996 National Water Quality Inventory estimates that about 40% of the bodies of water they surveyed were too polluted for such uses.[24] 59% of the North Coast Region is affected by sediment impairment.[25]

Access to clean drinking water is vital for health. Coliform bacterial contamination of water supplies can cause significant human illness, notably diarrheal illness. Infants, young children and the elderly are particularly prone to serious complications of such illnesses, which can include death. Other water contaminants can also cause disease.

As far as water quality is concerned, it is significantly safer to live in more densely populated areas served by larger PWS, as the data below shows.

Existing conditions

Public Water Systems: In Humboldt County there are 21 community Public Water System (PWS) with greater than 200 service connections. There are 25 PWS with fewer than 200 service connections. The lager PWSs tend to be used in more urban areas with denser populations.

Failures of the PWSs: The number of coliform failures (total coliform or e. coli) for PWS with greater than 200 service connections over last 3 years is approximately 1. The number of coliform failures (total coliform or e. coli) for PWS with fewer than 200 service connections over last 3 years is approximately 10. (In addition, there were approximately 13 failures to monitor for coliform in systems with fewer than 200 service connections over the last 3 years.) The number of community PWS with greater than 200 service connections using surface water is approximately 6. The number of community PWS with fewer than 200 service connections using surface water is approximately 12.

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[23] Heavner B. 1999. Toxics on Tap: Pesticides in California Drinking Water Sources California Public Interest Research Group. Available at http://www.environmentcalifornia.org/reports/environmental-health/environmental-health-reports/toxics-on-tap-pesticides-in-california-drinking-water-sources. Accessed on January 21, 2008.
[24] U.S. Environmental Protection Agency. "National Water Quality Inventory: 1996 Report to Congress." 1996.
[25] Winzler & Kelly Consulting Engineers. Nov 2007. Draft Water Resources Technical Report. http://co.humboldt.ca.us/planning/gp/PrelimHearingDraft/Group7b/Water_Resource_Tech_Rpt_11_21_07.pdf.

The number of turbidity failures (turbidity measures the amount of suspended matter/impurity in water) for PWS with greater than 200 service connections over last 3 years is approximately 3. The number of turbidity failures for PWS with fewer than 200 service connections over last 3 years is approximately 72.[26]

Data is not available for private water systems such as streams or wells, but water from wells in the County are often poor in quality and quantity.[27]

Water supply: There are currently shortages of water for domestic use in some areas of the County and these areas and the County as a whole require infrastructure development, including fixing leaks and improving storage capacity, to improve the situation and to avoid future health related issues. $180 million is needed currently to bring the sewer and water systems in the County into compliance with standards.[28]

Analysis

<u>Assumptions</u>

- Urban infill areas have access to Public Water Systems with greater than 200 service connections.
- Non-urban growth will occur in areas without access to a PWS with greater than 200 service connections. These include PWS with fewer connections and other water sources like streams and ponds.
- Existing municipal water supplies with infrastructure improvements can handle increased growth of urban areas.

<u>Logic</u>

- Homes built in existing urban areas would have access to municipal water supply; those built in non-urban areas would not.

<u>Quantitative Analysis</u>

Without data on the numbers of people served by different types of water systems and without data on the number of illnesses caused by water-borne contaminants over a given time period in the County, the changes in the number of people with access to public water systems or the changes in the number of people that become ill as a result of water-borne contaminants can not be quantified.

<u>Qualitative Analysis</u>

Water quality was a concern that was brought up in every focus group and appears to be a serious concern for residents of the County. Clean water was recognized for its contribution to food (fish), recreation, culture, and mental health (views of nature). Water diversion and conservation were raised as issues. Erosion was a concern as were stormwater runoff (impermeable surfaces) and runoff from agricultural lands. Having an emergency water supply was raised. Wastewater management was raised a number of times. Overall, water conservation was of high importance to participants.

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[26] Craig M. Bunas, P. E., Associate Sanitary Engineer, Drinking Water Field Operations Branch. California Department of Public Health

[27] Winzler & Kelly Consulting Engineers. Nov 2007. Draft Water Resources Technical Report. http://co.humboldt.ca.us/planning/gp/PrelimHearingDraft/Group7b/Water_Resource_Tech_Rpt_11_21_07.pdf.

[28] Winzler & Kelly Consulting Engineers. Nov 2007. Draft Water Resources Technical Report. http://co.humboldt.ca.us/planning/gp/PrelimHearingDraft/Group7b/Water_Resource_Tech_Rpt_11_21_07.pdf.

Conclusions

A) **Plan Alternative A would increase the proportion of households using municipal water systems** since housing would only be built in urban areas that are assumed to have such systems. The number of illnesses caused by water contamination would decrease in the County.

B) **Plan Alternative B would not lead to a significant change in the proportion of households using municipal water systems** since new housing would be distributed between urban areas that are assumed to have such systems and non-urban areas that do not. The rate of illnesses caused by water contamination would remain the same.

C) **Plan Alternative C would not lead to a decrease in the proportion of households using municipal water systems** since more new housing would be built in non-urban areas that do not have access to such systems. The number of illnesses caused by water contamination would increase in the County.

Alternative Health Promoting Mitigations

- Extend the existing Public Water Systems to serve new developments or build new systems. Developers could be made responsible for paying fees for this.

ES.5.a Total impervious area in County

Health–Based Rationale

Total impervious area (TIA) is a measure of the area taken up by rooftops and transport system components such as parking lots, roads and driveways. Rooftop runoff is typically absorbed by yards and not connected to a drainage system. Transport system related runoff is directly connected to drainage systems and often results in greater impact. Studies from many geographical areas have similarly concluded that stream degradation occurs at approximately 10-20% TIA.[29] Generally, when 10 to 15 % of an area is covered by impervious surfaces, the increased sediment and chemical pollutants in runoff have a measurable effect on water quality. When 15 to 25 % of a watershed is paved or impervious to drainage, increased runoff leads to reduced oxygen levels and harms stream life.[30]

Urban and suburban development cause profound changes to natural watershed conditions by altering the terrain, modifying the vegetation and soil characteristics, and introducing pavement, building, drainage and flood control infrastructure. Roughly 65% of impervious surfaces in the U.S. are for transportation (e.g., roads), while only 35% are for structures (e.g., houses).[31]

As TIA increases, less precipitation percolates into soil, increasing the volume of surface runoff. Flooding risk increases and the soil retains less moisture. There is a reduction of natural groundwater storage. An 18% increase in imperviousness results in an estimated 80% increase in annual average rainwater runoff.[32]

Water from this increased runoff may contain high concentrations of heavy metals, organic pollutants, fecal coliform bacteria, nutrients and total suspended solids. These pollutants have health consequences for those who use the water, eat fish from the water, or drink the water. Some contaminants are carcinogens and others cause infections. Fish can also be affected by the contaminants and by sediment[33], which affects the supply of locally available food, and has added economic and cultural significance for Native Americans.

Stream research generally indicates that certain zones of stream quality exist, most notably at about 10% impervious cover, where sensitive stream elements are lost from the system. A second threshold appears to exist at around 25 to 30% impervious cover, where most indicators of stream quality consistently shift to a poor condition (e.g., diminished aquatic diversity, water quality, and habitat scores).

10% TIA is suggested for stability.[34] Urban infill development leads to a smaller increase in TIA than non-urban development overall,[35] but it may increase the TIA in some urban areas above the critical value.

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[29] Scheuler, T. 1995. Environmental Land Planning Series: Site Planning for Urban Stream Protection. Prepared by the Metropolitan Washington Council of Governments and the Center for Watershed Protection, Silver spring, Maryland.
[30] Chandler L. New Satellite Maps Provide Planners Improved Urban Sprawl Insight. Nasa Goddard Space Flight Center. Available at http://www.gsfc.nasa.gov/gsfc/earth/landsat/sprawl.htm. Accessed on January 21, 2008.
[31] Livable Communities and Water Fact Sheet by The Local Government Commission available at: http://www.lgc.org/freepub/PDF/water/water_livable_communities.pdf.
[32] Bhaduri B, Harbor J, Engel B, Grove M. 2000. Assessing watershed-scale long-term hydrologic impacts of land-use change using a GIS-NPS model. Environmental Management 26:643-58.
[33] May et al., 1996 Assessment of Cumulative Effects of Urbanization of Small Streams in the Puget Sound Lowland Ecoregion. Urban Streams Conference, Arcata, CA, November 15-17, 1996.
[34] Schueler, T. The Importance of Imperviousness. Watershed Protection Techniques 1 (Fall 1994): 100.
[35] Schueler, T. and Clayton, RA, "Better Site Design: Changing Development Rules to Protect the Environment," Land Development (Spring-Summer 1999), pp. 16-18.

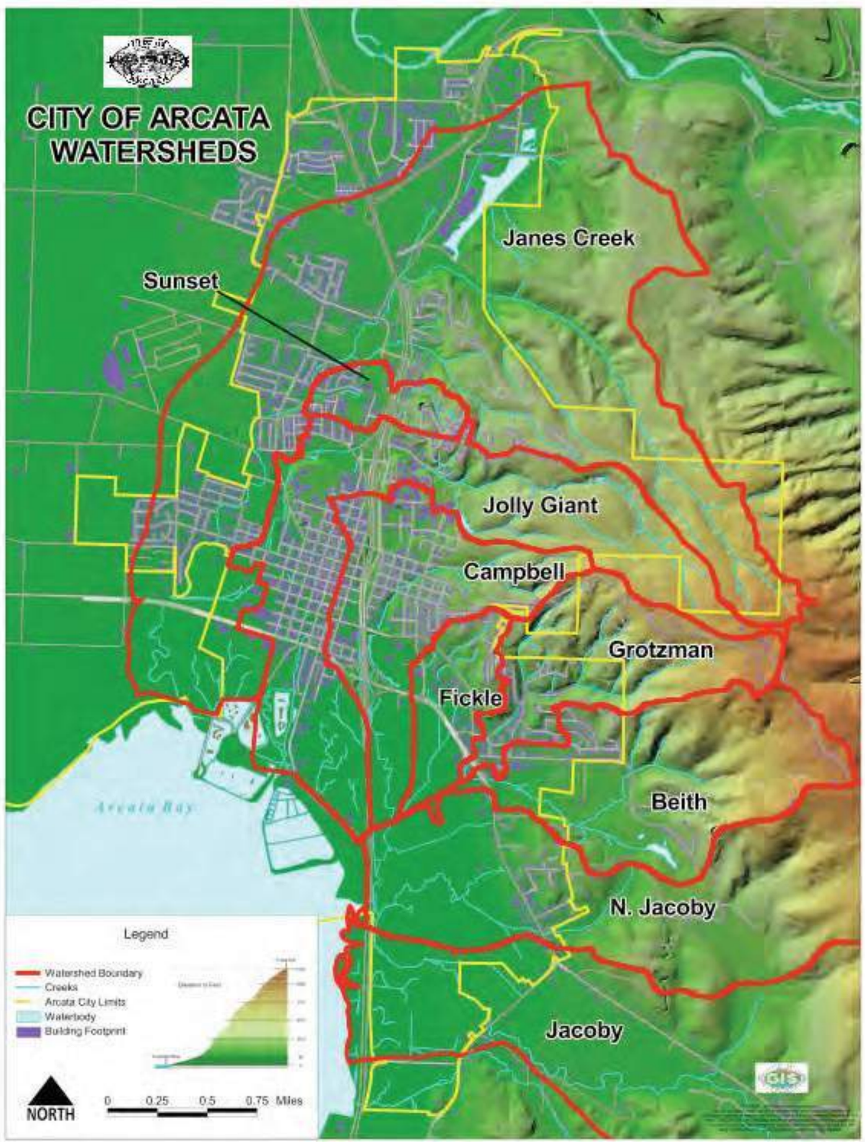
Existing conditions

Data on current TIA in Humboldt County is only available for the area around Arcata:[36]

Campbell Creek Watershed:	35%
Janes Creek Watershed:	12%
Jolly Giant Creek Watershed:	20%
Beith Creek Watershed:	6%
Grotzman Creek Watershed:	11%
Fickle Hill Creek Watershed:	20%
Sunset Creek Watershed:	32%

The figure below shows the location of these watersheds.

Figure ES.3. A map showing the watersheds near Aracata.[37]



[36] DATA SOURCE: Mark Andre, Environmental Services, City of Arcata

[37] DATA SOURCE: Mark Andre, Environmental Services, City of Arcata

Analysis

Assumptions

- Most non-urban development will include new roads and increase TIA.

Logic

- Urban development leads to a smaller increase in TIA due to less need to build new roads and parking lots and because multifamily housing in urban areas will reduce the square footage of new roofs.
- Non-urban development will require new roads and parking lots in non-urban areas, and will require new parking in urban areas to accommodate more drivers in the cities. New housing in non-urban areas also tends to be larger and may therefore have more roof square footage.

Quantitative Analysis

The difference in Total Impervious Area created by urban development versus non-urban development has not been quantified.

Qualitative Analysis

Water quality was a concern that was brought up in every focus group and appears to be a serious concern for residents of the County. Clean water was recognized for its contribution to food (fish), recreation, culture, and mental health (views of nature). Water diversion and conservation were raised as issues. Erosion was a concern as were stormwater runoff (impermeable surfaces) and runoff from agricultural lands. Having an emergency water supply was raised. Wastewater management was raised a number of times. Overall, water conservation was of high importance to participants.

Conclusions

Since all the Plan Alternative would bring the same number of housing units to urban areas, all could affect urban watersheds negatively.

A) **Plan Alternative A will lead to the least increase in TIA since all development would be urban**. Additional road construction would not be necessary and, if multi-family housing is built, the square footage of roofs could be reduced. Water quality would be least affected by this Alternative.

B) The mix of urban and non-urban housing in **Plan Alternative B will lead to a more significant increase in TIA than in Alternative A**. New roads would likely be built and cities would need to build more parking. Given the larger housing being built in non-urban areas, the square footage of roofing would be larger as well. Water quality would be degraded in this Alternative and this would impact health negatively.

C) **Plan Alternative C will lead to the most significant increase in TIA**. New roads would be built and cities would need to build more parking. Given the larger housing being built in non-urban areas, the square footage of roofing would be larger as well. Water quality would be significantly degraded in this Alternative and this would impact health negatively.

Alternative Health Promoting Mitigations:

- Minimize the impact on TIA by building more densely, building fewer roads and parking lots, and building smaller houses.

- Implement policies that decrease parking requirements for retail establishments in non-urban areas, decreased parking for office building and encourage parking garages instead of large parking lots.
- Limit development to areas near existing roads.
- Incentivize the use of porous materials for new roads and parking lots.
- Incorporate the Ahwahnee Water Principles into the General Plan: "City and County officials, the watershed council, LAFCO, special districts and other stakeholders sharing watersheds should collaborate to take advantage of the benefits and synergies of water resource planning at the watershed level."
- Set limits on TIA in each watershed.
- Encourage roofing partially or completely covered with vegetation and soil that can absorb water.

ES.1.b Residential electricity use (kWH) per capita

Health-Based Rationale

According to the Healthy Development Measurement Tool:[38]

> Electricity generated from fossil fuels produces air pollution in the form of particulate matter, nitrogen oxides, volatile organic compounds, and toxic air contaminants. Air pollution from these emissions in turn contributes to respiratory disease and deaths from cardio-vascular diseases. Electricity generation also contributes to greenhouse gas emissions and indirectly to climate change which threatens health through more extreme weather events, increased air pollution, limitations on food production, increased water-borne and food-borne illnesses, and increased infectious disease vectors.
>
> The benefits of energy efficiency go beyond environmental sustainability. Energy efficiency can have economic benefits for both residents and property managers by lowering utility bills. Furthermore, energy efficient design and construction techniques can contribute to household economic well-being through lowered energy costs.

Large homes on large lots that can be built in non-urban settings require more electricity (e.g., for lighting and heating) than smaller homes and multi-unit buildings that are typically built in urban areas. One study estimated that electricity consumption in a single family residence (3 units/acre) was almost twice that of a moderate high rise (~100 units per acre).[39]

Health impacts relate to individual family income spent on electric, general health impacts from global warming and climate change, and more generalized health effects laid out in Healthy Economy section from increasing locally produced electricity via alternative energy sources.

Existing conditions

In Humboldt, electricity use per capita is approximately 7300 kWh/year and is similar to that in California but about half the per capita electricity use in the US overall. In 2003, it is estimated that $134 million was spent on electricity in the County. Electricity consumption is divided as follows: 35% residential, 32% industrial, 31% commercial, and 2% agricultural.[40]

Electricity use in the County increased about 1.3% per year between 1990 and 2000, while population growth was about 0.6% per year. Due to decreased use in industry (mainly timber), energy use in the County decreased significantly (approximately 24%) between 2000 and 2003. It is expected that electricity consumption will grow over the next 20 years by between 0.5% and 1.5% per year, and that residential and commercial consumption will grow the fastest.[41]

There is a large potential for generation and use of renewable energy in Humboldt, both with mature technologies, such as wind power, and developing technologies, such as wave power.

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[38] San Francisco Department of Public Health's Healthy Development Measurement Tool. Available at: http://www.thehdmt.org/indicator.php?indicator_id=2.

[39] "The Costs of Sprawl," Real Estate Research Corporation, 1974.

[40] Zoellick, J. Humboldt County's Energy Picture. Presented on Sept 29, 2005 at Humboldt State University. Author is from Schatz Energy Research Center.

[41] Humboldt County Energy Element Appendices: Technical Report. Prepared for Redwood Coast Energy Authority by Schatz Energy Research Center, Humboldt State University. October, 2005.

Currently, the County produces a large portion of electricity (~73%) and a small portion of natural gas (~11%) needed.

Since Humboldt is remote, issues include uncertainty of supply, reliability and affordability of energy, and a shift toward decentralized electricity generation. Land use development greatly affects energy consumption and land use policy can affect future energy generation and transportation. There is significant interest in the County to create and implement a sustainable energy plan.

Analysis

Assumptions

- Housing developed in urban areas will tend to be smaller than housing developed elsewhere.
- Some of the housing in urban areas will be developed as multi-unit housing, as opposed to non-urban areas which will not have multi-unit housing.

Logic

- Housing in urban areas will consume less electricity due to their smaller size.

Quantitative Analysis

Data on difference in consumption between urban and non-urban residential development is not reliable enough to be used to quantify difference in the Plan Alternatives.

Qualitative Analysis

Energy consumption and sustainability are of great concern for Humboldt residents and were raised numerous times in the focus groups. Items discussed included: modes of transport, home heating type, house siting, and alternative energy.

Disparities

Higher income people tend to use a greater share of resources, such as electricity, but the cost is often borne by the poor, who will be affected more by global warming, for example.

Conclusions

A) Plan Alternative A includes only urban development, which will encourage smaller housing and multi-unit housing that consume less electricity. **Whether this Plan actually reduces per capita electricity consumption or does not change it will depend on the characteristics of housing being built.**

B) **Per capita electricity consumption would likely increase in Plan Alternative B** since many new non-urban homes that could consume larger amounts of electricity will be built. This will have effects on air pollution and global warming, both of which have health consequences. This will also increase the amount residents spend on electricity and leave less income for other health-promoting resources such as healthy food.

C) **Plan Alternative C will increase per capita electricity consumption most** since the highest number new non-urban homes that could consume larger amounts of electricity will be built. This will have more significant effects on air pollution and global warming, both of which have health consequences. This will also increase the amount residents spend on electricity and leave less income for other health-promoting resources such as healthy food.

Alternative Health Promoting Mitigations:

- Increase energy efficiency of housing.
- Encourage construction of multi-unit buildings and smaller housing.
- Encourage construction of buildings that follow environmental standards such as those proposed by Leadership in Energy and Environmental Design (LEED).
- Regulate electricity use by industry and businesses (e.g., turning lights off in office buildings at night).
- Promote solar and other locally produced energy production and consumption.
- Reduce the County's carbon footprint by following the recommendations of groups like the International Council for Local Environmental Initiatives (ICLEI).
- Implement outdoor lighting efficiency standards to decrease public and private use of electricity.

ES.3.c Percent of food consumption of food produced within the County

Health-Based Rationale

Agriculture is an important part of the economic base of Humboldt County, including many small producers and self-employed. Productive farming land is part of what many local residents value about the County.

Consumption of locally produced foods can reduce consumption of fossil fuels and reduce potential for pollution and for global warming.[42] It may also increase consumption of fruits and vegetables and reduce the consumption of processed foods by improving the freshness, and therefore the taste, of produce In addition, consumption of locally grown produce can have economic benefits. First, farmers only receive between 4 and 19 cents of every dollar spent on food while the remaining portion goes to marketers[43], processors, distributors, retailers, wholesalers, and goods movement. Second, money paid to local farmers is more likely to stay in the community. Every dollar spent on locally grown produce circulates 2.5 times in the local community, as compared to 1.4 times for dollars spent on conventionally grown food in a supermarket.[44]

Due to the rural nature and geographic location of the area, transportation of agricultural and industrial products to larger marketing areas within and outside of California is difficult and expensive, since most goods must be shipped over a mountainous or coastal highway to reach a major market area. Getting the crop from seed to harvest takes only one-fifth of the total oil used for our food. Most oil is consumed transporting food from the point of production to the point of consumption.[45] 16% of total US energy consumption goes into food production, processing, packaging, distribution and marketing.[46]

Importing food from other countries exposes the consumer to food produced under regulations concerning pesticides and production that may not be as vigorous as standards in this country.
Large commercial farming operations are the exception rather than the norm with smaller family farms making up the majority of agricultural operations in the area. Livestock related operations, including the dairy industry and beef cattle operations, are the most significant agricultural contributors to the local economies within the region. Other significant agricultural operations are nursery crops that include lily bulbs and woody ornamentals, pasture and hay land crops, and to a lesser extent, vegetable row crops, orchards and vineyards. Small family farm operators are finding it difficult to stay competitive[47] due to several limiting factors, not the least of which include higher operating and transportation costs to sell their products regionally or having to ship their products to larger market areas within or outside of California. Small farm operators are looking for ways to diversify their product lines and simplify marketing methods in order to offset their escalating operating costs, and health-conscious consumers are looking for ways to access locally-grown, environmentally-friendly foods. Direct farmer-to-consumer marketing methods have potential for growth and success.

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[42] La Trobe, H. Farmers' markets: consuming local rural produce. International Journal of Consumer Studies. 2001; 25;(3): 181-192.
[43] Elitzak H. Food Marketing Costs: A 1990's Retrospective. United States Department of Agriculture Economic Research Service. September-December 2000. Available at http://www.ers.usda.gov/publications/foodreview/septdec00/FRsept00e.pdf.
[44] Seyfang G. Local Organic Food: The Social Implications of Sustainable Consumption. CSERGE (Center for Social and Economic Research on the Global Environment) Working Paper EDM 04-09. University of East Anglia, Norwich, UK. 2004.
[45] Kingsolver, B. Animal, Vegetable, Miracle, Harper Collins Publishers, 2007, p. 5.
[46] Pirog R. Food, Fuel, and Freeways: An Iowa Perspective on How Far Food Travels, Fuel Usage, and Greenhouse Gas Emissions. Ames, Iowa. Leopold Center for Sustainable Agriculture. Iowa State University. 2001.
[47] Humboldt 2025 General Plan Update Agricultural Resources and Policies report available at http://co.humboldt.ca.us/planning/gp/pdf/agrprt_2.pdf.

Existing conditions
According to one source, around 85% of Humboldt's food, today, is brought in by trucks.[48] In the US, on average, an item of food travels 1500 miles between the farm and the plate.[49]

Opportunities for access to local produce include: 13 farmers markets, 6 local Community Supported Agricultural Farms programs, local grocery stores that highlight locally grown food, and a Farm-to-School program for education.

No data is available on home production of food.

Analysis

Assumptions
- Lands not currently designated as agriculture lands will be converted to that use.
- There will be a continued market for agricultural products.
- With escalating transportation costs and consciousness about global warming local consumer interest in local products will grow.
- Expansion of residential development could decrease agricultural lands.
- One limitation to consumption of locally produced food could be that there is not enough arable land to grow food.

Logic
- Preserving agricultural lands would ensure that local production continues.

Quantitative Analysis
It is impossible to estimate changes that would result from adoption of any of the three Plan Alternatives since information on what is limiting consumption of locally produced food is unavailable.

Qualitative Analysis
There is a strong desire to increase the self-sufficiency within the County and to support local farmers and businesses. Attendees from community meetings favored maintaining the rural character of the County and maintaining and supporting local agricultural production. Food miles traveled was discussed, as was supporting the local economy. Having local food was also considered a security issue.

Conclusions
A) Given that Plan Alternative A does not expand housing into agricultural lands, **there would not be a further limitation on local production of food and therefore consumption of locally produced food would not be hindered with Plan A.** Consumption of locally grown food would improve health because locally grown food could be more flavorful and therefore consumption of fruits and vegetable could increase. Additionally, transportation-related climate change would be limited.
B) **Plan Alternative B could result in some loss of farmland and could limit local production of food somewhat.** This could thereby limit consumption of locally grown food and lead to the need

[48] http://www.culturechange.org/HumboldtEcon.html.
[49] Pirog R. Food, Fuel, and Freeways: An Iowa Perspective on How Far Food Travels, Fuel Usage, and Greenhouse Gas Emissions. Ames, Iowa. Leopold Center for Sustainable Agriculture. Iowa State University. 2001.

to import more food from outside the County. Transportation-related climate change could increase as a result.

C) **Plan Alternative C would result in more significant loss of farmland and could limit local production of food.** This could thereby limit consumption of locally grown food and lead to the need to import more food from outside the County. Transportation-related climate change could increase as a result. The importing of fruits and vegetables could also affect flavor and may lead to a decrease in consumption of fruits and vegetables, which are necessary to maintain a healthy diet.

Caveats

Limitations on consumption could include: land for production, cost of locally produced food, types of food grown locally (including what food production is subsidized), outlets for locally produced food, successful business models, lack of interest in consuming locally produced food, etc.). It is unclear which of these is the biggest limitation currently.

Alternative Health Promoting Mitigations:

- Increase incentives to produce food locally and consume locally produced food.
- Increase programs and incentives for locally grown food businesses (e.g., see: http://guide.buylocalca.org/ and http://www.caff.org/programs/eco_index.shtml).
- Encourage County institutions (e.g., hospitals) to use locally grown foods.
- Support food incubator businesses in the County.

Exhibit V

Exhibit V

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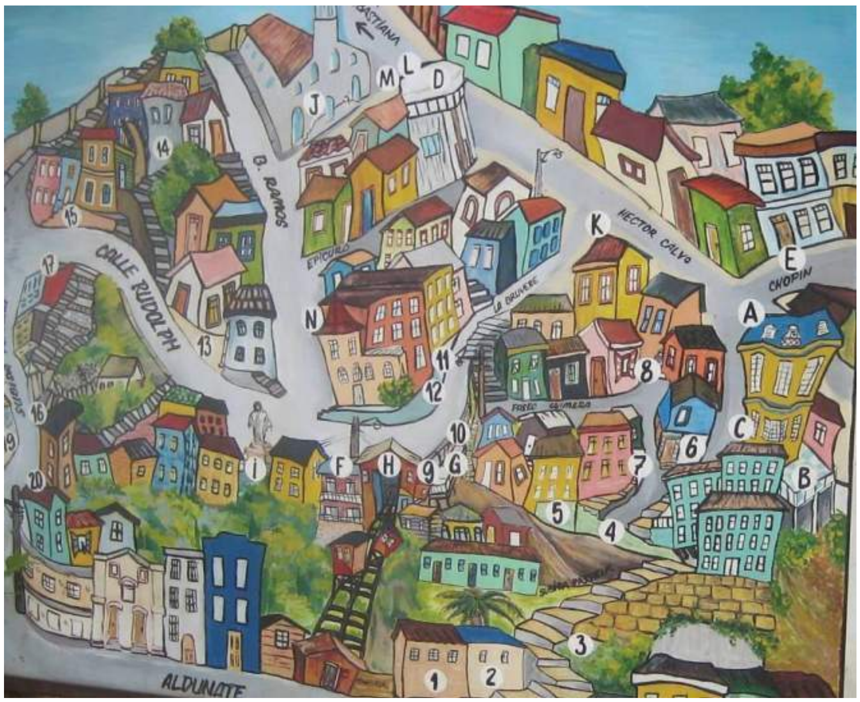
250-360-1560

Land Use Impacts on Transport

How Land Use Factors Affect Travel Behavior

27 January 2015

Todd Litman
Victoria Transport Policy Institute
With Rowan Steele



Land use factors such as density, mix, connectivity and walkability affect how people travel in a community. This information can be used to help achieve transport planning objectives.

Abstract

This paper examines how various land use factors such as density, regional accessibility, mix and roadway connectivity affect travel behavior, including per capita vehicle travel, mode split and nonmotorized travel. This information is useful for evaluating the ability of smart growth, new urbanism and access management land use policies to achieve planning objectives such as consumer savings, energy conservation and emission reductions.

Contents

Executive Summary

This paper investigates how various land use factors affect transport impacts, and therefore the ability of *smart growth* (also called *new urbanism* or *compact development*) policies to achieve various planning objectives, as summarized below.

Land Use Factors	Transport Impacts	Planning Objectives
Regional accessibility	Vehicle ownership	Congestion reduction
Density	Vehicle trips and travel (mileage)	Road and parking cost savings
Land use mix	Walking	Consumer savings and affordability
Centeredness	Cycling	Improved mobility for non-drivers
Road and path connectivity	Public transit travel	Traffic safety
Roadway design	Ridesharing	Energy conservation
Active transport (walking and cycling conditions)	Telecommuting	Pollution emission reduction
Public transit service quality	Shorter trips	Improved public fitness and health
Parking supply and management		Habitat protection
Site design		Improved community livability
Mobility management		
Integrated smart growth programs		

This report considers various land use factors, transport impacts and planning objectives.

Although most land use factors have modest individual impacts, typically affecting just a few percent of total travel, they are cumulative and synergistic. Integrated smart growth programs that result in community design similar to what developed prior to 1950 can reduce vehicle ownership and travel 20-40%, and significantly increase walking, cycling and public transit, with even larger impacts if integrated with other policy changes such as increased investments in alternative modes and more efficient transport pricing.

Care is needed when evaluating the impacts of specific land use factors. Impacts vary depending on definitions, geographic and time scale of analysis, perspectives and specific conditions, such as area demographics. Most factors only apply to subset of total travel, such as local errands or commute travel. *Density* tends to receive the greatest attention, although alone its travel impacts are modest. Density is usually associated with other factors (regional accessibility, mix, transport system diversity, parking management) that together have large travel impacts. It is therefore important to make a distinction between the narrow definition of density as an isolated attribute, and the broader definition (often called *compact development*) that includes other associated attributes.

A key question is the degree of consumer demand for more accessible, multi-modal development. Demographic and economic trends (aging population, rising fuel prices, increasing health and environmental concerns, changing consumer location preferences, etc.) tend to increase demand for more accessible, multi-modal locations. This suggests that smart growth policies are likely to have greater impacts and benefits in the future.

Table ES-1 summarizes the effects of land use factors on travel behavior. Actual impacts will vary depending on specific conditions and the combination of factors applied.

Table ES-1 **Land Use Impacts on Travel Summary**

Factor	Definition	Travel Impacts
Regional accessibility	Location of development relative to regional urban center.	Reduces per capita vehicle mileage. More central area residents typically drive 10-40% less than at the urban fringe
Density	People or jobs per unit of land area (acre or hectare).	Reduces vehicle ownership and travel, and increases use of alternative modes. A 10% increase typically reduces VMT 0.5-1% as an isolated factor, and 1-4% including associated factors (regional accessibility, mix, etc.).
Mix	Proximity between different land uses (housing, commercial, institutional)	Tends to reduce vehicle travel and increase use of alternative modes, particularly walking. Mixed-use areas typically have 5-15% less vehicle travel.
Centeredness (centricity)	Portion of jobs and other activities in central activity centers (e.g., downtowns)	Increases use of alternative modes. Typically 30-60% of commuters to major commercial centers use alternative modes compared with 5-15% at dispersed locations
Network Connectivity	Degree that walkways and roads are connected	Increased roadway connectivity can reduce vehicle travel and improved walkway connectivity increases non-motorized travel
Roadway design	Scale, design and management of streets	Multi-modal streets increase use of alternative modes. Traffic calming reduces VMT and increases non-motorized travel
Active transport (walking and cycling) conditions	Quantity, quality and security of sidewalks, crosswalks, paths, and bike lanes.	Improved walking and cycling conditions tends to increase nonmotorized travel and reduce automobile travel. Residents of more walkable communities typically walk 2-4 times more and drive 5-15% less than in more automobile-dependent areas.
Transit quality and accessibility	Quality of transit service and access from transit to destinations	Increases ridership and reduces automobile trips. Residents of transit oriented neighborhoods tend to own 10-30% fewer vehicles, drive 10-30% fewer miles, and use alternative modes 2-10 times more than in automobile-oriented areas.
Parking supply and management	Number of parking spaces per building unit or acre, and how parking is managed and priced	Tends to reduce vehicle ownership and use, and increase use of alternative modes. Cost-recovery pricing (users finance parking facilities) typically reduces automobile trips 10-30%.
Site design	Whether oriented for auto or multi-modal accessibility	More multi-modal site design can reduce automobile trips, particularly if implemented with improvements to other modes.
Mobility management	Strategies that encourage more efficient travel activity	Tends to reduce vehicle ownership and use, and increase use of alternative modes. Impacts vary depending on specific factors.
Integrated smart growth programs	Travel impacts of integrated programs that include a variety of land use management strategies	Reduces vehicle ownership and use, and increases alternative mode use. Smart growth community residents typically own 10-30% fewer vehicles, drive 20-40% less, and use alternative mode 2-10 times more than in automobile-dependent locations, and even larger reductions are possible if integrated with regional transit improvements and pricing reforms.

This table describes various land use factors that can affect travel behavior and population health.

Introduction

Transportation and land use planning decisions interact. Transport planning decisions affect land use development, and land use conditions affect transport activity. These relationships are complex, with various interactive effects. It is therefore important to understand these in order to integrate planning, so individual decisions support strategic goals. A companion report, *Evaluating Transportation Land Use Impacts* (Litman 2009) describes methods for evaluating how transport planning decisions affect land use. This report describes ways that land use planning decisions affect transport.

Land use patterns (also called *community design*, *urban form*, *built environment*, *spatial planning* and *urban geography*) refers to various land use factors described in Table 1.

Table 1 **Land Use Factors**

Factor	Definition	Mechanisms
Regional Accessibility	Location relative to regional centers, jobs or services.	Reduces travel distances between regional destinations (homes, services and jobs).
Density	People, jobs or houses per unit of land area (acre, hectare, square mile or kilometer).	Reduces travel distances. Increases destinations within walking and cycling distances. Increases sidewalk, path and public transit efficiencies. Increases vehicle congestion and parking costs.
Mix	Proximity of different land uses (residential, commercial, institutional, etc.). Sometimes described as *jobs/housing balance*, the ratio of jobs and residents in an area.	Reduces travel distances between local destinations (homes, services and jobs). Increases the portion of destinations within walking and cycling distances.
Centeredness (centricity)	Portion of jobs, commercial and other activities in major activity centers.	Provides agglomeration efficiencies and increases public transit service efficiency.
Connectivity	Degree that roads and paths are connected and allow direct travel between destinations.	Reduces travel distances. Reduces congestion delays. Increases the portion of destinations within walking and cycling distances.
Roadway design and management	Scale and design of streets, to control traffic speeds, support different modes, and enhance the street environment.	Improves walking, cycling and public transit travel. May improve local environments so people stay in their neighborhoods more.
Parking supply and management	Number of parking spaces per building unit or hectare, and the degree to which they are priced and regulated for efficiency.	Increased parking supply disperses destinations, reduces walkability, and reduces the costs of driving.
Active transport conditions	Quantity and quality of sidewalks, crosswalks, paths, bike lanes, bike parking, pedestrian security and amenities.	Improves pedestrian and bicycle travel, and therefore public transit access. Encourages more local activities.
Transit accessibility	The degree to which destinations are accessible by high quality public transit.	Improves transit access and supports other accessibility improvements.
Site design	The layout and design of buildings and parking facilities.	Improves pedestrian access.
Mobility Management	Various strategies that encourage use of alternative modes.	Improves and encourages use of alternative modes.

This table describes various land use factors that can affect travel behavior and population health.

This paper investigates how these factors affect transport activity, including vehicle ownership, vehicle travel (vehicle trips and *vehicle miles of travel* or *VMT*), mode share (the portion of trips by different modes), active transport (walking and cycling), and therefore impacts on various planning issues such as traffic congestion, infrastructure costs, consumer costs, accident rates, physical fitness, and social equity objectives. Note that different types of travel have different impacts on these issues. For example, because commuting tends to occur during peak periods it contributes significantly to traffic congestion. The land use factors described in this report primarily affect the 60-70% of travel that is intraregional, they do not directly affect the 30-40% of travel that is interregional, such as business or recreational trips to other cities.

Land use patterns affect *accessibility*, people's ability to reach desired services and activities, which affects mobility, the amount and type of travel activity (Litman 2003). Different land use patterns have different accessibility features. Urban areas have more accessible land use and more diverse transport systems, but slower and more costly automobile travel. Suburban and rural areas have less accessible land use and fewer travel options but driving is faster and cheaper per mile. Table 2 summarizes these differences.

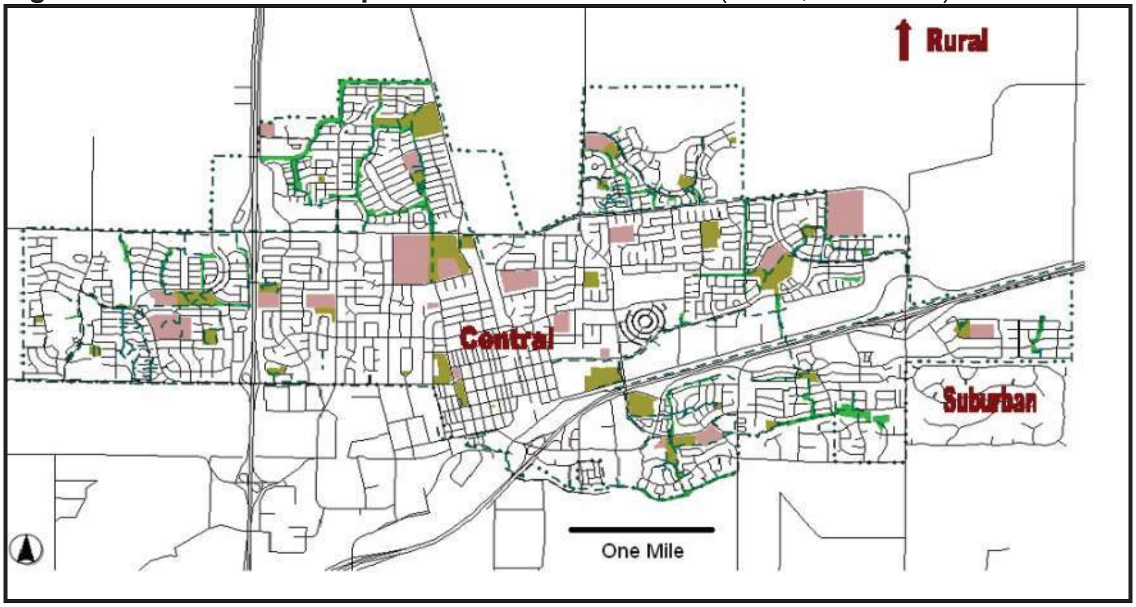
Table 2 **Land Use Features**

Feature	Urban	Suburb	Rural
Public services nearby	Many	Few	Very few
Jobs nearby	Many	Few	Very few
Distance to major activity centers (downtown or major mall)	Close	Medium	Far
Road type	Low-speed grid	Low-speed cul-de-sacs and higher-speed arterials	Higher-speed roads and highways
Road & path connectivity	Well connected	Poorly connected	Poorly connected
Parking	Sometimes limited	Abundant	Abundant
Sidewalks along streets	Usually	Sometime	Seldom
Local transit service quality	Very good	Moderate	Moderate to poor
Site/building orientation	Pedestrian-oriented	Automobile oriented	Automobile oriented
Mobility management	High to moderate	Moderate to low	Low

This table summarizes features of major land use categories.

These factors can significantly affect travel activity as illustrated in Figure 1. *Central* location residents typically drive 20-40% less and walk, cycle and use public transit two to four times more than they would at a *Suburban* location, and they drive 20-40% less than they would in a *rural* location. However, there are many variations among these categories. Suburban and rural villages can incorporate features such as sidewalks, bikelanes and land use mixing that increase accessibility and transport diversity. As a result, there are many degrees of accessibility and multi-modalism.

Figure 1 **Location Impacts on Travel Behavior** (Davis, California)



Residents of a **Central** *location drive less and walk, cycle and use public transit more than in* **Suburban** or **Rural** *location due to differences in accessibility and travel options.*

Table 3 illustrates typical differences in accessibility characteristics in various geographic areas of a typical U.S. city, indicating more nearby destinations (stores, schools, parks, etc.), and much higher rates of walking, cycling and public transit travel. These travel patterns are partly explained by demographic differences; urban households tend to be younger, smaller, have lower incomes, and lower employment rates.

Table 3 **Accessibility Differences** (Horning, El-Geneidy and Krizek 2008)

Characteristics	Urban	Inner Ring	Outer Ring	Overall
Mean age	43	51	54	50
Mean household size	1.85	2.25	2.77	2.35
Mean number of cars per household	1.26	1.79	2.17	1.80
Mean household income	$40 – 60k	$60 -$80k	$80 -$100k	$60 -$80k
Percent employed in the sample	38%	75%	72%	76%
Percent with college degrees in sample	44%	72%	72%	72%
Distance Perception				
Mean number of destinations within 1 km	44.29	26.17	12.90	41.50
Mean distance to all closest retail (km)	0.62	1.49	2.10	1.49
Non-auto modes use previous week				
Walked to work	33%	4%	2%	5%
Walked for exercise	49%	52%	54%	55%
Walked for to do errands	47%	20%	12%	29%
Biked	44%	24%	24%	24%
Used transit	45%	12%	5%	14%

This table summarizes differences in demographics, distance to common destinations, and travel activity between city, inner suburbs and outer suburbs.

Evaluating Land Use Impacts
Numerous studies measure the effects of various land use factors on travel activity (Barla, Miranda-Moreno and Lee-Gosselin 2010; CARB 2010 and 2011; Date, et al. 2014; Ewing, et al. 2007; Ewing and Cervero 2010; Guo and Gandavarapu 2010; Kuzmyak 2012; Outwater, et al. 2014; ULI 2010; USEPA 2013; Vernez Moudon and Stewart 2013). The report, *Effect of Smart Growth Policies on Travel Demand* (Outwater, et al. 2014) describes how smart growth policies affect travel. The *California Smart-Growth Trip Generation Rates Study* examined how smart growth policies affect trip generation rates and produced the *Smart Growth Trip-Generation Adjustment Tool* which can be used to model these impacts (Handy, Shafizadeh and Schneider 2013). The report, *Research on Practical Approach for Urban Transport Planning* by the Japan International Cooperation Agency includes detailed analysis of the geographic and demographic factors that affect urban travel in developing countries (JICA 2011).

Many land use factors overlap. For example, increased density tends to increase land use mix, transit accessibility and parking pricing, so analysis that only considers a single factor may exaggerate its effect (Stead and Marshall 2001). On the other hand, research is often based on aggregate (city, county or regional) data, impacts are often found to be greater when evaluated at a finer scale. For example, although studies typically indicate just 10-20% differences in average per capita vehicle mileage between Smart Growth and sprawled cities, much greater differences can be found at the neighborhood scale. As Ewing (1996) describes, "*Urban design characteristics may appear insignificant when tested individually, but quite significant when combined into an overall 'pedestrian-friendliness' measure. Conversely, urban design characteristics may appear significant when they are tested alone, but insignificant when tested in combination.*"

Impacts can be evaluated at four general levels:

1. Analysis of a single factor, such as density, mix or transit accessibility.
2. Regression analysis of various land use factors, such as density, mix and accessibility. This allows the relative magnitude of each factor to be determined.
3. Regression analysis of land use and demographic factors. This indicates the relative magnitude of individual land use factors and accounts for *self-selection* (also called *sorting*), that is, the tendency of people to choose locations based on their travel abilities, needs and preferences (Cao 2014).
4. Regression analysis of land use, demographic and preference factors. This analyzes takes into account sorting effects, including the tendency of people who, from preference or necessity, rely on alternative modes to choose more accessible locations.

Changes in vehicle mileage can involve various types of travel changes including trip frequency, destination, length and mode ("Transportation Elasticities," VTPI 2008). For example, urban residents tend to take more walking and public transit trips, and shorter automobile trips than sprawled location residents. Similarly, vehicle trip reduction incentives, such as congestion or parking pricing may cause people to consolidate trips, use closer destinations, and shift modes. These effects can affect benefit analysis. For example, destination shifts have very different cost impacts than mode shifts.

Travel impacts vary depending on the type of trip and traveler. For example, increasing land use mix and walkability tends to be particularly effective at reducing automobile shopping and recreational trips, while increasing regional accessibility and improved transit accessibility tend to reduce automobile commute trips. Shopping and recreation represent nearly half of all trips and about a third of travel mileage, but tend to be offpeak trips. As a result, improving mix and walkability tends to reduce energy consumption, pollution emissions and crashes but has less impact on traffic congestion. Commuting only represents 15-20% of total trips but often more than half of all trips on congested roadways and so have much larger congestion impacts.

Table 4 **U.S. Average Annual Person-Miles and Person-Trips** (ORNL 2004, Table 8.7)

	Commute	Shopping	Recreation	Other	Total
Annual Miles	2,540 (18.1%)	1,965 (14.0%)	4,273 (30.5%)	5,238 (37.4%)	14,016 (100%)
Annual Trips	214 (14.8%)	284 (19.6%)	387 (26.7%)	565 (39.0%)	1,450 (100%)

This table shows personal travel by trip purpose, based on the 2001 National Household Travel Survey.

Care is needed when evaluating this literature since studies vary in scale, scope and methodology, and the degree they account for confounding factors that affect both land use and travel (Fruits 2008). When evaluating impacts it may be important to account for *self selection*, the tendency of people to choose locations based on their abilities, needs and preferences (Cao, Mokhtarian and Handy 2008; Cervero 2007). For example, people who cannot or prefer not to drive tend to choose homes in more accessible neighborhoods. Some observed differences in travel activity reflect these effects, so it is inappropriate to assume that all households which move to smart growth locations necessarily reduce vehicle travel to neighborhood averages. As a result, policies which force people who prefer automobile-oriented lifestyles to live in smart growth communities may not achieve predicted vehicle travel reductions, energy savings and emission reductions. However, if there is latent demand for more multi-modal neighborhoods (some households want to locate in such areas but cannot due to a lack of appropriate and affordable housing), increasing the supply of such housing will tend to reduce total vehicle travel.

In many cities, more accessible older neighborhoods have high levels of poverty and related social and health problems, while more sprawled newer areas tend to be relatively wealthy, secure, and healthy. However, this does not necessarily mean that density and mix *cause* problems or that sprawl increases wealth and security overall. Rather, this reflects the effects of sorting. These effects can be viewed from three perspectives:

1. From individual households' perspective it is desirable to choose more isolated locations that exclude disadvantaged people with social and economic problems.
2. From a neighborhood's perspective it is desirable to exclude disadvantaged people and shift their costs (crime, stress on public services, etc.) to other jurisdictions.
3. From society's overall perspective it is harmful to isolate and concentrate disadvantaged people, which exacerbates their problems and reduces their economic opportunities.

Planning Objectives

Changes in travel behavior caused by land use management strategies can help solve various problems and help achieve various planning objectives. Table 5 identifies some of these objectives and discusses the ability of land use management strategies to help achieve them. These impacts vary in a number of ways. For example, some result from reductions in vehicle ownership, while others result from reductions in vehicle use. Some result from changes in total vehicle travel, others result primarily from reductions in peak-period vehicle travel. Some result from increased nonmotorized travel.

Table 5 **Land Use Management Strategies Effectiveness** (Litman 2004)

Planning Objective	Impacts of Land Use Management Strategies
Congestion Reduction	Strategies that increase density increase local congestion intensity, but by reducing per capita vehicle travel they reduce total regional congestion costs. Land use management can reduce the amount of congestion experienced for a given density.
Road & Parking Savings	Some strategies increase facility design and construction costs, but reduce the amount of road and parking facilities required and so reduces total costs.
Consumer Savings	May increase some development costs and reduce others, and can reduce total household transportation costs.
Transport Choice	Significantly improves walking, cycling and public transit service.
Road Safety	Traffic density increases crash frequency but reduces severity. Tends to reduce per capita traffic fatalities.
Environmental Protection	Reduces per capita energy consumption, pollution emissions, and land consumption.
Physical Fitness	Tends to significantly increase walking and cycling activity.
Community Livability	Tends to increase community aesthetics, social integration and community cohesion.

This table summarizes the typical benefits of land use management.

Land Use Management Strategies

Various land use management strategies are being promoted to help achieve various planning objectives, as summarized in Table 6. These represent somewhat different scales, perspectives and emphasis, but overlap to various degrees.

Table 6 **Land Use Management Strategies** (VTPI 2008; BA Consulting 2008)

Strategy	Scale	Description
Smart Growth	Regional and local	More compact, mixed, multi-modal development.
New Urbanism	Local, street and site	More compact, mixed, multi-modal, walkable development.
Transit-Oriented Development	Local, neighborhood and site	More compact, mixed, development designed around quality transit service, often designed around *transit villages*.
Location-Efficient Development	Local and site	Residential and commercial development located and designed for reduced automobile ownership and use.
Access management	Local, street and site	Coordination between roadway design and land use to improve transport.
Streetscaping	Street and site	Creating more attractive, walkable and transit-oriented streets.
Traffic calming	Street	Roadway redesign to reduce traffic volumes and speeds.
Parking management	Local and site	Various strategies for encouraging more efficient use of parking facilities and reducing parking requirements.

Various land use management strategies can increase accessibility and multi-modalism.

These land use management strategies can be implemented at various geographic scales. For example, clustering a few shops together into a mall tends to improve access for shoppers compared with the same shops sprawled along a highway (this is the typical scale of *access management*). Locating houses, shops and offices together in a neighborhood improves access for residents and employees (this is the typical scale of *New Urbanism*). Clustering numerous residential and commercial buildings near a transit center can reduce the need to own and use an automobile (this is the typical scale of *transit-oriented development*). Concentrating housing and employment within existing urban areas tends to increase transit system efficiency (this is the typical scale of *smart growth*). Although people sometimes assume that land use management requires that all communities become highly urbanized, these strategies are actually quite flexible and can be implemented in a wide range of conditions:

- In urban areas they involve infilling existing urban areas, encouraging fine-grained land use mix, and improving walking and public transit services.
- In suburban areas it involves creating compact downtowns, and transit-oriented, walkable development.
- For new developments it involves creating more connected roadways and paths, sidewalks, and mixed-use village centers.
- In rural areas it involves creating villages and providing basic walking facilities and transit services.

Individual Land Use Factors

This section describes how different land use factors affect travel patterns.

Regional Accessibility

Regional accessibility refers to a location relative to the regional urban center (either a central city or central business district), or the number of jobs and public services available within a given travel distance or time (Kuzmyak and Pratt 2003; Ewing 1995). Although regional accessibility has little effect on total trip generation (the total number of trips people make), it tends to have a major effect on trip length and mode choice, and therefore per capita vehicle travel (SACAG 2008). People who live and work distant from the urban center tend to drive significantly more annual miles than if located in similar neighborhood closer to the center.

Ewing and Cervero (2010) find that regional accessibility has the greatest single impact on per capita vehicle travel; the elasticity of VMT with respect to distance to downtown is -0.22 and with respect to jobs accessible by automobile is -0.20, indicating that a 10% reduction in distance to downtown reduces vehicle travel by 2.2% and a 10% increase in nearby jobs reduces vehicle travel by 2%. Kockelman (1997) also found that accessibility (measured as the number of jobs within 30-minute travel distance) was one of the strongest predictors of household vehicle travel.

Dispersing employment to suburban locations can reduce commute lengths, but tends to increases non-commute vehicle travel. Crane and Chatman (2003) find that a 5% increase in regional employment to outlying counties is associated with a 1.5% reduction in average commute distance but an increase in total per capita vehicle travel. Impacts vary by industry. Suburbanization of construction, wholesale, and service employment causes shorter commutes but for manufacturing and finance it lengthens commutes.

Based on detailed reviews of available research Handy, Tal and Boarnet (2010c) conclude the elasticity of vehicle travel with respect to regional accessibility (measured as distance from a central business district or travel time/distance to jobs and other destinations) is -0.13 to -0.25, so a 10% increase reduces VMT 1.3% to 2.5%. Miller and Ibrahim (1998) found that in Toronto, Canada average commute distances increase 0.25 kilometer for each additional kilometer from the city's central business district and 0.38 kilometer for every kilometer from a major suburban employment center. Prevedouros and Schofer (1991) found that Chicago region outer suburb residents make more local trips, longer trips and spend more time in traffic than residents of inner suburbs. Analysis by Boarnet, et al. (2011) indicates that Southern California urban fringe residents drive significantly more than residents of more central, accessible locations, suggesting that land use policy changes in such areas may be particularly effective at achieving VMT reduction and emission reduction targets.

Density

Density refers to the number of homes, people or jobs per unit of area (acres, hectares, square-miles or square kilometers) (Campoli and MacLean 2002; Kuzmyak and Pratt 2003; TRB 2009). It can be measured at various scales: site, block, census tract, neighborhood, municipality, county, urban region or country. Density can affect travel activity in several ways:

- *Increased proximity (geographic accessibility)*. Increased density tends to reduce travel distance to destinations and increases the portion of destinations within walking and cycling distances. This reduces average trip distances and reduces automobile travel.
- *Mobility options.* Increased density tends to increase the cost efficiency of sidewalks, paths, public transit services, delivery services, resulting in more and better transport options. For example, the cost per household of providing sidewalks is half for a neighborhood with 10 units per acre with 50-foot lot frontage than for 5 units per acre with 100-foot frontages. Similarly, the per capita costs of providing transit services declines with density.
- *Reduced automobile travel speeds and convenience.* Increased density tends to increase traffic friction (interactions among road users) which reduces traffic speeds, and higher land costs reduce parking supply and increase parking pricing. These increase the time and financial costs of automobile travel.
- *Complementary factors.* Density is often associated with other urban land use features such as regional accessibility (density is generally highest in central locations and declines to the periphery), centricity (more jobs are located in major urban centers), land use mix, roadway connectivity, reduced traffic speed, and better transport options (better walking, cycling, public transit and taxi services), reduced parking supply and increased parking prices, which reduce automobile travel speed and affordability.
- *Historical conditions*. Many denser neighborhoods developed prior to 1950 and so were designed for multi-modal access (with sidewalks, connected streets, local shops, transit services, limited parking, and regional accessibility), while newer, lower-density, urban fringe neighborhoods were designed primarily for automobile access (lacking sidewalks, dead-end streets, regional shopping, abundant parking and urban fringe locations).
- *Self-selection.* People who by need or preference rely on non-automobile modes tend to locate in denser urban areas.

Density data is widely available, so is one of the most commonly evaluated land use factors. As previously mentioned, density tends to be positively associated with other land use factors that affect travel including regional accessibility, mix, roadway network connectivity, improved transport options and reduced parking supply, plus self-selection as people who rely on non-automobile modes tend to locate in denser urban areas. A few studies have attempted to isolate density from these other factors (Ewing and Hamidi 2014; Liu 2007), which indicates that density itself is only a minor portion of the aggregated effects of these factors together. When evaluating the impacts of density on travel activity it is important to specify whether it considers *aggregated density* (density and its associated land use factors, sometimes called *compactness*) or *disaggregated density* (density by itself, with other land use factors such as mix, street connectivity and parking supply considered separately).

Measuring Density (Kolko 2011)
Density is usually measured as the number of people, workers or housing units per unit of area (acre, hectare, square kilometer or square mile), which often includes significant undeveloped or sparsely developed areas. For many applications it is better to use *weighted density*, which weights these densities by each tract's share of that factor for the metropolitan region. This reflect the weighted average densities in the areas where people actually live or work. An alternative approach is to use *net density* which excludes undeveloped land, such as farmland and large parks. This requires detailed land use data to identify and exclude undeveloped land, whereas weighted density requires only census tract population (or employment) and land area.

To understand how these measures work, consider two hypothetical cities, *Sparseville* and *Densetown*. Each has 1,000 residents and two one-square mile census tracts. In Sparseville, 500 people live in each tract, whereas in Densetown, all 1,000 residents live in one tract and the other is undeveloped. Both Sparseville and Densetown have 500 people per square mile overall density (1,000 residents divided by 2 square miles), but the weighted density is 500 people per square mile in Sparseville, since the average person lives in a tract with 500 people per square mile, but 1,000 people per square mile in Densetown, since the average person lives in a tract with 1,000 people per square mile.

Due to data limitations (comprehensive and comparable data on other land use factors such as mix and parking supply are often difficult to obtain) most density analysis is aggregated, so density represents a combination of compact land use factors, but disaggregated analysis can be important because it is possible to have dense sprawl (for example, large high-rise developments scattered over an automobile-dependent landscape) and rural smart growth (development concentrated in villages with common services within convenient walking distance of most households, connected to larger urban centers with convenient public transit services).

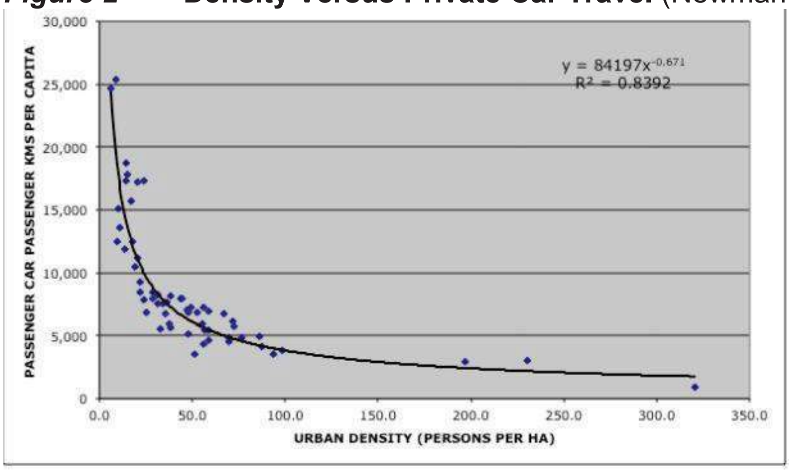
Also due to data limitations, density is often measured for relatively large geographic areas which may hide important differences in neighborhood density. For example, Los Angeles is a relatively dense city but lacks centricity (employment concentrated in major centers) and the type of neighborhood scale density needed to support frequent public transit service resulting in relatively high levels of per capita vehicle travel (Eidlin 2010).

Numerous studies indicate that as density increases per capita vehicle travel tends to decline, and use of alternative modes increases (Boarnet and Handy 2010; Ewing and Cervero 2010; JICA 2011). Overall, doubling urban densities typically reduces per capita vehicle travel 25-30% (Ewing and Cervero 2010). Manville and Shoup (2005) found the coefficient between urban population density and per capita annual vehicle mileage is -0.58, meaning that 1% population density increase is associated with a 0.58% reduction in VMT. Using detailed regression analysis of U.S. cities, McMullen and Eckstein (2011, Table 5.6) found the long-run elasticity of vehicle travel with respect to population density to be -0.0431. Turcotte (2008) found negative correlation between local density, automobile mode share and average daily minutes devoted to automobile travel in Canadian cities. Mindali, Raveh and Salomon (2004) reanalyzed this data and identified the specific density-related factors that affect vehicle use, including per capita vehicle ownership, road supply, CBD parking supply, mode share and inner-area employment.

Employment density affects commute mode share more than residential density (Barnes 2003). Frank and Pivo (1995) found that automobile commuting declines significantly when workplace densities reach 50-75 employees per gross acre. Employment and industrial density also seems reduce truck VMT per capita (Bronzini 2008). Levinson and Kumar (1997) found that as land use density increases, both travel speeds and trip distances tend to decline. As a result, automobile commute trip times are lowest for residents of medium-density locations.

Figure 2 shows the relationship between density and vehicle travel for 58 higher-income cities. The relationship between density and vehicle travel is statistically strong (R^2 0.8392) and the largest reductions occur as density increases from low (under 10 residents per hectare) to moderate (25-50 residents per hectare), which suggests that relatively modest land use changes (such as reductions in single-family lot size) can achieve large vehicle travel reductions.

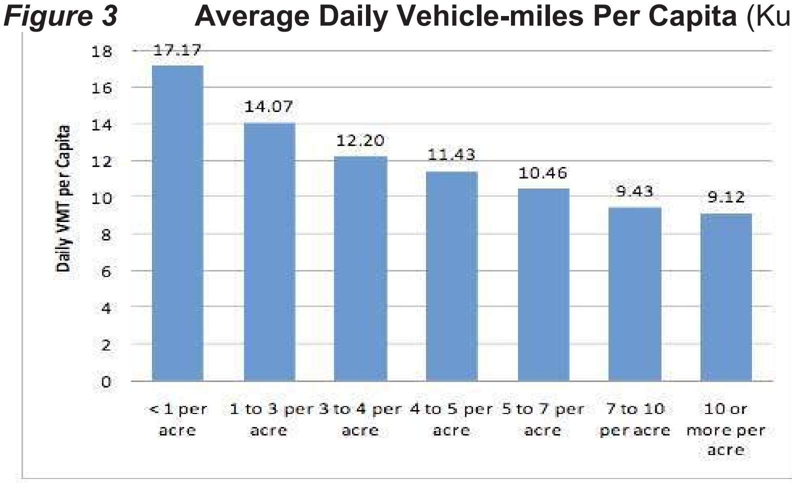
Figure 2 **Density Versus Private Car Travel** (Newman and Kenworthy 2011)



This figure illustrates the negative relationship between density and per capita vehicle travel in 58 high-income cities. The relationship is statistically strong. The largest reductions result from relatively modest density increases, indicating the relatively modest land use policy changes can significantly reduce vehicle travel.

Figure 3 shows how density affects average daily vehicle-miles per capita in Arizona.

Figure 3 **Average Daily Vehicle-miles Per Capita** (Kuzmyak 2012, Figure 76)



Increased density reduces vehicle mileage even in relatively new cities such as Phoenix, Arizona.

Beaton (2006) found that local density has a greater effect on transit ridership than household income. Boston neighborhoods that developed around commuter rail stations but lost rail service after 1970 retained relatively high rates of transit ridership, indicating that local land use factors such as density and mix have a significant impact on travel. Increased population density tends to increase walking and cycling activity (ABW 2010).

Various studies have examined how density affects fuel consumption (Karathodorou, Graham and Noland 2010). Brownstone and Golob (2009) found that, accounting for household demographics and income, 1,000 fewer housing units per square mile (1.56 units per acre) increases average vehicle travel 5%, and increases fuel consumption 6% due to increased vehicle travel and ownership of less fuel efficient vehicles (particularly trucks) in suburban areas, resulting in a -0.12 elasticity of VMT with respect to population density. Bhat and Guo (2007) also found that, accounting for demographic factors, vehicle ownership and use decline with residential and employment density, street density and transit service quality. Using California data, Niemeier, Bai and Handy (2011) found that increased density reduces vehicle travel, particularly in areas with more than 1,500 households per square mile. A major meta-analysis concluded that the elasticity of VMT with respect to population density is in the range of -0.05 to -0.12, and several land use variables together (density, mix, connectivity, etc.) can have a combined VMT elasticity of -0.25.

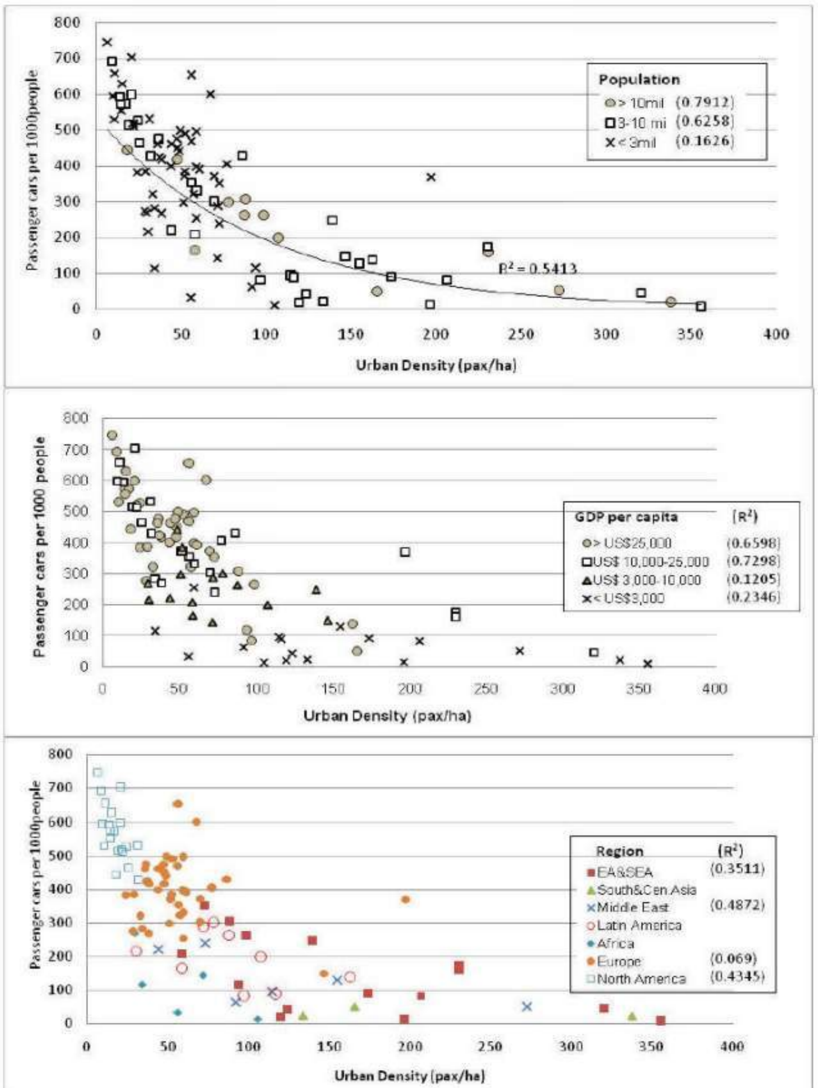
However, there is debate concerning why and how much (TRB 2009; Handy and Boarnet 2010). Analysis by Kockelman (1995), and Ewing and Cervero (2010) indicate that these travel changes result primarily from other factors associated with density, such as regional accessibility, land use mix and walkability, and from the self-selection of people who choose locations with these attributes.

These various factors, in turn, tend to reduce vehicle ownership, which in turn reduces vehicle travel. Described differently, in automobile-dependent areas, where private automobile travel is necessary for a significant portion of trips, households will tend to purchase one vehicle per driver, and because automobiles have high fixed costs and low variable costs, once a driver owns a vehicle they will use it for a major portion of trips, including many marginal value automobile travel (vehicle-kilometers that provide small net user benefits). In order to reduce vehicle ownership (and therefore leverage reductions in these marginal-value vehicle-kilometers) by higher-income households a neighborhood must include the combination mobility services that provide a high level of accessibility without requiring private automobile travel. This includes:

- Commonly-used services (shops, schools, parks, healthcare, etc.) located within convenient walking distances.
- Good walking and cycling conditions, and good public transit and taxi services (including safety and comfort). These need to be integrated, so for example, it is easy to walk and bike to transit stops and stations, which have secure bicycle parking.
- Convenient vehicle rental services (including carsharing).
- Social acceptability of non-automobile modes. As more community residents rely on walking, cycling and public transit the social acceptability of these modes increases.

Figure 4 illustrates the relationships between density and vehicle ownership from a study of approximately 400 large cities around the world. This study found much weaker relationships between density and transit mode share and between incomes and transit mode share, which probably reflect the large variations in transit service quality: if transit service quality is very poor, even residents of dense, congested, low-income cities will continue to rely on automobile travel, while residents of affluent, moderate density cities will commute by public transit if they have high quality service.

Figure 4 **Density Versus Private Vehicle Ownership** (JICA 2011)



These three figures illustrate the relationships between population density and vehicle ownership, taking into account city size, per capita gross domestic product (GDP), and world region. The high R^2 values indicate strong relationships. This indicates that even in affluent cities, increased density reduces per capita vehicle ownership, which in turn leverages reductions in per capita vehicle travel.

Table 7 summarizes the key findings of these studies. Overall this research indicates that increased density is associated with significantly reduced vehicle ownership and mileage, and increased use of alternative modes, but these impacts partly reflect various factors associated with density including regional accessibility, land use mix, centricity, roadway connectivity, transport system diversity, and parking supply. Most density analysis considers these factors in aggregate, which is sometimes called *compactness*. Disaggregated analysis is sometimes useful to isolate the effects of density itself. This research indicates that vehicle travel reductions do not require high urban densities, relatively modest increases, from low (under 10 residents per hectare or 4 residents per acre) to moderate (over 25 residents per hectare or 10 residents per acre) can significantly reduce vehicle travel if implemented with complementary smart growth policies that increase accessibility and transport system diversity. Such policies can be implemented in various geographic scales; they can be tailored to urban, suburban and rural conditions.

Table 7 **Density Impacts on Travel** (Kuzmyak & Pratt 2003; Boarnet and Handy 2010)

Study (Date)	Analysis Method	Key Findings
Prevedouros & Schofer (1991)	Analyzed weekday travel patterns in 4 Chicago area suburbs – 2 inner ring versus 2 outer ring	Outer suburb residents make more local trips, longer trips, use transit less, and spend 25% more time in traffic despite higher speeds
Schimek (1996)	Models using 1990 NPTS data quantify role of density, location and demographic factors on vehicle ownership, trips, and VMT	Estimated household vehicle trip/ density elasticity of -0.085 Household VMT/density elasticity of -0.069
Sun, Wilmot & Kasturi (1998)	Analyzed Portland, OR, travel data using means tests and regression	Population and employment density strongly correlated with vehicle ownership and VMT, but not trips
Ewing, Haliyur & Page (1994)	Analyzed effects of land use and location on household travel in 6 Palm Beach County, FL, communities	Households in least dense and accessible areas generated 63% more daily vehicle hours of travel per capita than in densest areas
Kockelman (1996)	Modeled density, accessibility, and land use balance using 1990 San Francisco Area travel survey and hectare-level land use	Estimated vehicle ownership/density elasticity of -0.068, but no significant direct effect of density on VMT
Bento, et al. (2005)	Analysis of city shape, jobs-housing balance, road density and rail supply and 1990 NHTS travel activity data for 114 U.S. Metropolitan Statistical Areas	Elasticity of VMT with respect to (wrt) individual land use factors, including density is -0.07, but a combination of land use factors can provide a total elasticity of -0.25
Brownstone and Golob (2009)	California land use statistics and subsample of the 2001 U.S. NHTS	Elasticity of VMT wrt individual land use factors, including density is 0.04 to -0.12
Fang (2008)	California land use statistics and subsample of the 2001 NHTS	Elasticity of VMT with respect to density -0.08 to -0.09
2010 Ewing and Cervero	Meta-analysis of various studies	Elasticity of VMT with respect to density -0.04 to -0.1
Heres-Del-Valle and Niemeier (2011)	Multivariate two-part model of vehicle travel which corrects for residential location self-selection bias. California data	Elasticity of VMT with respect to density -0.19

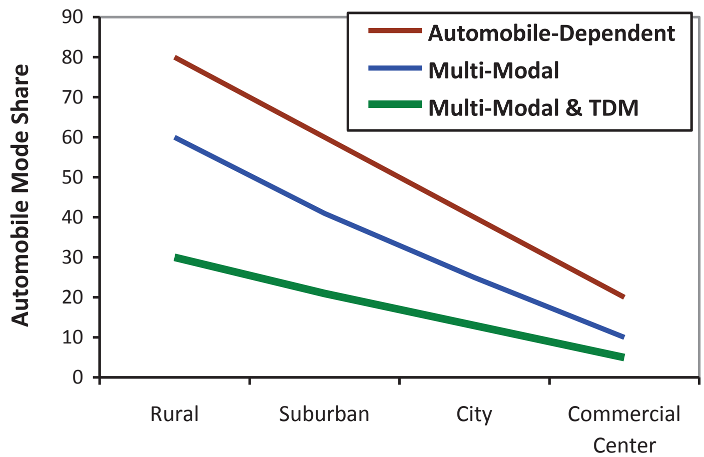
This table summarizes research on the relationships between land use density and travel behavior.

Centricity

Centricity (also called *centeredness*) refers to the portion of employment, commercial, entertainment, and other major activities concentrated in multi-modal centers, such as central business districts (CBDs), downtowns and large industrial parks. Such centers reduce the amount of travel required between destinations and are more amenable to alternative modes. People who live or work in major activity centers tend to rely more on alternative modes and drive less than in dispersed locations, as illustrated in Figure 6.

Comprehensive modeling by Kuzmyak, et al. (2012) indicates that employment density, job/population balance, street network grain and connectivity, transit service quality, and regional accessibility all have a significant effect on vehicle trip and vehicle travel. Franks and Pivo (1995) found that automobile commuting declines significantly when workplace densities reach 50-75 employees per gross acre. Barnes and Davis (2001) also found that employment center density encourages transit and ridesharing. Centeredness affects overall regional travel, not just the trips made to the center (Ewing, Pendall and Chen 2002). For example, Los Angeles is a dense city but lacks strong centers and so is relatively automobile dependent, with higher rates of vehicle ownership and use than cities with similar density but stronger centers (Eidlin 2010).

Figure 6 **Economically Automobile Optimal Mode Shares**



Automobile mode shares vary depending on location and transport options. Automobile mode shares decline as communities become more multi-modal and compact.

Analysis by Holian and Kahn (2012) found that all else being equal, residents of urban regions with more vibrant downtowns (indicated by its share of residents who are college graduates, center city crime rate, number of cultural and consumer-oriented establishments downtown, and the share of the metropolitan area’s jobs and population growth downtown), drive less, rely more on walking and public transport, consume less fuel and produce less vehicle emissions than in urban regions with less vibrant downtowns. Census data indicate that metropolitan areas with more vibrant downtowns experienced less sprawl between 2000 and 2010. This suggests that vibrancy influences land-use patterns, and land-use patterns in turn influence driving and public transit use.

Land Use Mix

Land use mix refers to locating different types of land uses (residential, commercial, institutional, recreational, etc.) close together. This can occur at various scales, including mixing within buildings (such as ground-floor retail, with offices and residential above), along streets, and within neighborhoods. It can also include mixing housing types and price ranges that accommodate different demographic and income classes. Such mixing is normal in cities and is a key feature of New Urbanism. Land use mix can be measured using *entropy indices* (the variety of different uses in a neighborhood) or *dissimilarity indices* (the number of adjacent parcels with different uses). Both methods result in scores from 0 (least mixed) to 1.0 (most mixed).

Another way to measure mix is using the *jobs/housing balance* ratio. A jobs/housing balance of about 1.0 tends to minimize average commute distance and per capita vehicle travel (Weitz 2003; Kuzmyak and Pratt 2003). Boarnet, Hsu and Handy (2011) conclude that the elasticity of vehicle travel (both commute travel and total per capita VMT) with respect to jobs/housing balance is 0.29 to 0.35, so a 10% increase reduces VMT 2.9 to 3.5%. Crane and Chatman (2003) find that a 5% increase in fringe county employment reduces average commute distance 1.5% but increases non-work vehicle mileage.

Increased mix reduces travel distances and allows more walking and cycling trips. It can reduce commute distances, particularly if affordable housing is located in job-rich areas, and mixed-use area residents are more likely to commute by alternative modes (Modarres 1993; Kuzmyak and Pratt 2003; Ewing, et al. 2010). Analyzed the trip generation rates in a mixed-use development, Sperry, Burris and Dumbaugh (2012) found that total trips increased, indicating induced travel, but many of these were walking trips, so total vehicle travel declined. Certain land use combinations create *complete communities* (also called *urban villages*); compact walkable neighborhood centers containing commonly used services and activities, such as stores, schools and parks. Wang, Khattak and Zhang (2013) found that vehicle travel and tailpipe emissions are about 9% lower for households that reside in mixed land use neighborhoods with good network connections.

Based on a detailed review of research, Spears, Boarnet and Handy (2010) conclude that the elasticity of vehicle travel with respect to land use mix is -0.02 to -0.11 (a 10% increase in an entropy or dissimilarity index reduces average VMT 0.2% to 01.1%). Ewing and Cervero (2010) found that land use mix reduces vehicle travel and significantly increases walking. Frank, et al. (2011) found that per capita vehicle travel and pollution emissions tend to decline with increased land use mix: shifting from the 25th percentile to the 75th percentile level of mix reduces total VMT 2.7%. Krizek (2003a) found that households located in highly accessible neighborhoods travel a median distance of 3.2 km (2.0 mi) one-way for errands versus 8.1 km (5.0 mi) for households in less accessible locations.

Table 8 summarizes the results of one study concerning how various land use features affected drive-alone commute rates. Important amenities include bank machines, cafes, on-site childcare, fitness facilities, and postal services. One study found that the presence of worksite amenities such as banking services (ATM, direct deposit), on-site childcare, a cafeteria, a gym, and postal services could reduce average weekday car travel by 14%, due to a combination of reduced errand trips and increased ridesharing (Davidson 1994).

Table 8 **Worksite Drive Alone Share** (Cambridge Systematics 1994, Table 3.12)

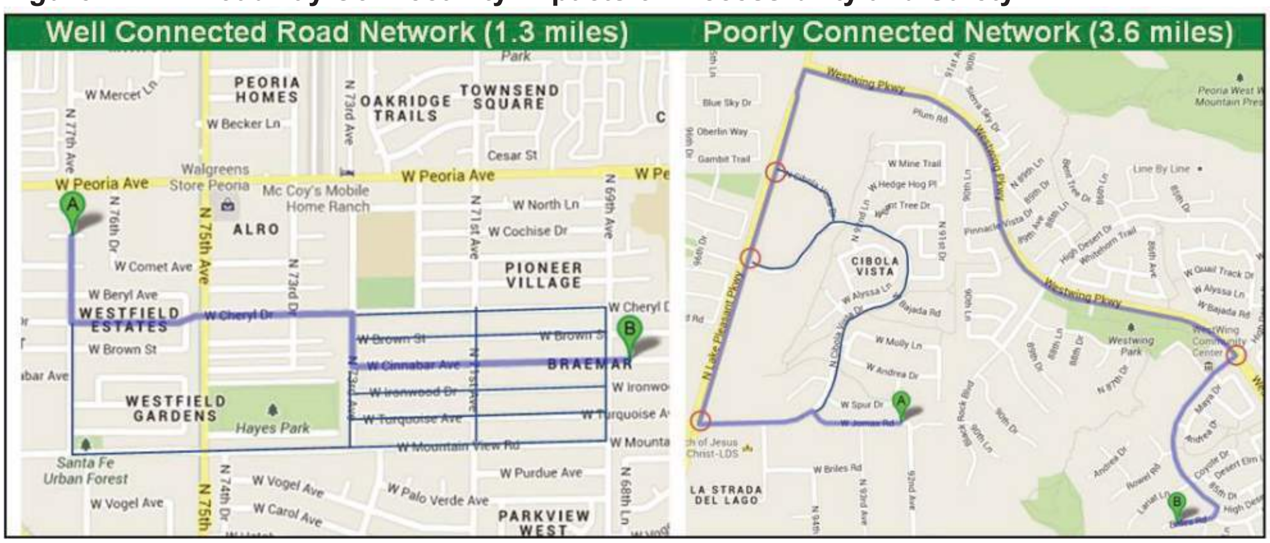
Land Use Characteristics	Without	With	Difference
Mix of Land Uses	71.7	70.8	*-0.9*
Accessibility to Services	72.1	70.5	*-1.6*
Preponderance of Convenient Services	72.4	69.6	*-2.8*
Perception of Safety	73.2	70.6	*-2.6*
Aesthetic Urban Setting	72.3	66.6	*-5.7*

This table summarizes how various land use factors affect automobile commuting rates.

Connectivity

Connectivity refers to the degree to which a road or path system is connected, and therefore the directness of travel between destinations ("Connectivity," VTPI 2008). A poorly connected road network with many dead-end streets that connect to a few major arterials provides less accessibility than a well-connected network, as illustrated in Figure 7. Increased connectivity reduces vehicle travel by reducing travel distances between destinations and by improving walking and cycling access, particularly where paths provide shortcuts so walking and cycling are more direct than driving.

Figure 7 **Roadway Connectivity Impacts on Accessibility and Safety**



Although points ***A*** *and* ***B*** *are approximately the same distance apart in both maps, the functional travel distance is nearly three times farther with the poorly-connected road network which forces most trips onto major arterials. This tends to increase total vehicle travel, traffic congestion and accident risk, particularly where vehicles turn on and off major arterials (red circles), and reduces the feasibility of walking and cycling to local destinations.*

Connectivity can be measured using various indices, including road or intersection density, portion of four-way intersections, and portion of dead-end streets (Handy, Paterson and Butler 2004; Dill 2005). It can be measured separately for different modes.

Ewing and Cervero (2010) find that intersection density and street connectivity has the second greatest impact on travel activity of all land use factors analyzed. They conclude that the elasticity of vehicle travel with respect to connectivity is -0.12, so increasing intersection or street density 10% reduces vehicle travel 1.2%. Based on detailed reviews of available research Handy, Tal and Boarnet (2010b) conclude that increased street intersection density reduces VMT, and increases walking and public transit travel. They find elasticity values from reliable studies ranging from -0.06 up to -0.59.

The Atlanta, Georgia SMARTRAQ Project found that doubling current regional average intersection density, from 8.3 to 16.6 intersections per square kilometer, would reduce average per capita weekday vehicle travel about 1.6%, from 32.6 to 32.1 daily miles, all else held constant. The LUTAQH (Land Use, Transportation, Air Quality and Health) research project sponsored by the Puget Sound Regional Council also found that per household VMT declines with increased street connectivity. It concluded that a 10% increase in intersection density reduces VMT by about 0.5%.

Emrath and Siniavskaia (2009) found that, accounting for other demographic and geographic factors, non-motorized commute mode share increases as block size declines, with approximately 10% of commuters using these modes in areas with the smallest block size (under five acres per block) about four times higher than the overall average. They find that commute time has a U-shape response to block size, meaning that average commute time first declines and then rises as block size increases. Tracts where workers average the quickest commutes, less than 25 minutes, have six to 20 acre block size.

Wang, Khattak and Zhang (2013) found that vehicle travel and tailpipe emissions are about 9% lower for households that reside in mixed land use neighborhoods with good network connections. Analysis by Larco (2010) indicates that increasing connectivity in suburban multi-family developments can significantly increase use of alternative modes. Residents of more-connected developments were more than twice as likely to walk or bike to local amenities (with 87% and 70% reporting that they did so) than in less connected locations. Respondents from the less-connected developments reported the ease and safety of nonmotorized travel as the largest barrier to walking and biking.

Frank and Hawkins (2007) estimate that in a typical urban neighborhood, a change from a pure small-block grid to a modified grid (a *Fused Grid*, in which pedestrian and cycling travel is allowed, but automobile traffic is blocked at a significant portion of intersections) that increases the relative connectivity for pedestrians by 10% would typically increase home-based walking trips by 11.3%, increase the odds a person will meet the recommended level of physical activity through walking in their local travel by 26%, and decrease vehicles miles of local travel by 23%. On the other hand, roadway supply is positively correlated with vehicle mileage, as indicated in Figure 8. This may partly reflect other factors that also affect road supply, such as population density.

Roadway Design

Roadway design refers to factors such as block size, road cross-section (lane number, widths and management, on-street parking, medians, and sidewalks), design speeds and speed control, sidewalk condition, street furniture (utility poles, benches, garbage cans, etc.), landscaping, and the number and size of driveways. Roadway designs that reduce motor vehicle traffic speeds, improve connectivity, and improve walking and cycling conditions tend to reduce automobile traffic and encourage use of alternative modes, depending on specific conditions.

Detailed analysis by Marshall and Garrick (2012) of travel patterns in 24 mid-size California cities found that roadway design factors significantly affect resident's vehicle travel. The found that per capita vehicle travel tends to:

- Decline with increased total street network density (intersections per square-kilometer).
- Decline with a grid street system (which provides many routes between destinations) compared with a hierarchical systems (which requires traveling on major arterials for a greater portion of trips).
- Decline with on-street parking, bike lanes, and curbs/sidewalks.
- Decline land use density and mix, and proximity to the city center.
- Decline with increased walking, bicycling and transit commute mode share.
- Increase with street connectivity (street link-to-node-ratio, which declines with more dead-end streets).
- Increase with increased major street network density (arterial intersections per square-kilometer).
- Increase with the number of lanes and outside shoulder widths on major roadways.
- Increase with curvilinear streets.

For example, their model indicates that, holding other factors constant, increasing intersection density from 31.3 to 125 intersections per square kilometer is associated with a 41% decrease in vehicle travel, from 44.7 to 26.5 daily vehicle-kilometers.

Traffic Calming tends to reduce total vehicle mileage in an area by reducing travel speeds and improving conditions for walking, cycling and transit use (Crane 1999; Morrison Thomson and Petticrew 2004). Traffic studies find that for every 1 meter increase in street width, the 85th percentile vehicle traffic speed increases 1.6 kph, and the number of vehicles traveling 8 to 16 kph [5 or 10 mph] or more above the speed limit increases geometrically ("Appendix," DKS Associates 2002). Various studies indicate an elasticity of vehicle travel with respect to travel time of –0.5 in the short run and –1.0 over the long run, meaning that a 20% reduction in average traffic speeds will reduce total vehicle travel by 10% during the first few years, and up to 20% over a longer time period.

Active Transport (Walking and Cycling) Conditions

The quality of active transport (walking and cycling, also called *nonmotorized* transport) conditions affect can affect travel activity in several ways. Improved walking and cycling conditions tend to increase nonmotorized travel, increase transit travel, and reduce automobile travel ("Nonmotorized Transport Planning," VTPI 2008; Mackett and Brown 2011; Buehler and Pucher 2012).

Non-motorized travel activity tends to be more common, and therefore more important, than travel statistics generally indicate because conventional travel surveys undercount shorter trips (those occurring within a *traffic analysis zone*), off-peak trips, non-work trips, travel by children, and recreational travel (ABW 2010). Many surveys ignore non-motorized links of motor vehicle trips. For example, a *bike-transit-walk* trip is usually classified simply as a transit trip, and a motorist who parks several blocks from their destination and walks for local errands is classified simply as automobile user. More comprehensive surveys indicate that non-motorized travel is three to six times more common than conventional surveys indicate (Rietveld 2000). As a result, if official data indicates that only 5% of trips are non-motorized, the actual amount is probably 10-30%.

Walking and biking conditions are affected by (TRB 2008):

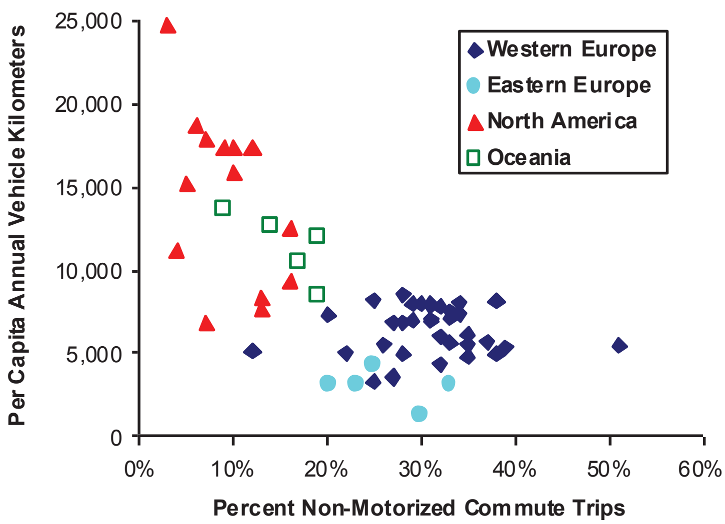
- The quality of sidewalks, crosswalks, paths, bike parking, and changing facilities.
- Ease of road crossing (road width, traffic speeds and volumes, presence and quality of crosswalks) and protection (separation between traffic and non-motorized travelers).
- Network connectivity (how well sidewalks and paths are connected and the overall extent of the pedestrian and cycling network).
- Security (how safe people feel while walking).
- Environmental quality (exposure to noise, air pollution, dust, sun and rain).
- Topography (inclines).
- Land use accessibility (distances to common destinations such as shops and schools).
- Attractiveness (quality of urban design).

Sidewalks and path improvements tends to increase non-motorized travel, with impacts that vary depending on conditions (ABW 2010; Barnes and Krizek 2005; Handy and Mokhtarian 2005; Handy, Tal and Boarnet 2010a; Sciara, Handy and Boarnet 2011). Each additional bikeway-mile per 100,000 residents increases bicycle commuting 0.075%, all else being equal (Dill and Carr 2003). Morris (2004) found that residents living within a half-mile of a cycling trail are three times as likely to bicycle commute as the country average. Ryan and Frank (2009) found that improved walkability around bus stops increases transit travel. Guo and Gandavarapu (2010) found that completing the sidewalk network in a typical U.S. town would increase average per capita non-motorized travel 16% (from 0.6 to 0.7 miles per day) and reduce automobile travel 5% (from 22.0 to 20.9 vehicle-miles). Cervero and Radisch (1995) found that pedestrian-friendly area residents walk, bicycle or ride transit for 49% of work trips and 15% of non-work trips, 18- and 11-percentage points more than in a comparable automobile-oriented community. Walking is three times more common in communities with pedestrian friendly streets than in otherwise comparable communities (Moudon, et al. 1996).

Research by Bassett, et al. (2011) using comparable travel surveys in Germany and the U.S. in 2001 and 2008 indicates that transport and land use policies can significantly affect walking and cycling activity. Between 2001 and 2008, the proportion of "any walking" was stable in the U.S. (18.5%) but increased in Germany from 36.5% to 42.3%. The proportion of "any cycling" in the U.S. remained at 1.8% but increased in Germany from 12.1% to 14.1%. In 2008, the proportion of "30 minutes of walking and cycling" in Germany was 21.2% and 7.8%, respectively, compared to 7.7% and 1.0% in the U.S. Virtually all demographic groups in Germany walk and cycle much more than their counterparts in the U.S.

However, not every public trail significantly increases non-motorized travel. Burbidge and Goulias (2009) surveyed residents of West Valley City, a suburb of Salt Lake City, Utah, before and after the construction of a neighborhood trail. They found that most trail users come from outside the areas, neighborhood residents seldom use the facility, new residents did not move to the neighborhood because of the trail. Similarly, not all additional nonmotorized travel substitutes for driving: a portion may consist of recreational travel (i.e., "strolling") or substitutes for public transit travel. Handy (1996b) and Handy and Clifton (2001) found that a more pedestrian-friendly residential and commercial environment in Austin, Texas neighborhoods increases walking and reduces automobile travel for errands such as local shopping. About two-thirds of walking trips to stores replaced automobile trips. A short walking or cycling trip often substitutes for a longer motorized trip. For example, people often choose between walking to a neighborhood store or driving across town to a larger supermarket, since once they decide to drive the additional distance is accessible.

Figure 8 **Non-motorized Vs. Motorized Transport** (Kenworthy and Laube 2000)



International data show that vehicle travel tends to decline as non-motorized travel increases.

Non-motorized transport improvements can leverage additional vehicle travel reductions by helping create more compact, multi-modal communities where residents own fewer vehicles and travel shorter distances (see discussion on the following page). For example, Guo and Gandavarapu (2010) found that sidewalk improvements in a typical town would increase average daily per capita non-motorized travel by 0.097 miles and reduce automobile travel by 1.142 vehicle-miles, about 12 miles of reduced driving for each mile of increased non-motorized travel. Similarly, international data indicates that percentage-point increase in non-motorized transport is associated with a reduction of 700 annual vehicle-miles, about seven vehicle-miles reduced for each additional active transport mile, as indicated in Figure 8.

The *Walkability Tools Research Website* (www.levelofservice.com) provides information on methods for evaluating walking conditions. The *Pedestrian and Bicycle Information Center* (www.bicyclinginfo.org) produced a community bikeability checklist (www.walkinginfo.org/library/details.cfm?id=12). It includes ratings for road and off-road facilities, driver behavior, cyclist behavior, barriers, and identifies ways to improve bicycling conditions. *WalkScore* (www.WalkScore.com) automatically calculates a neighborhood's walkability rating by identifying the distance to public services such as grocery stores and schools. Frank, et al. (2011) developed a model which can predict how sidewalk network expansion affects a community's vehicle travel and carbon emissions. Their analysis indicates that increasing sidewalk coverage from a ratio of 0.57 (sidewalks on both sides of 30% of all streets) to 1.4 (sidewalks on both sides of 70% of streets) could reduce vehicle travel 3.4% and carbon emissions 4.9%.

Non-motorized Indirect Travel Impacts

The previous analysis suggests that each mile of increased non-motorized travel resulting from walking and cycling improvements typically reduces five to fifteen motor vehicle-miles through leverage effects. Conventional planning analysis generally ignores these indirect impacts and so underestimates the potential of non-motorized transport improvements to achieve benefits such as reduced traffic congestion, accidents and pollution emissions. Considering these indirect impacts tends to increase estimated benefits by an order of magnitude, justifying much greater support for non-motorized transport. It is therefore important to understand these impacts.

Direct travel impacts consist of a mile of vehicle travel that shifts to a mile of walking or cycling. Indirect impacts result from the following factors:

- *Vehicle Ownership*. Motor vehicles are costly to own but relatively cheap to use, so once a household purchases an automobile they tend to use it, including discretionary travel that could easily be avoided. Households tend to own one vehicle per driver if located in an automobile-dependent community but fewer, and so drive significantly less, in a multi-modal community.
- *Travel Conditions.* Walking and cycling improvements often include roadway system changes, such as traffic calming and increased network connectivity, that reduce vehicle traffic speeds and so tend to reduce vehicle travel.
- *Public Transit Improvements.* Since most public transit trips include non-motorized links, to reach bus stops and for circulation at destinations, active transport improvements support use of this mode.
- *Land Use Patterns*. Walking and cycling improvements support more compact and mixed land use by reducing the amount of land required for roads and parking facilities and encouraging pedestrian-scale development. It may be difficult to determine cause and effect: increased walking and cycling both allow and require this type of land use.
- *Social Norms.* In automobile-dependent communities, use of alternative modes tends to be stigmatized. Walking and cycling improvements, and the increase in their use, can help change social attitudes allowing more shifts from driving to walking, cycling and public transit.

A portion of these impacts reflect self-selection, that is, more walkable areas attract people who, from necessity or preference, minimize vehicle travel. For example, if somebody cannot drive due to disability or low income they will often choose a more walkable home location if possible. Such neighborhoods will have lower average vehicle travel, providing local traffic reduction benefits, but do not necessarily reflect an overall reduction in regional vehicle travel. However, if there is latent demand for multi-modal neighborhoods, that is, some households want to live in less automobile dependent locations but there is insufficient supply, creating more walkable and bikeable communities will allow more households to reduce their vehicle travel, reducing regional vehicle travel. Several consumer preference surveys do indicate significant and growing latent demand for more multi-modal home locations, indicating that walking and cycling improvements can provide overall traffic reduction benefits.

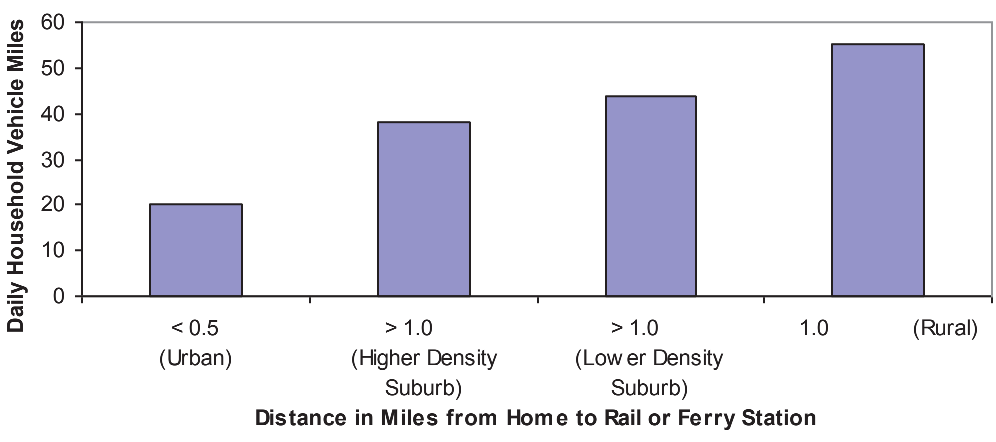
Not every non-motorized improvement has all these effects. By itself, a single policy or project usually has minimal impacts. However, if there is latent demand for walking and cycling, and improvements to non-motorized modes are integrated with other transport system and land use changes, vehicle travel reduction leverage effects can be large.

Transit Accessibility

Transit accessibility refers to the quality of transit serving a location and the ease of accessing that service by walking, cycling and automobile. *Transit-Oriented Development* (TOD) refers to residential and commercial areas designed to maximize transit access. Several studies indicate that people who live and work in TODs tend to own fewer vehicles, drive less and rely more on alternative modes than they would in more automobile dependent locations (Cervero, et al. 2004; Evans and Pratt 2007; CNT 2010; Gard 2007; Portland 2009; Pushkarev and Zupan 1977; Suzuki, Cervero and Iuchi 2013; Tal, Handy and Boarnet 2010; TransForm 2014). The *National TOD Database* (www.toddata.cnt.org) provides detailed demographic, geographic and economic data for 3,776 U.S. urban rail transit stations and 833 proposed stations in 47 metropolitan areas which can be used to evaluate the impacts of transit service quality and station area conditions on travel activity.

Ewing and Cervero (2010) found that increased proximity to transit stop, intersection density and land use mix increase transit travel. Cervero, et al. (2004) found that increased residential and commercial density, and improved walkability around a station increase transit ridership: for example, increasing station area residential density from 10 to 20 units per gross acre increases transit commute mode share from 20.4% to 24.1%, and up to 27.6% if implemented with pedestrian improvements. Lund, Cervero and Willson (2004) found that California transit station area residents are about five times more likely to commute by transit as the average worker in the same city. Gard (2007) proposes a methodology for adjusting predicted trip generation rates in TODs. He found that TOD typically increases per capita transit ridership 2-5 times and reduces vehicle trip generation 8% to 32% compared with conventional land use development.

Figure 9 **Transit Accessibility Impacts on Vehicle Travel** (MTC 2006)

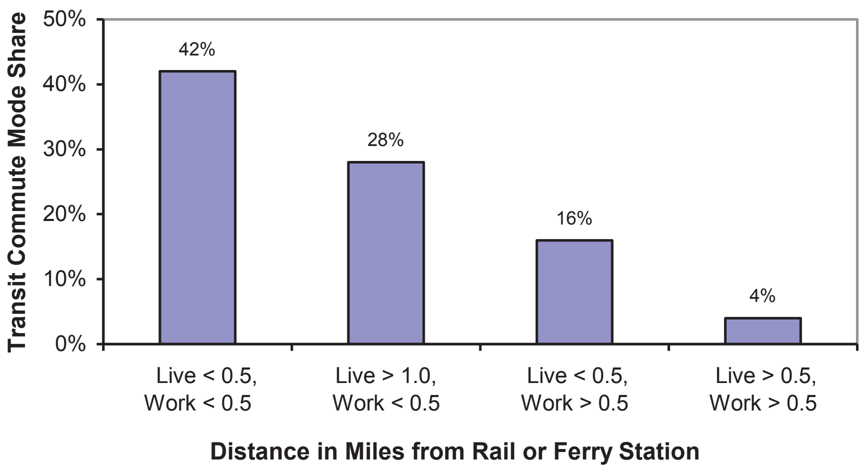


People who live closer to rail or ferry stations tend to drive fewer daily miles.

The report, *Why Creating And Preserving Affordable Homes Near Transit Is A Highly Effective Climate Protection Strategy* (TransForm 2014) used detailed data from the California Household Travel Survey to measure how demographic, geographic and economic factors affect household travel activity and fuel consumption. The results indicate that all types of households, and particularly lower-income households, tend to own fewer vehicles, drive less and consume less fuel if they live in transit-oriented neighborhoods. All else being equal, lower-income households drive 25-30% fewer miles when living within 1/2 mile of transit than those living in non-TOD, and 50% fewer miles when living within 1/4 mile of frequent transit service. The analysis also indicates that extremely-low-income households living within 1/4 mile of frequent transit own half as many vehicles and drive half as many annual miles as higher income households located the same distance from frequent transit service.

Automobile travel declines and public transit travel increases as households locate closer to San Francisco region rail and ferry terminals drive, as indicated in Figures 9 and 10. Arrington, et al. (2008), found that Transit-Oriented Developments generate much less (about half) the automobile trips as conventional, automobile-oriented development.

Figure 11 **Transit Accessibility Impacts on Transit Mode Share** (MTC 2006)



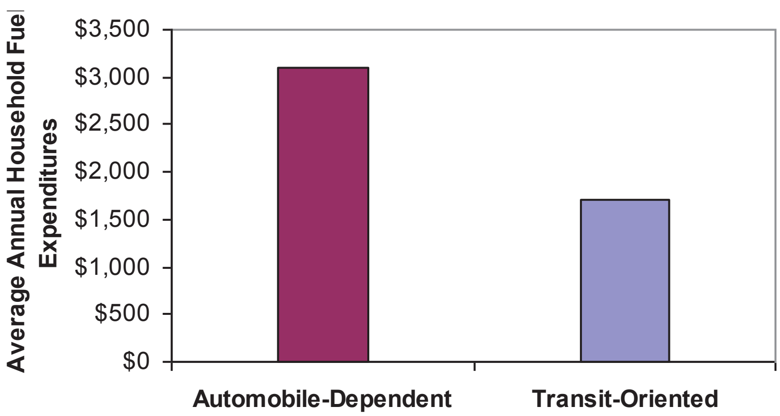
People who live or work closer to rail or ferry stations tend to commute more by public transit.

Various factors influence transit ridership rates. TOD residents are more likely to use transit if it is relatively time-competitive with driving, if there is good pedestrian connectivity, if commuters have flexible work hours, and if they have limited vehicle availability. TOD residents are less likely to use transit for trips involving multiple stops (chained trips), if highway accessibility is good, if parking is unpriced. Physical design factors such as neighborhood design and streetscape improvements show some influence in predicting project-level differences, but have relatively minor influences on transit choice among individual station area residents.

Detailed analysis of Washington DC and Baltimore TODs by Jeihani, et al. (2013) indicates that all else being equal (accounting for demographic and geographic factors), TOD residents drive about 20% fewer annual miles than non-TOD residents, and rely significantly more on walking, cycling and public transport for both commute and non-commute trips. Bento, et al (2003) found a 10% reduction in average distance between homes and rail transit stations reduces VMT about 1%, and “rail supply has the largest effect on driving of all our sprawl and transit variables.” They concluded that a 10% increase in rail supply reduces driving 4.2%, and a 10% increase in a city’s rail transit service reduces 40 annual vehicle-miles per capita (70 VMT including New York City), compared with just a one mile reduction from a 10% increase in bus service. They found a 3.0 elasticity of rail transit ridership with regard to transit service supply (7.0 including New York) indicating economies of scale in transit network scale.

Renne (2005) found that although transit commuting in major U.S. metropolitan regions declined during the last three decades (from 19.0% in 1970 to 7.1% in 2000), in the 103 TODs within those regions it increased from 15.1% in 1970 to 16.7% in 2000. TODs in Portland, OR and Washington D.C., which aggressively promoted transit, experienced even greater ridership growth (58% for both). Households in TODs also owned fewer vehicles; only 35.3% of TOD households own two or more vehicles compared with 55.3% in metropolitan regions overall, although TOD residents have higher average incomes. Transit-oriented development tends to "leverage" larger reductions in vehicle travel than what is directly shifted from automobile to transit (Litman, 2005b).

Figure 11 **Average Household Fuel Expenditures** (Bailey 2007)

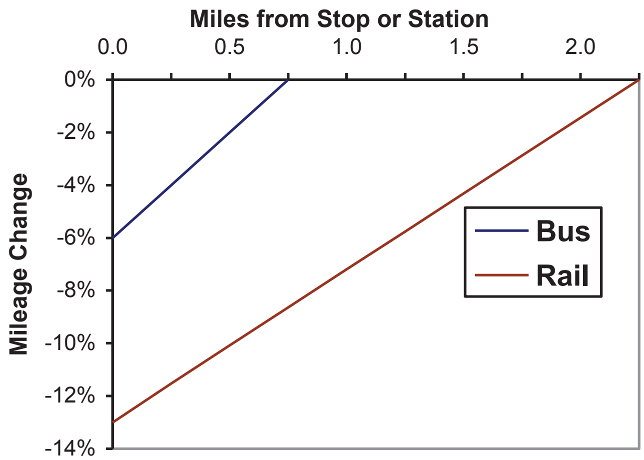


Households in transit-oriented neighborhoods tend to own fewer cars and drive less than otherwise comparable households in more automobile-oriented locations. This provides substantial energy and financial savings.

Reconnecting America (2004) studied demographic and transport patterns in *transit zones*, defined as areas within a half-mile of existing transit stations in U.S. cities. It found that households in transit zones own an average of 0.9 cars, compared to an average of 1.6 cars in the metro regions as a whole, and that automobile travel is also much lower in transit zones. Only 54% of residents living in transit zones commute by car, compared to 83% in the regions as a whole. Transit service quality seems to be a significant determinant of transit use, with more transit ridership in cities with larger rail transit systems. Similarly, Litman (2004) found that residents of cities with large, well-established rail transit systems drive 12% fewer annual miles than residents of cities with small rail transit systems, and 20% less than residents of cities that lack rail systems.

Goldstein (2007) found that household located within walking distance of a metro (rail transit) station drive 30% less on average than if they located in less transit-accessible locations. Bailey (2007) found that households located within ¾-mile of high-quality public transit service average of 11.3 fewer daily vehicle-miles, regardless of land use density and vehicle ownership rates. A typical household reduces annual mileage 45% by shifting from an automobile-dependent location with poor travel options that requires ownership of two cars, to a transit-oriented neighborhood, which offers quality transit service and requires of just one car (Figure 11). This saves 512 gallons of fuel annually, worth about $1,920 at $3.75 per gallon. Base on a detailed review of research Tal, Handy and Boarnet (2010) conclude that residents' average per capita vehicle travel declines 6% per mile closer to a rail station starting at 2.25 miles from the station, and 2% per 0.25 miles closer to a bus stop starting at 0.75 miles from the stop.

Figure 12 **Transit Proximity Vehicle Travel Impacts** (Tal, Handy and Boarnet 2010)



Average household vehicle travel declines with proximity to transit stops and stations.

Beaton (2006) found that in the Boston region, rail transit zones (areas within a 10-minute drive of commuter rail stations) had higher land use density, lower commercial property vacancy rates, and higher transit ridership than other areas. Although regional transit ridership declined during the 1970s and 80s (it rebounded after 1990), it declined significantly less in rail zones. In 2000, transit mode split averaged 11-21% for rail zone residents, compared with 8% for the region overall. Areas where commuter rail stations closed during the 1970s retained relatively high transit ridership rates, indicating that the compact, mixed land use patterns that developed near these stations has a lasting legacy. Land use density did not increase near stations built between 1970 and 1990, but did increase near stations build after 1990. This can be explained by the fact that the value of smart growth development (using land use policies to create more compact, mixed, multi-modal land use) only became widely recognized in the 1990s, and much of the research and literature on transit oriented development is even more recent (Cervero et al, 2004).

Residents of Orenco Station, a transit-oriented suburban community near Portland, Oregon, use public transit significantly more than residents of comparable communities (Podobnik 2002; Steuteville 2009). Orenco transit commute mode share is 22% compared with 5% average for the region, and 69% report using public transit more frequently than they did in their previous neighborhood.

A survey of 17 transit-oriented developments (TOD) in five U.S. metropolitan areas showed that vehicle trips per dwelling unit were substantially below what the Institute of

Transportation Engineer's *Trip Generation* manual estimates (Cervero and Arrington 2009). Over a typical weekday period, the surveyed TOD housing projects averaged 44% fewer vehicle trips than the manual predicts (3.8 versus 6.7), and were particularly low in more urban locations. Similarly, a parking and traffic generation study of Portland, Oregon transit oriented developments recorded 0.73 vehicles per housing unit, about half the 1.3 value in the ITE *Parking Generation Handbook*, and vehicle trip generation rates about half the values in the *Trip Generation Handbook* (PSU ITE Student Chapter 2007).

Chatman (2013) argues that many of the factors that reduce vehicle travel in transit-oriented areas, such as more compact and mixed development with reduced parking supply, can be implemented without rail.

Evans and Pratt (2007) summarize extensive research on TOD travel impacts:

- In Portland, Oregon the average central area TOD transit share for non-work travel was roughly four times that for outlying TODs, which in turn had over one-and-two-thirds times the corresponding transit share of mostly-suburban, non-TOD land development.
- In the Washington DC area, average transit commute mode share to office buildings declines from 75% in downtown to 10% at outer suburb rail stations. Transit mode share decreases by 7 percentage points for every 1,000 feet of distance from a station in the case of housing and by 12 percentage points in the case of office worker commute trips.
- California office workers who live located within 1/2 mile of rail stations to have transit commute shares averaging 19% compared to 5% regionwide. The statewide average transit commute mode share is 27% for workers living within 1/2 mile of a station compared to 7% for residents between 1/2 mile and 3 miles of the station.
- TOD residents tend to have lower motor vehicle ownership rates.

How Far Will Transit Users Walk? How Large Can A Transit-Oriented Development Be?
Experts generally conclude that typical transit riders will walk up to a quarter-mile to a bus stop and a half-mile to a train station, but acceptable walking distances can vary significantly due to:

- *Demographics.* Whether travelers are transit dependent or discretionary users (transit dependent users tend to be willing to walk farther).
- *Walkability.* The better the walking conditions (good sidewalks, minimum waits at crosswalks, attractive and secure streetscapes) the farther people will walk.
- *Transit service quality.* People tend to walk farther if transit service is frequent, and vehicles and stations are comfortable and attractive.

For information see:

B. Alshalalfah and A. Shalaby (2007), "Case Study: Relationship Of Walk Access Distance To Transit With Service, Travel, And Personal Characteristics" *Journal of Urban Planning and Development*, Vol. 133, No. 2, June, pp. 114-118.

M. Iacono, K. Krizek and A. El-Geneidy (2008), "How Close Is Close Enough? Estimating Accurate Distance Decay Functions For Multiple Modes And Different Purposes," University of Minnesota (www.cts.umn.edu); at www.cts.umn.edu/access-study/research/6/index.html.

Boris S. Pushkarev and Jeffrey M. Zupan (1977), *Public Transportation and Land Use Policy*, Indiana University Press (Bloomington); http://davidpritchard.org/sustrans/PusZup77/index.html.

Marc Schlossberg, et al. (2008), *How Far, By Which Route, And Why? A Spatial Analysis Of Pedestrian Preference*, Mineta Transportation Institute (www.transweb.sjsu.edu); at http://transweb.sjsu.edu/mtiportal/research/publications/documents/06-06/MTI-06-06.pdf.

C. Upchurch, M. Kuby, M. Zoldak and A. Barranda (2004), "Using GIS To Generate Mutually Exclusive Service Areas Linking Travel On And Off A Network," *Journal of Transport Geography*, Volume 12, Issue 1, March 2004, Pages 23-33.

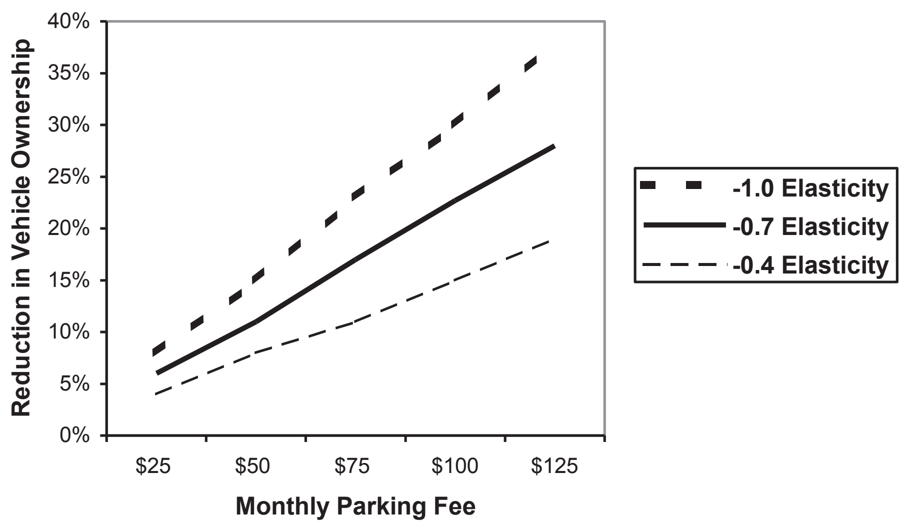
F. Zhao, L. Chow, M. Li, I. Ubaka and A. Gan (2003), Forecasting Transit Walk Accessibility," *Transportation Research Record 1835*, TRB (www.trb.org), pp. 34-41.

Parking Management

Parking Management refers to the supply, price and regulation of parking facilities. More efficient management can reduce the parking supply needed, allowing increased land use density and mix, wider sidewalks and bikepaths (bikelanes often conflict with on-street parking), and parking pricing, *unbundling* (renting parking spaces separate from building space, so for example, rather than paying $1,000 per month for an apartment with two parking spaces, renters pay $800 for the apartment and $100 for each parking space they choose to rent) and *cash out* (commuters can choose between a free parking space or its cash equivalent if they use an alternative mode) can significantly reduce automobile ownership and use (Morrall and Bolger 1996; Shoup 1997; Mildner, Strathman and Bianco 1997; Litman 2006; Weinberger, et al. 2008).

Figure 13 illustrates the likely reduction in vehicle ownership that typically results if residents pay directly for parking. As households reduce their vehicle ownership they tend to drive fewer annual miles. For example, Weinberger, et al. (2008) found that residents of urban neighborhoods with conventional parking requirements are 28% more likely to commute by automobile than in otherwise comparable neighborhood where parking supply is optional and therefore more constrained.

Figure 13 **Reduction in Vehicle Ownership From Residential Parking Prices**



This figure illustrates typical vehicle ownership reductions due to residential parking pricing, assuming that the fee is unavoidable (free parking is unavailable nearby).

Shifting from free to cost-recovery parking (prices that reflect the cost of providing parking facilities) typically reduces automobile commuting 10-30% (Shoup, 2005; "Parking Pricing," VTPI 2008). Nearly 35% of automobile commuters surveyed would consider shifting to another mode if required to pay daily parking fees of $1-3 in suburban locations and $3-8 in urban locations (Kuppam, Pendyala and Gollakoti 1998). The table below shows the typical reduction in automobile commute trips that result from various parking fees.

Table 9 **Vehicle Trips Reduced by Daily Parking Fees** ("Trip Reduction Tables," VTPI 2008, based on Comsis 1993; 1993 US Dollars)

Worksite Setting	$1	$2	$3	$4
Low density suburb	6.5%	15.1%	25.3%	36.1%
Activity center	12.3%	25.1%	37.0%	46.8%
Regional CBD/Corridor	17.5%	31.8%	42.6%	50.0%

This table indicates the reduction in vehicle trips that result from daily parking fees in various geographic locations. See VTPI (2008) for additional tables and information.

TRACE (1999) provides detailed estimates of parking pricing on various types of travel (car-trips, car-kilometres, transit travel, walking/cycling, commuting, business trips, etc.) under various conditions. The table below summarizes long-term elasticities for automobile-oriented urban regions.

Table 10 **Parking Price Elasticities** (TRACE, 1999, Tables 32 & 33)

Term/Purpose	Car Driver	Car Passenger	Public Transport	Slow Modes
Commuting	-0.08	+0.02	+0.02	+0.02
Business	-0.02	+0.01	+0.01	+0.01
Education	-0.10	+0.00	+0.00	+0.00
Other	-0.30	+0.04	+0.04	+0.05
Total	*-0.16*	*+0.03*	*+0.02*	*+0.03*

Slow Modes = Walking and Cycling

Frank, et al. (2011) used detailed data on various urban form factors to assess their impacts on vehicle travel and carbon emissions. They found that increasing parking fees from $0.28 to $1.19 per hour (50th to 75th percentile) reduces vehicle travel 11.5% and emissions 9.9%. The team developed a spreadsheet tool that can be used to evaluate the impacts of urban form, sidewalk coverage, and transit service quality and other policy and planning changes suitable for neighborhood and regional scenario analysis.

Local Activity Self-Sufficiency – Urban Villages

Local *self-sufficiency* (also called *self-containment*) refers to the portion of services and activities provided within a local area (Cervero 1995). *Urban villages* are areas with high local self-sufficiency, that is, the demands of area residents, employees and visitors can be met within a walkable neighborhood or district. For example, self-sufficiency will tend to increase in a community with many children if an area has suitable schools and parks, and will increase in a community with many seniors if the area has suitable medical services and stores that satisfy those populations. Stores in neighborhood shopping districts and downtowns tend to generate fewer vehicle trips than stores located in automobile-oriented shopping malls. Neighborhood shopping districts and downtowns have more *park once* trips (motorists park in one location and walk to several stores, rather than driving to each individually), which reduces parking demand (Abley 2007).

Site Design and Building Orientation
Some research indicates that people walk more and drive less in areas with traditional pedestrian-oriented commercial districts where building entrances connect directly to the sidewalk than in areas with automobile-oriented commercial strips where buildings are set back and separated by large parking lots, and where sites have poor pedestrian connections (Moudon 1996; Kuzmyak and Pratt 2003). Variations in site design and building orientation can account for changes of 10% or more in VMT per employee or household (PBQD 1994; Kuzmyak and Pratt 2003).

Mobility Management
Mobility management (also called *Transportation Demand Management*) includes various policies and programs that reduce motor vehicle travel and encourage use of alternative modes, as summarized in Table 11.

Table 11 **Mobility Management Strategies** (VTPI 2008)

Improved Transport Options	Incentives to Shift Mode	Land Use Management	Policies and Programs
Flextime	Bicycle and pedestrian encouragement	Car-free districts	Access management
Bicycle improvements	Congestion pricing	Compact land use	Data collection
Bike/transit integration	Distance-based pricing	Location efficient development	Commute trip reduction programs
Carsharing	Commuter financial incentives	New urbanism	Freight transport management
Guaranteed ride home	Fuel tax increases	Smart growth	Marketing programs
Park & ride	High occupant vehicle (HOV) priority	Transit oriented development (TOD)	School and campus trip management
Pedestrian improvements	Parking pricing	Street reclaiming	Special event management
Ridesharing	Road pricing		Tourist transport management
Improved taxi service	Vehicle use restrictions		Transport market reforms
Telework			
Traffic calming			
Transit improvements			

Mobility management includes numerous strategies that affect vehicle travel behavior.

Mobility management affects land use indirectly, by reducing the need to increase road and parking facility capacity, providing incentives to businesses and consumers to favor more accessible, clustered, development with improved transport choices. Conversely, most mobility management strategies become more effective if implemented in compact, mixed, walkable communities. For example, Guo, et al. (2011) found that congestion pricing is more effective in denser, mixed, transit-oriented communities. Similarly, a major road pricing study found that Smart Growth can be considered the land use component of mobility management, and mobility management can be considered the transportation component of Smart Growth.

Community Cohesion

Community cohesion refers to the quantity and quality of positive interactions among people who live and work in a community. This tends to increase perceptions of safety for residents and pedestrians. Some research indicates that walking activity tends to increase in more cohesive communities. For example, McDonald (2007) found higher rates of children walking to school in more cohesive neighborhoods, after controlling for other factors such as income and land use.

Cumulative Impacts

Land use effects on travel behavior tend to be cumulative and synergistic, so an integrated smart growth program can significantly change overall travel activity.

Most development between 1950 and 2000 was *automobile dependent*, designed primarily for automobile access with little consideration for other modes. *Multi-modal development* (also called *transit oriented development* or *TOD*) refers to areas designed for walking, cycling and public transit, as well as automobile access; driving in such areas is unrestricted, but traffic speeds tend to be lower, vehicle parking less convenient, and a few (London and Stockholm) apply road tolls in certain areas. *Carfree* areas have significant restrictions on private automobile ownership and use, ranging from mild (a few streets or times) to comprehensive (larger areas and permanent). The table below compares the travel impacts of these different development patterns. Although residents generate the same number of trips in each area, mode shares vary significantly, since automobile dependency requires driving for almost all travel.

Table 12 **Typical Mode Share By Trip Purpose For Various Transport Systems**

Trip Purpose	Automobile Dependent	Multi-Modal Development	Carfree
Work commuting	🚗 🚗 🚗 🚗 🚗	🚲 🚌 🚌 🚗 🚗	🚶 🚲 🚲 🚌 🚌
School commuting	🚲 🚌 🚗 🚗 🚗	🚶 🚲 🚲 🚌 🚗	🚶 🚶 🚲 🚲 🚌
Work-related business	🚗 🚗	🚌 🚗	🚲 🚗
Personal travel (errands)	🚶 🚗 🚗 🚗 🚗 🚗 🚗	🚶 🚶 🚲 🚲 🚗 🚗 🚗	🚶 🚶 🚲 🚲 🚌 🚌 🚗
Social and recreation	🚶 🚗 🚗 🚗 🚗 🚗	🚶 🚶 🚲 🚌 🚗 🚗	🚶 🚶 🚲 🚲 🚌 🚗
Total car trips	*21*	*9*	*3*
Total transit trips	*1*	*5*	*6*
Total non-motorized trips	*3*	*11*	*16*
Total trips	***25***	***25***	***25***

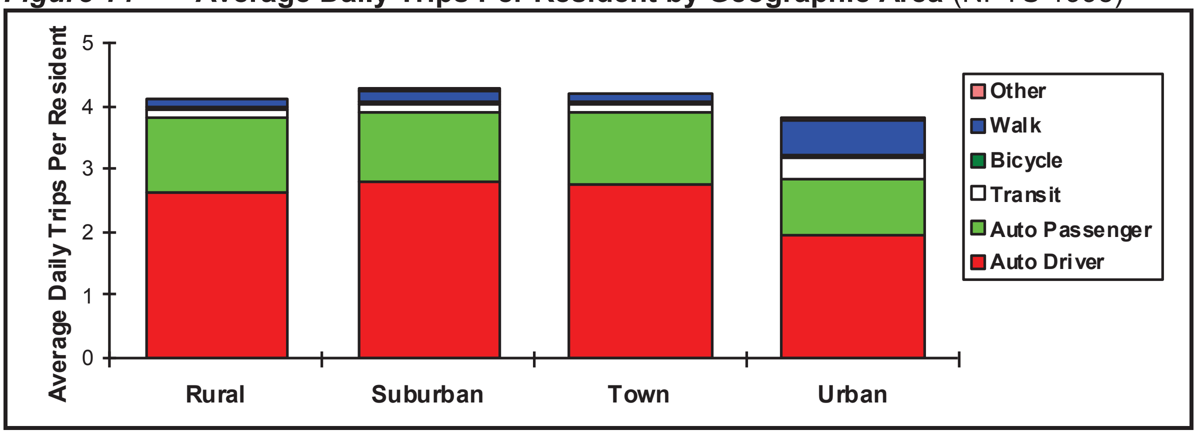
Residents of automobile-dependent communities use automobiles for most trips. Multi-modal development results in mixed mode use. Carfree development results in minimal driving.

Vehicle ownership influences vehicle travel (Ewing and Cervero 2010). Most households have a significant amount of marginal-value vehicle travel, trips they will make by automobile if one is available and driving is cheap (low fuel prices, free parking and uncongested roads), but will be made by another mode if driving is less convenient. For example, a parent may chauffeur children to school if a vehicle is available, but if not will walk or bicycle. Similarly, adding a household car encourages driving for shopping and commuting that would otherwise be by alternative modes.

Automobile dependency encourages each driver to own a personal vehicle. More multi-modal community design allows households to reduce their vehicle ownership by sharing vehicles among multiple drivers or relying on rentals. Residents of multi-modal communities tend to own 10-50% fewer vehicles per capita, which in turn reduces vehicle use. Hess and Ong (2001) find the probability of owning an auto decreases by 31 percentage points in traditional, mixed-use urban neighborhoods, all else being equal. Analysis by Kockelman (1995) indicates that the reduction in vehicle travel associated with increased density in the San Francisco Bay region results from lower vehicle ownership in denser areas, not density itself.

Data from the National Personal Transportation Survey shown in the figure below indicate that residents of higher density urban areas make about 25% fewer automobile trips and more than twice as many pedestrian and transit trips as the national average. Daisa and Parker (2010) also find that automobile trip generation rates and mode shares are much lower (typically 25-75%) in urban areas than ITE publication recommendations for both residential and commercial buildings.

Figure 14 **Average Daily Trips Per Resident by Geographic Area** (NPTS 1995)



Urban residents drive less and use transit, cycling and walking more than elsewhere.

Tomalty, Haider and Fisher (2012) found substantial differences in travel activity between new urbanist and conventional suburban neighborhoods: 51% of new urban households reported walking and cycling to local services several times a week compared with 19% in conventional neighborhoods, and new urban residents averaged 37.1 daily vehicle-kilometers compared with 46.0 in conventional neighborhoods. Nearly twice as many new urbanist residents report walking much more and driving less than in their previous neighborhood, indicating that these differences reflect behavioral change rather than self-selection. Burt and Hoover (2006) found that each 1% increase in the share of Canada's population living in urban areas reduced car travel 2.4% and light truck travel 5.0%. Ewing, Pendall and Chen (2002) developed a sprawl index based on 22 variables related to land use density, mix, street connectivity and commercial clustering. They found that a higher sprawl index is associated with higher per capita vehicle ownership and use, and lower use of alternative modes.

Ewing and Cervero (2002 and 2010) calculate the elasticity of vehicle trips and travel with respect to various land use factors, as summarized in Table 12. For example, this indicates that doubling neighborhood density reduces per capita vehicle travel 5%, and doubling land use mix or improving land use design to support alternative modes also reduces per capita automobile travel 5%.

Table 12 **Typical Travel Elasticities** (Ewing and Cervero 2002)

Factor	Description	Trips	VMT
Local Density	Residents and employees divided by land area	-0.05	-0.05
Local Diversity (Mix)	Jobs/residential population	-0.03	-0.05
Local Design	Sidewalk completeness, route directness, and street network density	-0.05	-0.03
Regional Accessibility	Distance to other activity centers in the region.	--	-0.20

This table shows Vehicle Trip and Vehicle Miles Traveled elasticities with respect to land use factors.

Comparing two automobile-oriented suburban areas in Nashville, Tennessee, Allen and Benfield (2003) found that a combination of improved roadway connectivity, better transit access, and modest increases in density reduces per capita VMT 25%. Comparing communities in Chapel Hill, North Carolina, Khattak and Rodriguez (2005) found that residents of a relatively new urbanist (or *neo-traditional*) neighborhood generate 22.1% fewer vehicle trips and take three times as many walking trips than residents of an otherwise similar (in terms of size, location and demographics) conventional design neighborhood, controlling for demographic factors and preferences. The two communities differ in average lot size (the conventional neighborhood's lots average 2.5 time larger), street design (modified grid vs. curvilinear), land use mix (the new urbanist neighborhood has some retail) and transit service (the new urbanist has a park-and-ride lot). In the new urbanist community, 17.2% of trips are by walking compared with 7.3% in the conventional community.

Boarnet, et al. (2011) use regression analysis of a detailed Los Angeles region travel survey to evaluate employment accessibility impacts on vehicle travel. They find non-linear effects; for households in the third and fourth employment accessibility quintiles, the elasticity of VMT with respect to employment accessibility is three to four times larger than average. This suggests a more important role for land use in transportation and climate change policy, and suggests that employment accessibility is a key variable.

Liu regressed National Household Travel Survey and Census data to estimate how various demographic and geographic factors affect household vehicle travel and gasoline consumption. Table 13 summarizes the results. It shows how income affects vehicle travel and fuel consumption, for a given household size, income and location. It indicates that vehicle travel and fuel consumption decline with neighborhood density, and households located in Metropolitan Statistical Areas (MSAs) with rail transit systems drive 6% less and consume 11% less fuel than otherwise equal households located in regions that lacks rail.

Table 13 **NAHB Statistical Models and Estimated Coefficients** (Liu 2007)

	Annual Miles		Gasoline (gals.)	
	Coefficient	Percent	Coefficient	Percent
Intercept	14,832	*100%*	694	*100%*
Single family home	1,645	11%	96	14%
Homeowner	1,297	9%	72	10%
Number of persons in household	1,789	12%	94	13%
Number of workers in household	6,384	43%	264	38%
Male householder	1,633	11%	101	15%
Black householder	-1201	-8%	-81	-12%
Hispanic householder	315	2%	26	4%
Other minority	-1,072	-7%	-72	-10%
Householder has a at least bachelor's degree	-1,294	-9%	-88	-13%
Age of householder	-61	0%	-2.84	0%
Annual household income $23.5k-$41.1k	720	5%	31	5%
Annual household income $41.1k-$58.8k	3,285	22%	168	24%
Annual household income $58.8k-$76.4k	5,241	35%	278	40%
Annual household income $76.4k-$94.0k	5,753	39%	315	45%
Annual household income $94.0k and up	8,597	58%	464	67%
Living in Northeast	-1,803	-12%	-84	-12%
Living in Midwest	65	0%	14	2%
Living in South	1,100	7%	70	10%
MSA has rail	-865	-6%	-74	-11%
0.08 to 0.39 units per acre	-1,600	-11%	-91	-13%
0.39 to 1.56 units per acre	-1,886	-13%	-93	-13%
1.56 to 4.69 units per acre	-4,248	-29%	-201	-29%
4.69 to 7.81 units per acre	-4,623	-31%	-218	-31%
7.81 units or more per acre	-6,574	-44%	-312	-45%
Rural areas in MSA, MSA population under 1 million	-2,589	-17%	-109	-16%
Urban areas in MSA, MSA population under 1 million	-5,445	-37%	-276	-40%
Rural areas in MSA, MSA population 1-3 million	-129	-1%	26	4%
Urban areas in MSA, MSA population 1-3 million	-5,114	-34%	-272	-39%
Rural areas in MSA, MSA population 3 million and up	384	3%	66	9%
Urban areas in MSA, MSA population 3 million and up	-3,816	-26%	-190	-27%
Urban areas, non-MSA	-3,425	-23%	-171	-25%
Urban areas, MSA pop. 3+mil., density<0.39 per acre	510	3%	87	12%
Urban areas, MSA pop. 1-3mil., density<0.39 per acre	1,733	12%	78	11%

This table summarizes Liu's results for vehicle travel and gasoline consumption.

Liu (2007) also found that residents of more compact communities tend to drive at less efficient speeds (below 45 mph) due to congestion, but not enough to offset vehicle travel reductions so households in more compact development tend to use less gasoline and generate fewer emissions overall. Table 14 summarizes these impacts. Although this data set does not allow direct quantification of individual land use factors such as land use mix, road connectivity and walkability (although they are generally associated with urban areas and the Northeast region), the results indicate that compact development tends to reduce vehicle travel and fuel use.

Table 14 **Factors That Increase Vehicle Travel and Fuel Consumption** (Liu 2007)

Geographic	Household	
• Located in the Midwest or South • Located in a lower-density neighborhood • Located in an rural area • Region lacks rail transit	• Are larger (more people) • Contain more workers • Have higher incomes • Own their homes • Live in single family homes	• Are younger • Are less educated • Have a male householder • Have a white householder • Have a Hispanic householder

All else being equal, residents of more compact regions tend to drive less and consume less fuel.

A major study, found substantially lower vehicle ownership and use in older, high-density, mixed-used urban areas than in more contemporary, sprawled, automobile-dependent areas in the Phoenix, Arizona region (Kuzmyak 2012). Higher-density neighborhood residents make substantially shorter trips: for example, work trips average about seven miles in higher-density neighborhoods compared with 11 miles in suburban neighborhoods, and shopping trip average less than three miles compared with over four miles in suburban areas. As a result, urban dwellers drive about a third fewer daily miles than their suburban counterparts. Smart growth area roads had considerably less traffic congestion despite much higher densities, apparently due to more land use mixing and more connected streets, which reduce vehicle travel and allow more walking and public transit trips and shifts to alternative routes.

Phoenix Household Vehicle Travel

	Smart Growth	Sprawled
Vehicle ownership per household	1.55	1.92
Daily VMT per capita	10.5	15.4
Average home-based work trip length (miles)	7.4	10.7
Home-based shopping trip length (miles)	2.7	4.3
Home-based other trip length (miles)	4.4	5.2
Non-home-based trip length	4.6	5.3

Dill (2004) found that residents of Fairview Village, a new urbanist neighborhood, own about 10% fewer cars and drive 20% fewer miles per adult, and make about four times as many walking trips than residents of more sprawled neighborhoods. The analysis indicates that residents of this community often substitute walking for driving due to increased land use mix, improved walkability and more attractive commercial center.

Table 15 **Travel In Conventional And New Urbanist Neighborhoods** (Dill 2004)

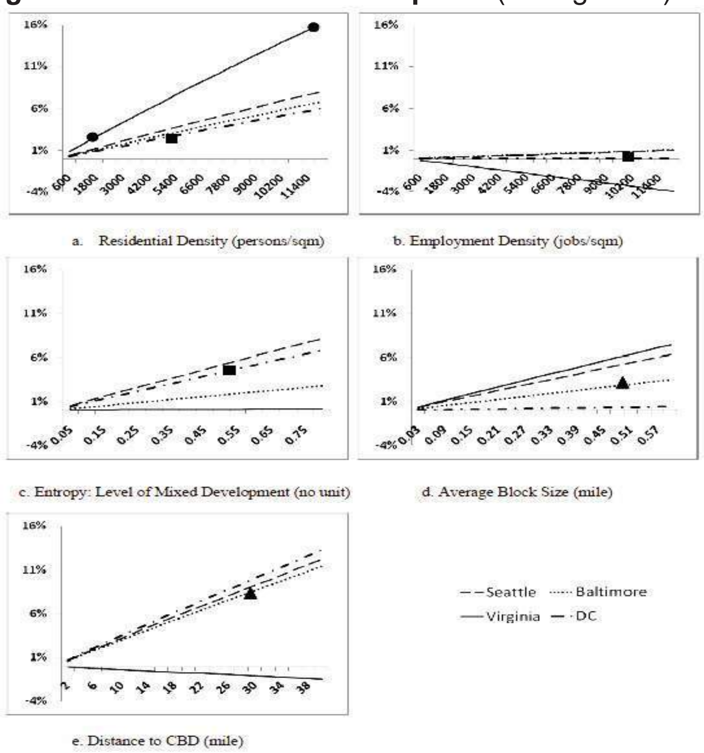
	Control Neighborhood	Fairview (New Urbanist)	Difference
Vehicles Per Adult	1.11	0.99	-0.12 (11%)
Weekly VMT Per Adult	151.2	121.8	-29.4 (19%)
Weekly Driving Trips	14.62	12.37	-2.25 (15%)
Weekly Cycling Trips	0.14	0.41	+0.27 (1.93%)
Weekly Walking Trips	1.66	6.55	+4.89 (295%)

Residents of a new urbanist neighborhood own few cars, drive fewer miles and make more walking and cycling trips than residents of more conventional neighborhoods.

More recent research by Dill (2006) found that 30% or more of Portland area Transit Oriented Development (TOD) residents commuted by MAX (the regional light rail system) at least once a week, and 23-33% used transit as their primary commute mode. This compares to less than 10% of workers in the automobile-oriented suburbs of Hillsboro and Beaverton, and 15% of Portland workers. Transit commuting increased significantly when people moved to TODs. Nearly 20% of the commuters switched from non-transit to transit modes while 4% did the opposite, for a net of about 16%.

Zhang (2011) used a Bayesian regression model to measure the travel impacts of various land use factors in Baltimore, Seattle, Virginia and Washington DC, summarized in Figure 15. The analysis indicates that residential and employment density, land use mix, block size and distance to city center all affect per capita vehicle mileage, although the effects vary depending on community type. For example, in lower-density areas like urban Virginia with 1,950 persons per sq. mile, a 20% density increase would reduce VMT 3%, but in an area that currently has 11,400 persons per sq. mile, VMT would decline 16%. Reducing city block length, an indicator of roadway connectivity, had the greatest impact on reducing VMT in smaller, less dense, automobile-oriented urban areas.

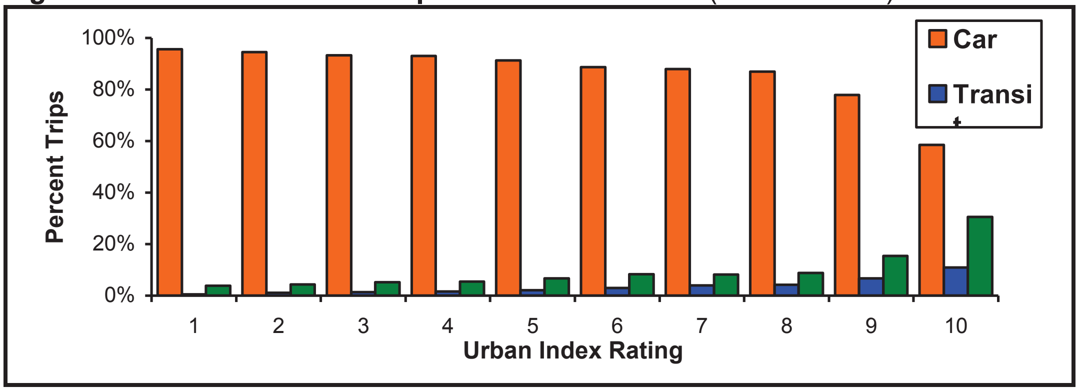
Figure 15 **Vehicle Travel Impacts** (Zhang 2011)



These graphs illustrate the vehicle travel reductions (vertical axis) caused by a 20% change in various land use factors (horizontal axis), including increased population and employment density, land use mix, block size and distance to the central business district (CBD), for four U.S. urban regions.

Lawton (2001) used Portland, Oregon data to model the effects of land use density, mix, and road network connectivity on personal travel. He found that these factors significantly affect residents' car ownership, mode split and per capita VMT. Adults in the least urbanized areas of the city averaged about 20 motor vehicle miles of travel each day, compared with about 6 miles per day for residents of the most urbanized areas, due to fewer and shorter motor vehicle trips, as indicated in Figure 16.

Figure 16 **Urbanization Impact On Mode Share** (Lawton 2001)



As an area becomes more urbanized the portion of trips made by transit and walking increases.

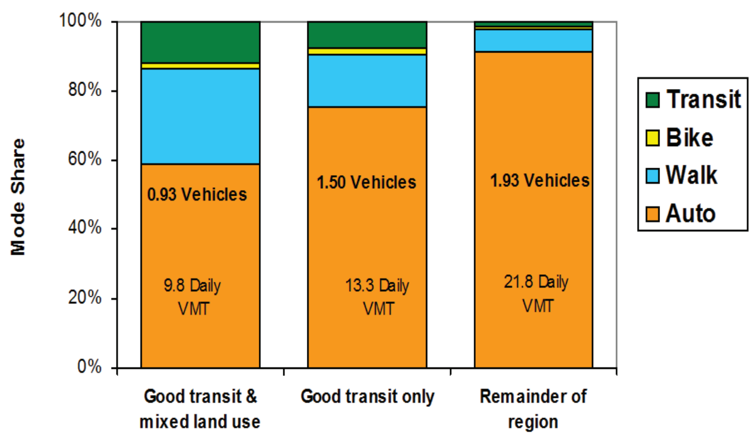
Table 16 and Figure 19 show how location factors affect vehicle ownership, daily mileage and mode split in the Portland, Oregon region. Transit-oriented neighborhoods, with good transit and mixed land use, have far lower vehicle ownership and use, and more walking, cycling and public transit use than other areas. Residents of areas with high quality transit drive 23% less, and residents of areas with high quality public transit *and* mixed land use drive 43% less than elsewhere in the region, indicating that land use and transportation factors have about the equal impacts on travel activity.

Table 16 **Impacts on Vehicle Ownership and Travel** (Portland 2009)

Land Use Type	Auto Ownership	Daily VMT	Mode Share				
	Per Household	Per Capita	Auto	Walk	Transit	Bike	Other
Good transit/Mixed use	0.93	9.80	58%	27%	12%	1.9%	1.5%
Good transit only	1.50	13.3	74%	15%	7.9%	1.4%	1.1%
Remainder of county	1.74	17.3	82%	9.7%	3.5%	1.6%	3.7%
Remainder of region	1.93	21.8	87%	6.1%	1.2%	0.8%	4.0%

Residents of transit-oriented neighborhoods tend to own significantly fewer motor vehicles, drive significantly less, and rely more on walking and public transit than residents of other neighborhoods.

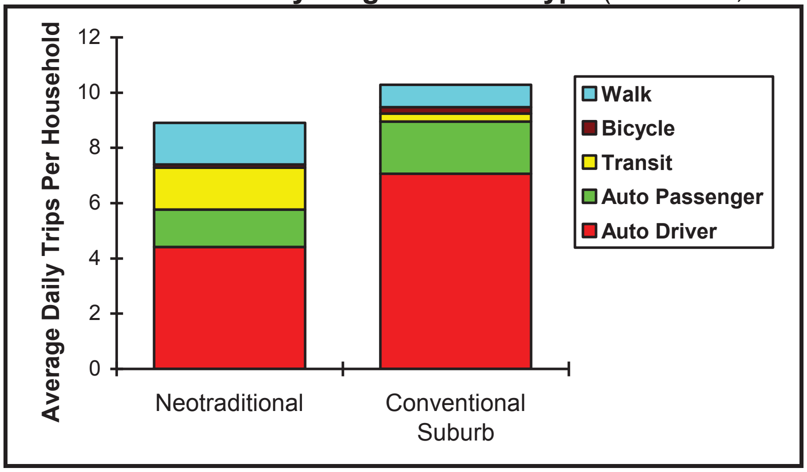
Figure 19 **TOD Impacts On Vehicle Ownership and Use** (Portland 2009)



Transit-oriented development residents tend to own fewer vehicles, drive less and use alternative modes more than in automobile-oriented communities. "Daily VMT" indicates average daily vehicle miles traveled per capita.

Other studies also find significantly lower per capita vehicle travel in higher-density, traditional urban neighborhoods than in modern, automobile-oriented suburbs, as illustrated in Figure 17.

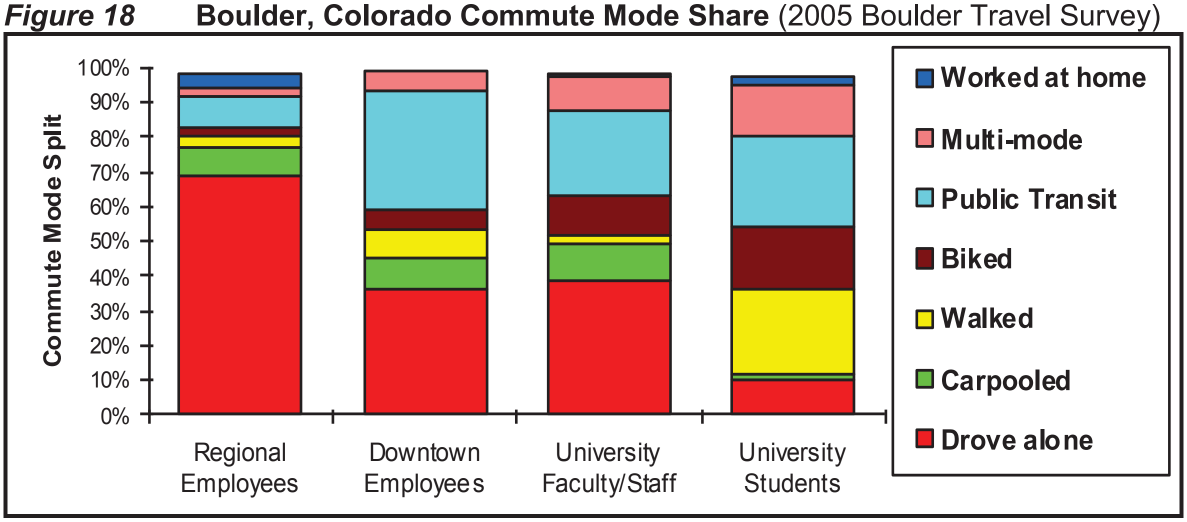
Figure 17 **Household Travel by Neighborhood Type** (Friedman, Gordon and Peers 1995)



Household vehicle trips are significantly lower in neotraditional (new urbanist) neighborhoods than conventional automobile-dependent suburbs due to higher densities and better travel options.

A Cambridge Systematics (1992) study predicts that households make 20-25% fewer vehicle trips if located in a higher density, transit-oriented suburb than in a conventional, low density, auto-oriented suburb. A 2005 Boulder, Colorado travel survey found much lower drive alone rates and much greater use of alternative modes in the downtown and university campus area than for the region overall, as illustrated in Figure 18.

Figure 18 **Boulder, Colorado Commute Mode Share** (2005 Boulder Travel Survey)



Vehicle trips per household are significantly lower in neotraditional neighborhoods than in conventional automobile dependent suburbs due to higher densities and better travel choices.

Frank, et al. (2010a) evaluated the effects of urban form on walking and driving energy consumption, assuming that increased walking energy consumption contributes to more physical fitness and more vehicle energy consumption contributes to climate change. They conclude that land use strategies to reduce driving and increase walking are largely convergent: increasing residential density, street connectivity, and transit accessibility (both through better transit service and more transit-oriented development) all help achieve both goals, as indicated by a higher energy index.

Bento, et al (2004) conclude that residents reduce vehicle travel about 25% if they shift from a dispersed, automobile-dependent city such as Atlanta to a more compact, multi-modal city such as Boston, holding other economic and demographic factors constant. Transit-oriented land use affects both commute and non-commute travel. Although less than ten percent of the respondents used transit to non-commute destinations on a weekly basis, TOD residents walk significantly more for non-commute travel.

A U.S. Environmental Protection Agency study identified substantial energy conservation and emission reductions if development shifts from the urban fringe to infill (USEPA 2007). The study found that individual households that shift from urban fringe to infill locations typically reduce VMT and emissions by 30-60%, and in typical U.S. cities, shifting 7-22% of residential and employment growth into existing urban areas could reduce total regional VMT, congestion and pollution emissions by 2-7%.

Tomalty and Haider (2009) evaluated how community design factors (land use density and mix, street connectivity, sidewalk supply, street widths, block lengths, etc.) and a subjective walkability index rating (based on residents' evaluation of various factors) affect walking and biking activity, and health outcomes (hypertension and diabetes) in 16 diverse British Columbia neighborhoods. The analysis reveals a statistically significant association between improved walkability and more walking and cycling activity, lower body mass index (BMI), and lower hypertension. Regression analysis indicates that people living in more walkable neighbourhoods are more likely to walk for at least 10 daily minutes and are less likely to be obese than those living in less walkable areas, regardless of age, income or gender. The study also includes case studies which identified policy changes likely to improve health in specific communities.

Higher rates of transit and walking travel may partly reflect *self selection* (also called *sorting*): people who by necessity or preference, drive less and rely more on alternative modes tend to choose more multi-modal locations. However, studies that account for self-selection statistically, and linear studies that track travel activity before and after people move to new locations, indicate that land use factors do affect travel behavior (Krizek 2003b; Cao 2014; Cervero 2007).

Even if self-selection explains a portion of differences in travel behavior between different land use types, this should not detract from the finding that such land use patterns and resulting travel behaviors provide consumer benefits, and reduce trip and parking generation (and therefore road and parking facility costs) at a particular location. A study sponsored by CalTrans (2008) found that trip generation and automobile mode split rates are significantly lower (often less than half) at urban infill developments than ITE standards. This apparently reflects the cumulative effects of various land use factors such as density, mix, walkability, transit accessibility and parking pricing.

Nelson/Nygaard (2005) developed a model that predicts how Smart Growth and TDM strategies affect capita vehicle trips and related emissions. This model indicates that significant reductions can be achieved relative to ITE trip generation estimates. Table 17 summarizes the projected VMT reduction impacts of typical smart growth developments.

Table 17 **Smart Growth VMT Reductions** (CCAP 2003)

Location	Description	VMT Reduction
Atlanta	138-acre brownfield, mixed-use project.	15-52%
Baltimore	400 housing units and 800 jobs on waterfront infill project.	55%
Dallas	400 housing units and 1,500 jobs located 0.1 miles from transit station.	38%
Montgomery County	Infill site near major transit center	42%
San Diego	Infill development project	52%
West Palm Beach	Auto-dependent infill project	39%

This table summarizes reductions in per capita vehicle travel from various Smart Growth developments

A major study by the University of Utah's Metropolitan Research Center developed a sprawl index that incorporates four factors: *density* (people and jobs per square mile), *mix* (whether neighborhoods had a mix of homes, jobs and services), *centricity* (the strength of activity centers and downtowns) and *roadway connectivity* (the density of connections in the roadway network); a higher rating indicates more compact, *smart growth* development (Ewing and Hamidi 2014). This index was used to evaluate how these land use factors affects various travel, economic and health outcomes. It indicates that:

- People in smart growth areas own fewer cars and spend less time driving. For every 10% increase in index score, vehicle ownership rates decline 0.6% and drive time declines 0.5%.
- For every 10% increase in an index score, the walk mode share increases by 3.9%.
- The portion of household income spent on housing is greater but the portion of income spent on transportation is lower, in smart growth communities. Each 10% increase in an index score was associated with a 1.1% increase in housing costs and a 3.5% decrease in transportation costs relative to income. Since transportation costs decline faster than housing costs rise, this results in a net decline in combined housing and transportation costs.
- For every 10% increase in an index score, there is a 4.1% increase in the probability that a child born to a family in the bottom quintile of the national income distribution reaches the top quintile of the national income distribution by age 30.
- Smart growth community residents tend to live longer. For every doubling in an index score, life expectancy increases by about 4%. For the average American with a life expectancy of 78 years, this translates into a three-year difference in life expectancy between people in a less compact versus a more compact county. This probably reflects significantly lower rates of traffic fatalities, obesity, high blood pressure and diabetes in

smart growth communities, although these are somewhat offset by slightly higher air pollution exposure and murder risk.

- Counties with less sprawl have more but less severe vehicle crashes. For every 10% increase in an index score, fatal crashes decrease by almost 15%. People in smarter growth communities also have significantly lower blood pressure and rates of diabetes.

Table 18 summarizes these results.

Table 18 **Summary of Sprawl Outcomes** (SGA 2014; Ewing and Hamidi 2014)

Outcome	Relationship to Compactness	Impact of 10% Score Increase
Average household vehicle ownership	Negative and significant	0.6% decline
Vehicle miles traveled	Negative	7.8% to 9.5% decline
Walking commute mode share	Positive and significant	3.9% increase
Public transit commute mode share	Positive and significant	11.5% increase
Average journey-to-work drive time	Negative and significant	0.5% decline
Traffic crashes per 100,000 population	Positive and significant	0.4% increase
Injury crash rate per 100,000 pop.	Positive and significant	0.6% increase
Fatal crash rate per 100,000 population	Negative and significant	13.8% decline
Body mass index	Negative and significant	0.4% decline
Obesity	Negative and significant	3.6% decline
Any physical activity	Not significant	0.2% increase
Diagnosed high blood pressure	Negative and significant	1.7% decline
Diagnosed heart disease	Negative and significant	3.2% decline
Diagnosed diabetes	Negative and significant	1.7% decline
Average life expectancy	Positive and significant	0.4% increase
Upward mobility (probability a child born in a bottom-income-quintile family reaches the top quintile by age 30)	Positive and significant	4.1% increase
Transportation affordability	Positive and significant	3.5% decrease in transport costs relative to income
Housing affordability	Negative and significant	1.1% increase in housing costs relative to income.

This table summarizes economic, health and environmental impacts from compact development.

These results validate previous research indicating that more compact development reduces motor vehicle travel and associated costs. This disaggregated analysis of sprawl factors is useful because it is possible to have dense sprawl (for example, dispersed high-rise development in an automobile-dependent area) and rural smart growth (development concentrated in villages with commonly used services within walking distance of most households, connected to larger urban centers with convenient public transit services). This expands the range of policy tools that can be used to increase transport system efficiency, for example, even if a city cannot increase development density it may be able to increase mix, road connectivity, and the quality of resource-efficient travel modes (walking, cycling and public transport).

Vernez Moudon and Stewart (2013) reviewed research on how various land use factors affect travel activity, and the tools available for modeling these imapcts and related outcomes such as vehicle emissions and health co-benefits. Table 19 summarizes their findings.

Table 19 **Typical Elasticities of Travel With Respect to the Built Environment** (Vernez Moudon and Stewart 2013)

Category	Variable	VMT	Walking	Transit
Density	Household/population density	–0.04	0.07	0.07
	Job density	0.00	0.04	0.01
	Commercial Floor Area Ratio (FAR)	n/a	0.07	n/a
Diversity	Land use mix	-0.09	0.15	0.12
	Jobs/housing balance	-0.02	0.19	n/a
	Distance to a store	n/a	0.25	n/a
Design	Intersection/street density	-0.12	0.39	0.23
	Percent 4-way intersections	-0.12	-0.06	0.29
Destination accessibility	Job accessibility by auto	-0.20	n/a	n/a
	Job accessibility by transit	-0.05	n/a	n/a
	Jobs within one mile	n/a	0.15	n/a
	Distance to downtown	– 0.22	n/a	n/a
Distance to Transit	Distance to nearest transit stop	-0.05	0.15	0.29

An extensive body of literature examines how various land use factors affect travel activity.

Kahn (2000) used household-level sets to study some environmental impacts of location. He found that suburban households drive 31% more than their urban counterparts and western households drive 35% more than northeastern households due to differences in travel options and land use patterns. International studies also find significant differences in travel patterns, as illustrated in Table 20.

Table 20 **Mode Split In Selected European Cities** (ADONIS 2001)

City	Foot and Cycle	Public Transport	Car	Inhabitants
Amsterdam (NL)	47 %	16 %	34 %	718,000
Groningen (NL)	58 %	6 %	36 %	170,000
Delf (NL)	49 %	7 %	40 %	93,000
Copenhague (DK)	47 %	20 %	33 %	562,000
Arhus (DK)	32 %	15 %	51 %	280,000
Odense (DK)	34 %	8 %	57 %	198,300
Barcelona (Spain)	32 %	39 %	29 %	1,643,000
L'Hospitalet (Spain)	35 %	36 %	28 %	273,000
Mataro (Spain)	48 %	8 %	43 %	102,000
Vitoria (Spain)	66 %	16 %	17 %	215,000
Brussels (BE)	10 %	26 %	54 %	952,000
Gent (BE)	17 %	17 %	56 %	226,000
Brujas (BE)	27 %	11 %	53 %	116,000

Many cities in wealthy countries have relatively high rates of alternative modes.

Using a detailed travel survey integrated with a sophisticated land use model, Frank, et al. (2008) found that automobile mode share declines and use of other modes (walking, cycling and public transit) increases with increased land use density, mix and intersection density at both home and worksite areas. Increasing destination retail floor area ratio by 10% was associated with a 4.3% increase in demand for transit. A 10% increase in home location intersection density was associated with a 4.3% increase in walking to work. A 10% increase in residential area mix was associated with a 2.2% increase in walking to work. A 10% increase in home location retail floor area ratio was associated with a 1.2% increase in walking to work. Increasing residential area intersection density by 10% was associated with an 8.4% increase in biking to work. A 10% increase in fuel or parking costs reduced automobile mode split 0.7% and increased carpooling 0.8%, transit 3.71%, biking 2.7% and walking 0.9%. Transit riders are found to be more sensitive to changes in travel time, particularly waiting time, than transit fares. Increasing transit in-vehicle times for non-work travel by 10% was associated with a 2.3% decrease in transit demand, compared to a 0.8% reduction for a 10% fare increase. Non-work walking trips increased in more walkable areas with increased density, mix and intersection density. Increasing auto travel time by 10% was associated with a 2.3% increase in transit ridership, a 2.8% increase in bicycling, and a 0.7% increase in walking for non-work travel.

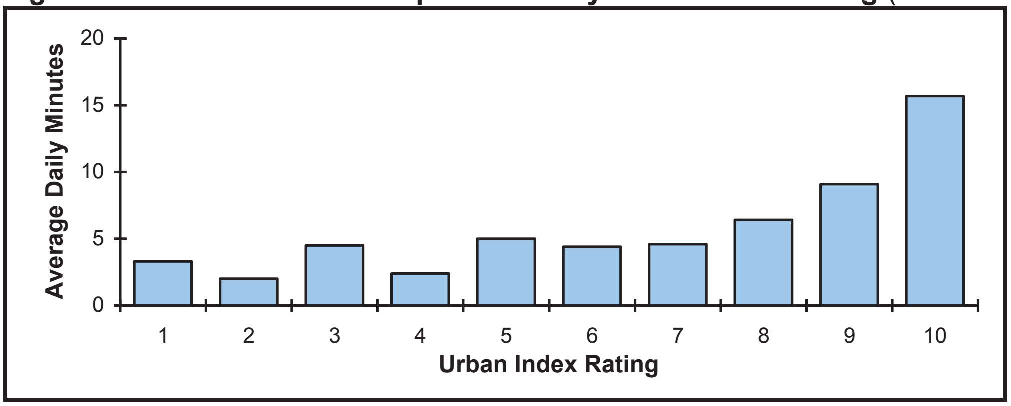
Chattopadhyay and Taylor (2012) developed an innovative way to predict people's behavior, particularly how people make decisions about where to live. The study focused on 18 urban areas across the United States and used census data and information from the 2001 National Household Travel Survey and the National Transit Database. They found that a 10% increase in a city’s smart growth features, such as residential density, jobs per capita and public transit infrastructure, would lead to a 20% decrease in vehicle miles traveled per household. According to study author Sudip Chattopadhyay, professor and chair of economics at SF State, “We found that changing the way cities are designed would significantly reduce travel demand. People’s travel habits would change, and they would drive less.”

Other factors also affect travel activity. In a detailed analysis of transport and land use factors, Buehler (2010) found that fuel prices and transport investments rather than land use conditions are the largest factor that explain the differences in travel activity (per capita walking, cycling, public transit and automobile travel) between the U.S. and Germany. He found that, although increased land use density and mix tend to reduce automobile travel in both countries, at any population density Americans drive between 60% to 80% more than Germans.

Nonmotorized Travel

Certain planning objectives, such as improving physical fitness and increasing neighborhood social interactions, depend on increasing nonmotorized travel (Litman 2003; Frumkin, Frank and Jackson 2004; Mackett and Brown 2011; Marcus 2008). Research by Ewing, et al (2003) and Frank (2004) indicate that physical activity and fitness tend to decline in sprawled areas and with the amount of time individuals spend traveling by automobile.

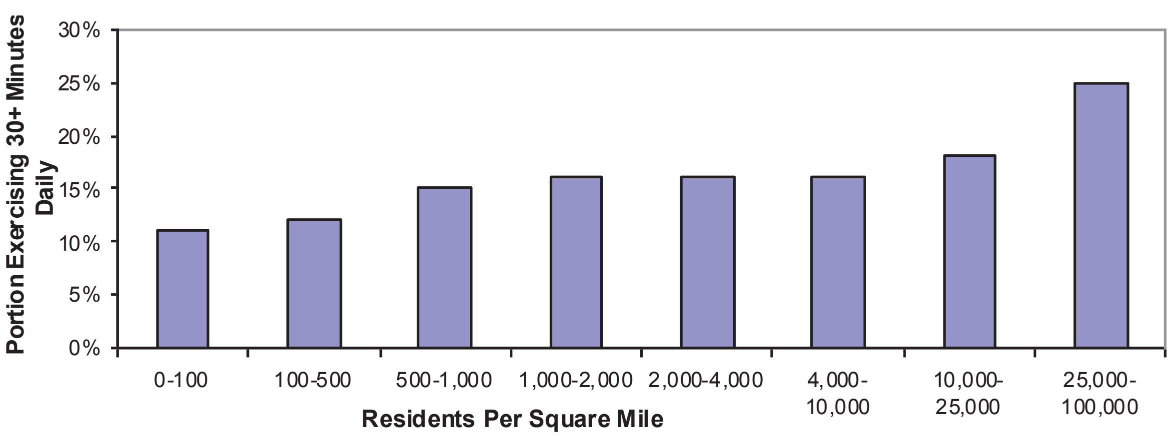
Figure 20 **Urbanization Impact On Daily Minutes of Walking** (Lawton 2001)



As an area becomes more urbanized the average amount of time spent walking tends to increase.

Lawton (2001), Khattak and Rodriguez (2003) and Marcus (2008) found that residents of more walkable neighborhoods tend to achieve most of the minimum amount of physical activity required for health (20 minutes daily), far more than residents of automobile-oriented suburbs. Unpublished analysis by transport modeler William Gehling found that the portion of residents who walk and bicycle at least 30 minutes a day increases with land use density, from 11% in low density areas (less than 1 resident per acre) up to 25% in high density (more than 40 residents per acre) areas, as illustrated below.

Figure 21 **Portion of Population Walking & Cycling 30+ Minutes Daily** (Unpublished Analysis of 2001 NHTS by William Gehling)



As land use density increases the portion of the population that achieves sufficient physical activity through walking and cycling increases. Based on 2001 NHTS data.

Cao, Handy and Mokhtarian (2005) evaluated the effects of land use patterns on strolling (walking for pleasure or exercise) and utilitarian walking trips in Austin, Texas. They found that residential pedestrian environments have the greatest impact on strolling trips, while the destination area pedestrian environment (such as commercial area) is at least as important for utilitarian trips. Pedestrian travel declines with increased vehicle traffic on local streets. They found that strolling accounts for the majority of walking trips, but tends to be undercounted in travel surveys.

Weinstein and Schimek (2005) discuss problems obtaining reliable nonmotorized information in conventional travel surveys, and summarize walking data in the U.S. 2001 National Household Travel Survey (NHTS). They find that about 10% of total measured trips involved nonmotorized travel. Respondents average 3.8 walking trips per week, but some people walk much more than others. About 15% of respondents report walking on a particular day, and about 65% of respondents reported walking during the previous week. The median walk trip took 10 minutes and was about 0.25 mile in length, much less than the mean walking trip (i.e., a small number of walking trips are much longer in time and distance). The table below summarizes walking trip data.

Table 21 **NHTS Walking Trip Attributes** (Weinstein and Schimek 2005)

Purpose	Frequency	Mean Distance	Median Distance	Mean Duration
	Percent	Mile	Mile	Minutes
Personal business/shopping/errands	48%	0.44	0.22	11.9
Recreation/exercise	20%	1.16	0.56	25.3
To transit	16%	N/A	N/A	19.6
To or from school	7%	0.62	0.33	13.3
To or from work	4%	0.78	0.25	14.1
Walk dog	3%	0.71	0.25	19.0
Other	2%	0.57	0.22	14.8
Totals	*100%*	*0.68*	*0.25*	*16.4*

This table summarizes the results of NPTS walking trip data. N/A = not available.

Besser and Dannenberg (2005) used the NHTS to analyze walking associated with public transit trips. They found that Americans who use public transit on a particular day spend a median of 19 daily minutes walking to and from transit, and that 29% achieve the recommended 30 minutes of physical activity a day solely by walking to and from transit. In multivariate analysis, rail transit, lower-income, age, minority status, being female, being a nondrivers or zero-vehicle household, and population density were all positively associated with the amount of time spent walking to transit.

Frank, et al. (2006) developed a *walkability index* that reflects the quality of walking conditions, taking into account residential density, street connectivity, land use mix and retail floor area ratio (the ratio of retail building floor area divided by retail land area). They found that in King County, Washington a 5% increase in their walkability index is associated with a 32.1% increase in time spent in active transport (walking and cycling), a 0.23 point reduction in body mass index, a 6.5% reduction in VMT, and similar reductions in air pollution emissions.

Study: Kids Take Walks If Parks, Stores Nearby
Stacy Shelton, *The Atlanta Journal-Constitution*, 12 December 2006

Young people in metro Atlanta are more likely to walk if they live in a city or within a half-mile of a park or store, according to a new study published in the *American Journal of Health Promotion*.

Of the 3,161 children and youth surveyed from 13 counties, the most important neighborhood feature for all age ranges was proximity to a park or playground. It was the only nearby walking attraction that mattered for children ages 5 to 8, who were 2.4 times more likely to walk at least half a mile a day than peers who don't live near a park, researchers said.

For older children and young adults up to age 20, a mix of nearby destinations including schools, stores and friends' houses also translated into more walking. Preteens and teenagers ages 12 to 15 who live in high-density or urban neighborhoods were nearly five times more likely to walk half a mile or more a day than those who live in low-density or suburban neighborhoods.

Lawrence Frank, the study's lead author and a former urban planning professor at Georgia Tech, said the research shows young people are particularly sensitive to their surroundings, most likely because they can't drive. "Being able to walk in one's neighborhood is important in a developmental sense," said Frank, now at the University of British Columbia. "It gives youth more independence. They start to learn about environments and where they live. There are also benefits for social networking for children."

The study used data collected from a larger study of land use and travel patterns, called SMARTRAQ, in the metro Atlanta area. It is funded by the Centers for Disease Control and Prevention, the Environmental Protection Agency, the Georgia Department of Transportation and the Georgia Regional Transportation Authority. Other SMARTRAQ findings showed a strong link between time spent driving and obesity.

Elke Davidson, executive director of the Atlanta Regional Health Forum, said getting kids to walk is "one of the most important health interventions that we need right now." Her group is a privately funded organization that works to make public health goals a part of local and regional planning.

Health officials say half of all children diagnosed with diabetes today have Type 2, formerly known as adult-onset, which is linked to obesity. Exercise is a key strategy for preventing and treating the disease.

"We need not just to tell kids to get off their computers and go outside. If there are no parks and no place to walk, they're stuck," Davidson said. "A lot of the natural opportunities for physical activity, like walking to school or walking to your friends' house or walking downtown to get a soda ... those opportunities are increasingly limited when we build communities that are so auto-dependent."

George Dusenbury, executive director of Park Pride, said he chose to live in Atlanta's Candler Park neighborhood because it's close to parks, restaurants, stores and MARTA. Both his sons, ages 5 and 8, are used to walking, he said. "We recognize that encouraging your kids to walk early is the best way to ensure they stay healthy," he said. "I hate driving with a passion. So for me it's an environmental thing and it's a health thing."

Modeling Land Use Impacts on Travel Behavior

Planners often use models to predict the impacts of specific policies and planning decisions. For more than fifty years transport planners have used traffic models to estimate demand (how many people would like to travel between different areas under specific conditions) and evaluate the impacts of transport system changes. These models use land use factors (the number and type of people, jobs and businesses in particular areas) as an input. However, these models are not very sensitive to many of the land use factors discussed in this report, they are either not considered at all or modelers lack the data needed to evaluate them (USEPA 2001; Hunt and Brownlee 2001; Lee, et al. 2012; Lewis Berger Group 2004; Sadek et al. 2011). For example, most models use analysis zones that are too large to capture small-scale design features, and none are very accurate in evaluating non-motorized travel. As a result, the models are unable to predict the full travel impacts of land use management strategies such as transit-oriented development or walking and cycling improvements.

The following improvements are recommended to help existing models better evaluate land use management strategies (Rosenbaum and Koenig 1997; Sadek, et al. 2011):

- Analyze land use at finer spatial resolutions, such as census tracts or block level (called *micro-level* analysis).
- Determine effects of special land use features, such as pedestrian-friendly environments, mixed-use development, and neighborhood attractiveness.
- Determine relationships between mixed-use development and travel mode selection.
- Improved methods for analyzing trip chaining.
- Improve the way temporal choice (when people take trips) is incorporated into travel models.

Integrated land use and transportation models, such as the gravity-based *Integrated Transportation Land Use Package* (ITLUP) and the economic equilibrium *CATLUS*, attempt to address traditional models' shortcomings by connecting submodels that represent various aspect of the urban system (land use development, traffic, etc.) (Bartholomew and Ewing 2009; Outwater, et al. 2014; TRB 2012). Such models must be calibrated to unique local data due to their sensitivity to small changes in parameters and assumptions. This makes them expensive and difficult to compute.

Another new approach, called *activity-based modeling*, predicts travel based on information about people's demand to participate in activities such as work, education, shopping, and recreation, and the spatial and temporal distribution of those activities (Dong, et al. 2006; UT 2004). They include a "behavioural core" of four interrelated components (land use, location choice, activity/travel, and auto ownership). Each behavioural component involves various sub-models that incorporate supply/demand interactions, and interact among each other. For example, land use evolves in response to location needs of households and firms, and people relocate their homes and/or jobs at least partially in response to accessibility factors.

Because of the complexity of creating comprehensive, integrated models that are sensitive to land use factors, some organizations have developed simplified and targeted models for evaluating smart growth strategies.

The *Smart Growth Area Planning* (SmartGAP) tool synthesizes households and firms in a region and determines the travel demand characteristics of these households and firms based on the characteristics of their built environment and transportation policies affecting their travel behavior (TRB 2012). The *Smart Growth Index (SGI) Model*, is a sketch model developed by the U.S. Environmental Protection Agency for simulating alternative land-use and transportation scenarios (USEPA 2002).

The *Rapid Fire Model* developed for Vision California (www.visioncalifornia.org) is a user-friendly spreadsheet tool that evaluates regional and statewide land use and transportation scenarios, including various combinations of land use density, mix, building types and transport policies, and predicts their impacts on vehicle travel, pollution emissions, water use, building energy use, transportation fuel use, land consumption, and public infrastructure costs. All assumptions are clearly identified and can be easily modified.

Frank, et al. (2011) developed a spreadsheet tool to estimate the potential reduction in vehicle travel and emissions from changes in urban form, including increased sidewalk coverage, improved and more affordable transit service, and increased road or parking fees, suitable for neighborhood and regional planning. This model was applied in two Seattle-area neighborhoods. It indicates that increasing sidewalk coverage from a ratio of 0.57 (the equivalent of sidewalk coverage on both sides of 30% of all streets) to 1.4 (coverage on both sides of 70% of all streets) could reduce vehicle travel 3.4% and carbon emissions 4.9%. Land use mix and parking pricing also had significant impacts. Increasing parking fees from approximately $0.28 to $1.19 per hour (50th to 75th percentile) reduced vehicle travel 11.5% and emissions 9.9%.

Table 22 summarizes various model that can be used to evaluate how land use factors affect travel behavior, energy consumption and pollution emissions.

Table 22 **Models for Evaluating Travel Impacts** (Vernez Moudon & Stewart 2013)

Tool	Developer	Description	URL	Applications
Spreadsheet Tools				
CCAP Transportation Emissions Guidebook Emissions Calculator	Center for Clean Air Policy	Estimates GHG and other emissions based on TDM policies and Vehicle technologies	www.ccap.org/safe/guidebook/guide_complete.html	Unknown
COMMUTER	US EPA	Estimates travel and emissions impacts of commuting programs	www.epa.gov/otaq/stateresources/policy/pag_transp.htm#cp	Unknown
Conserve by Bicycling and Walking	FDOT	Estimates corridor-level NMT and co-benefits from area BE and demographic factors	http://www.dot.state.fl.us/safety/4-Reports/Bike-Ped-Reports.shtm	Florida

Tool	Developer	Description	URL	Applications
King County State Environmental Policy Act (SEPA) GHG Emissions Worksheet	King County, Washington	Estimates all GHG emissions from a development project (has not been updated since 2007)	http://your.kingcounty.gov/ddes/forms/SEPA-GHGEmissionsWorksheet-Bulletin26.xls	King County, WA
Rapid Fire	Calthorpe Associates	Models VMT, GHG emissions, etc. based on land use scenarios	www.calthorpe.com/scenario_modeling_tools	California, Honolulu
VMT reduction: Phase One	WSDOT	Estimates neighborhood residential VMT and CO2 based on BE and demographic factors	www.wsdot.wa.gov/research/reports/fullreports/765.1.pd	Rainier Beach and Bitter lake, Seattle
VMT Spreadsheet	Fehr and Peers	Estimates mobile GHG emissions from land use development projects.	www.coolconnections.org/vm	Northgate, Seattle
VMT Spreadsheet with Smart Growth Adjustments	Fehr and Peers	Estimates mobile GHG emissions from development adjusted for BE characteristics.	www.coolconnections.org/4ds	Northgate, Seattle
GIS and/or model-based tools				
Bay Area Simplified Simulation of Travel, Energy and Greenhouse Gases (BASSTEGG)	Bay Area Metropolitan Transportation Commission	GIS simulation of Regional VO, VMT, and GHG based on TAZ-level BE and SES	ftp://ftp.abag.ca.gov/pub/mtc/planning/forecast/BASSTEGG	Bay Area, CA
Clean Air and Climate Protection (CACP) 2009 Software	International Council for Local Environmental Initiatives (ICLEI)	Estimates GHG emissions for communities based on wide range of local activity data	www.icleiusa.org/actioncenter/tools/cacp-software	Fort Collins, CO; Missoula, MT; San Diego, CA
CommunityViz	Placeways LLC	GIS tool to visualize and quantify various aspects of planning	http://placeways.com/communityviz/	Boston, MA;Victor, ID
Energy and Emissions Reduction Policy Analysis Tool (EERPAT)	The Federal Highway Administration (FHWA)	State-level screening tool for GHG reduction policies on transport	www.planning.dot.gov/FHWA_tool/	Florida
Envision Tomorrow	Fregonese Associates	GIS tool that tests financial feasibility of development regulations and their impact on indicators	www.frego.com/services/envision-tomorrow/	Various, including Mountlake Terrace, WA
GreenSTEP	Oregon Department of Transportation (ODOT)	Adds GHG emissions to statewide or metro travel models that account for BE	www.oregon.gov/ODOT/TD/TP/Pages/GreenSTEP.aspx	Oregon
Improved Data and Tools for Integrated Land Use-	UC Davis	Uses California-specific relationships of BE and travel for	http://ultrans.its.ucdavis.edu/projects/improved-data-and-	Various locations in California

Tool	Developer	Description	URL	Applications
Transportation Planning in California		scenario planning at multiple scales using various tools	toolsintegrated-land-usetransportation-planning-california	
INDEX/SPARC	Criterion Planners	Map-based tool for ranking scenarios based on various performance indicators	www.crit.com/the_tool.html	200+ organizations in 35 states, including PSRC
I-PLACE3S/PLACE3S	California Energy Commission and the Sacramento Area Council of Governments (SACOG)	Parcel-level GIS tool for estimating land use and transportation GHG emissions accounting for BE factors	www.sacog.org/services/scenario-planning/	Sacramento area, California
Local Sustainability Planning	Southern California Association of Govts (SCAG)	GIS tool to model land use scenarios on VO, VMT, mode share, and GHG emissions.	http://rtpscs.scag.ca.gov/Pages/Local-Sustainability-Planning-Tool.aspx	Various communities in Southern California
Low-carb Land	Sonoma Technology, Inc.	Web tool for examining VMT and GHG under various growth and land use scenarios	www.sonomatech.com/project.cfm?uprojectid=672	Thurston County, WA; Marin County, CA
UPlan	UC Davis Information Center for the Environment (ICE)	Rule-based urban growth model that assigns land uses to parcels based on location attractiveness and plan requirements, for use at county or regional scale	http://ice.ucdavis.edu/doc/uplan	Shasta county, CA; Delaware Valley Transportation Commission
Urban Footprint	Calthorpe Associates	GIS scenario creation and modeling tool with full co-benefits analysis capacity	www.calthorpe.com/scenario_modeling_tools	California, Honolulu
Urbemis	Rimpo and Associates, Inc.	Estimates GHG emissions for development projects accounting for some BE	www.urbemis.com	California

Various tools can be used to predict how specific land use development factors affect travel activity and associated pollution emissions.

Feasibility, Costs and Criticism

This section discusses Smart Growth feasibility and costs, and evaluates various criticisms.

Feasibility

Land use patterns evolve slowly, reflecting historical trends, accidents, forces and the fashions in place when an area developed. Land use planning policies and practices tend to preserve the status quo rather than facilitate change. Current policies tend to stifle diversity, encourage automobile-dependency and discouraged walkability.

But positive change is occurring. In recent years planning organizations have developed Smart Growth strategies and tools (ITE 2003; "Smart Growth," VTPI 2008). We know that it is possible to build more accessible and multi-modal communities, and that many families will choose them if they have suitable design features and amenities. The number of people who prefer such locations is likely to increase due to various demographic and economic trends, including population aging, higher fuel prices, and growing appreciation of urban living (Reconnecting America 2004). Demand for Smart Growth communities may also increase if consumers are better educated concerning the economic, social and health benefits they can gain from living in such communities.

Although it is unrealistic to expect most households to shift from a large-lot single-family home to a small urban apartment, incremental shifts toward more compact, accessible land use is quite feasible. For example, many households may consider shifting from large- to medium-lot or from medium- to small-lot homes, provided that they have desirable amenities such as good design, safety and efficient public services. Such shifts can have large cumulative effects, reducing total land requirements by half and doubling the portion of households in walkable neighborhoods, as summarized in Table 23.

Table 23 **Housing Mix Impacts On Land Consumption** (Litman 2004b)

	Large Lot (1 acre)	Medium Lot (1/2 acre)	City Lot (100' x 100')	Small Lot (50' x 100')	Multi-Family	Totals	Single Family
Homes Per Acre	*1*	*2*	*4.4*	*8.7*	*20*		
Sprawl							
Percent	30%	25%	25%	10%	10%	*100%*	90%
Number	300,000	250,000	250,000	150,000	100,000	*1,000,000*	
Total Land Use (acres)	300,000	125,000	57,392	11,494	5,000	***451,497***	
Standard							
Percent	20%	20%	20%	20%	20%	*100%*	80%
Number	200,000	200,000	200,000	200,000	200,000	*1,000,000*	
Total Land Use (acres)	200,000	100,000	45,914	22,989	10,000	***378,902***	
Smart Growth							
Percent	10%	10%	20%	35%	25%	*100%*	75%
Number	100,000	100,000	200,000	350,000	250,000	*1,000,000*	
Total Land Use (acres)	100,000	50,000	45,914	40,230	12,500	***248,644***	

Even modest shifts can significantly reduce land consumption. The Smart Growth option only requires 15% of households to shift from single- to multi-family homes, yet land requirements are reduced by half compared with sprawl.

Costs

Smart growth and related land use management strategies tend to increase some development costs but reduce others. In particular they tend to increase planning costs, unit costs for land and utility lines, and project costs for infill construction and higher design standards. However, this is offset by less land required per unit, reduced road and parking requirements, shorter utility lines, reduced maintenance and operating costs, more opportunities for integrated infrastructure and transport cost savings. As a result, smart growth often costs the same or less than sprawl, particularly over the long-term.

The main real resource of smart growth is the reduction in housing lot size. To the degree that smart growth is implemented using negative incentives (restrictions on urban expansion and higher land costs) people who really want a large yard may be worse off. However, many people choose large lots for prestige rather than function, and so would accept smaller yards or multi-family housing if they were more socially acceptable. If implemented using positive incentives (such as improved services, security and affordability in urban neighborhoods) users (the people who choose those locations) must be better off overall or they would not make that choice.

Criticisms

Critics raise a number of other objections to smart growth management strategies. These include (Litman 2004b and 2011).

- *Land Use Management Is Ineffective At Achieving Transportation Objectives.* Some experts argued that in modern, automobile-oriented cities it is infeasible to significantly change travel behavior (Gordon and Richardson 1997). However, as our understanding of land use effects on travel improves, the potential effectiveness of land use management for achieving transport planning objectives has increased and is now widely accepted (ITE 2003)
- *Consumers Prefer Sprawl and Automobile Dependency.* Critics claim that consumers prefer sprawl and automobile dependency. But there is considerable evidence that many consumers prefer smarter growth communities and alternative transport modes (Litman 2010).
- *Smart Growth Increases Regulation and Reduces Freedom*. Critics claim that smart growth significantly increases regulation and reduces freedoms. But many smart growth strategies reduce existing regulations and increase various freedoms, for example, by reducing parking requirements, allowing more flexible design, and increasing travel options.
- *Smart Growth Reduces Affordability*. Critics claim that smart growth increases housing costs, but ignore various ways it saves money by reducing unit land requirements, increasing housing options, reducing parking and infrastructure costs, and reducing transport costs.
- *Smart Growth Increases Congestion.* Critics claim that smart growth increases traffic congestion and therefore reduces transport system quality, based on simple models of the relationship between density and trip generation. However, smart growth reduces per capita vehicle trips, which, in turn reduces congestion. Empirical data indicates that smart growth communities have lower per capita congestion costs than sprawled communities.

Impact Summary

Table 24 summarizes the effects of land use factors on travel behavior. Actual impacts will vary depending on specific conditions and the combination of factors applied.

Table 24 **Land Use Impacts on Travel Summary**

Factor	Definition	Travel Impacts
Regional accessibility	Location of development relative to regional urban center.	Reduces per capita vehicle mileage. Central area residents typically drive 10-30% less than at the urban fringe
Density	People or jobs per unit of land area (acre or hectare).	Reduces vehicle ownership and travel, and increases use of alternative modes. A 10% increase typically reduces VMT 0.5-1% as an isolated factor, and 1-4% including associated factors (regional accessibility, mix, etc.).
Mix	Proximity between different land uses (housing, commercial, institutional)	Tends to reduce vehicle travel and increase use of alternative modes, particularly walking. Mixed-use areas typically have 5-15% less vehicle travel.
Centeredness (centricity)	Portion of jobs in commercial centers (e.g., central business districts and town centers)	Increases use of alternative modes. Typically 30-60% of commuters to major commercial centers use alternative modes compared with 5-15% at dispersed locations
Network Connectivity	Degree that walkways and roads are connected	Increased roadway connectivity can reduce vehicle travel and improved walkway connectivity increases non-motorized travel
Roadway design	Scale, design and management of streets	Multi-modal streets increase use of alternative modes. Traffic calming reduces VMT and increases non-motorized travel
Active transport (walking and cycling)	Quantity, quality and security of sidewalks, crosswalks, paths, and bike lanes.	Improved walking and cycling conditions tends to increase nonmotorized travel and reduce automobile travel. Residents of more walkable communities typically walk 2-4 times more and drive 5-15% less than in automobile-dependent areas.
Transit quality and accessibility	Quality of transit service and whether neighborhoods are considered transit-oriented development (TOD)	Increases ridership and reduces automobile trips. Residents of transit oriented developments tend to own 20-60% fewer vehicles, drive 20-40% fewer miles, and use alternative modes 2-10 times more than in automobile-oriented areas.
Parking supply and management	Number of parking spaces per building unit or acre, and how parking is managed and priced	Tends to reduce vehicle ownership and use, and increase use of alternative modes. Cost-recovery pricing (users finance parking facilities) typically reduces automobile trips 10-30%.
Site design	Whether oriented for auto or multi-modal accessibility	More multi-modal site design can reduce automobile trips, particularly if implemented with improvements to other modes.
Mobility management	Strategies that encourage more efficient travel activity	Tends to reduce vehicle ownership and use, and increase use of alternative modes. Impacts vary depending on specific factors.
Integrated smart growth programs	Travel impacts of integrated programs that include a variety of land use management strategies	Reduces vehicle ownership and use, and increases alternative mode use. Smart growth community residents typically own 10-30% fewer vehicles, drive 20-40% less, and use alternative mode 2-10 times more than in automobile-dependent locations, and larger reductions are possible if integrated with improved regional transit and more efficient transport pricing.

This table summarizes typical impacts of various land use factors on travel activity.

Care is needed when predicting the impacts of these land use factors. The magnitude of these travel impacts vary depending on specific conditions, user demographics, their degree of integration, and analysis perspective. Impacts may be large for affected travel (such as the trips generated at a particular site or district, or area commute trips), but this may represent a small portion of total travel, and some of the reduction may represent self-selection (people who drive less than average choose more accessible locations) so net regional trip reductions may be small.

Total impacts are multiplicative not additive, because each additional factor applies to a smaller base. For example, if one factor reduces demand 20% and a second factor reduces demand an additional 15%, their combined effect is calculated 80% x 85% = 68%, a 32-point reduction, rather than adding 20% + 15% = a 35-point reduction. This occurs because the 15% reduction applies to a base that is already reduced 20%. If a third factor reduces demand by another 10%, the total reduction provided by the three factors together is 38.8% (calculated as (100% - [80% x 85% x 90%]) = (100% - 61.2%) = 38.8%), not 45% (20% + 15% + 10%).

On the other hand, impacts are often synergistic (total impacts are greater than the sum of their individual impacts). For example, improved walkability, improved transit service, and increased parking pricing might only reduce vehicle travel by 5% if implemented alone, but if implemented together might reduce vehicle travel by 20-30%, because they are complementary.

Conclusions

This paper investigates the transport impacts of various land use factors, and evaluates land use management strategies (generally called *smart growth*, *new urbanism* or *compact development*) at achieving planning objectives, as summarized below.

Transport Impacts	Land Use Factors	Planning Objectives
Vehicle ownership Vehicle trips and travel (mileage) Walking Cycling Public transit travel Ridesharing Telecommuting Shorter trips	Regional accessibility Density Land use mix Centeredness Road and path connectivity Roadway design Active transport (walking and cycling) conditions Public transit service quality Parking supply and management Site design Mobility management Integrated smart growth programs	Congestion reductions Road and parking facilities Consumer savings and affordability Improved mobility for non-drivers Traffic safety Energy conservation Pollution emission reductions Improved public fitness and health Community livability objectives

This report considers various transport impacts, land use factors and planning objectives.

Although most land use factors have modest individual impacts, typically affecting just a few percent of total travel, they are cumulative and synergistic. Integrated smart growth programs that result in community design similar to what developed prior to 1950 can reduce vehicle ownership and travel 20-40%, and significantly increase walking, cycling and public transit, with even larger impacts if integrated with other policy changes such as increased investments in alternative modes and more efficient transport pricing.

Care is needed when evaluating the impacts of specific land use factors. Impacts vary depending on definitions, geographic and time scale of analysis, perspectives and specific conditions, such as area demographics. Most factors only apply to subset of total travel, such as local travel or commute travel. *Density* tends to receive the greatest attention, although alone its travel impacts are modest. Density is usually associated with other factors (regional accessibility, mix, transport system diversity, parking management) that together have large travel impacts. It is therefore important to make a distinction between the narrow definition of density as an isolated attribute, and the broader definition (often called *compact development*) that includes other associated attributes.

A key question is whether there is latent demand for alternative modes. Demographic and economic trends (aging population, rising fuel prices, increased health and environmental concerns, changing consumer location preferences, etc.) tend to increase demand for more accessible, multi-modal locations (Litman 2010). Real estate market studies indicate a growing shortage of such development (ULI 2009). This suggests that smart growth land use policies are likely to have greater impacts and benefits in the future.

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Exhibit W

Exhibit W




WESTERN RIVERSIDE COUNCIL OF GOVERNMENTS

SUBREGIONAL CLIMATE ACTION PLAN

FINAL DRAFT
MAY 2014

Western Riverside County CLIMATE ACTION PLAN

WRCOG WESTERN RIVERSIDE COUNCIL OF GOVERNMENTS

A Letter to the Subregion

It is a pleasure to present the Western Riverside Council of Governments (WRCOG) Subregional Climate Action Plan, the result of over three years of collaborative efforts among community leaders, industry experts, renowned scientists and consultants, and local governments. This plan describes the effects climate change could have on our subregion and suggests ways we can work together to address these challenges and reduce our collective carbon footprint while concurrently growing the economy and improving community livability and public health.

In 2012, WRCOG made a commitment to achieve a sustainable quality of life by adopting a Sustainability Framework, which is a blueprint that serves as a beginning point to establish, implement, and continuously refine a subregional sustainability plan for jurisdictions within WRCOG. This Framework presents a practical, integrated approach to sustainability which consists of six core components: Economic Development, Education, Health, Transportation, Water and Wastewater, and Energy and the Environment. WRCOG continues to demonstrate leadership in implementing programs that are environmentally, economically, and socially beneficial to the subregion including innovative award winning programs such as the HERO Program - an energy efficiency and water conservation financing program, the Transportation Uniform Mitigation Fee (TUMF), the Western Riverside Energy Leader Partnership (WRELP), and the Western Riverside County Clean Cities Coalition.

We believe our efforts demonstrate that implementing sustainable practices creates green jobs and a better economy, and makes our subregion a cleaner, safer, more enjoyable place to live. As you will notice in this report, some of the steps we need to take – such as investing in transportation infrastructure – require the involvement of the state and federal government. But many other important – and simple – steps can be achieved at the local level, such as driving less and walking more, using energy-efficient light bulbs, or turning down the thermostat a few degrees in the winter.

This Climate Action Plan provides a roadmap – a set of ideas – to help expand on our successes to slow the effects of climate change. It's no secret that this will require an enormous amount of hard work and cooperation. It will require the commitment of not only government, but of communities, individuals and businesses in our subregion. Our goal is to make WRCOG a vibrant example of how a subregion can collaborate to achieve climate protection goals and, as a result, enhance quality of life for all its residents and businesses. We are confident that if we can embrace this common challenge with creativity and commitment, WRCOG and its member jurisdictions will continue to lead the effort toward a sustainable future.

Sincerely,

Rick Bishop
Executive Director

Acknowledgements

The preparation of the Subregional Climate Action Plan was funded by a Sustainable Communities Planning Grant through California's Strategic Growth Council. The Strategic Growth Council, created in September 2008 by Senate Bill 732, is a cabinet level committee that is tasked with coordinating the activities of member state agencies to improve air and water quality, improve natural resource protection, meet the goals of the California Global Warming Solution Act of 2006, encourage sustainable land use planning, and revitalize urban and community centers in a sustainable manner. The Sustainable Communities Planning Grant Program is funded by The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Proposition 84).

We would like to especially thank the WRCOG Planning Directors' Technical Advisory Committee for their leadership and passion for the project and the communities of Western Riverside County.

WRCOG Planning Directors' Technical Advisory Committee

Clara Miramontes, Chair, City of Perris
Deanna Elliano, Vice-Chair, City of Hemet

Western Riverside Council of Governments

Ruthanne Taylor Berger, Deputy Executive Director
Barbara Spoonhour, Director of Energy and Environmental Programs
Alexa Washburn, Program Manager
Jennifer Ward, Staff Analyst

Consultant Team

PMC: Jeff Henderson
Atkins: Cheryl Laskowski, PhD
AECOM: Joshua Lathan
Fehr & Peers: Chris Gray
ICLEI USA: Brian Holland and J.R. Killigrew

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Acronyms

AB – Assembly Bill

AR4 – Fourth Assessment Report

AFV – Alternative Fuel Vehicle

ARRA – American Recovery and Reinvestment Act

BAU – Business-as-Usual

BEU – Banning Electric Utility

BTA – Bicycle Transportation Account

CALGreen – California Green Building Standards Code

CAP – Climate Action Plan

CAPCOA – California Air Pollution Control Officers Association

CARB – California Air Resources Board

CAT – Climate Action Team

CEC – California Energy Commission

CEESP – California Long-Term Energy Efficiency Strategic Plan

CEQA – California Environmental Quality Act

CESA – California Endangered Species Act.

CH_4 – Methane

CIP – Capital Improvement Plan

CO_2 – Carbon Dioxide

CO_2e – Carbon Dioxide Equivalents

EAP – Energy Action Plan

EGPR – Environmental Goals and Policy Report

EIR – Environmental Impact Report

ESA – U.S. Endangered Species Act

EO – Executive Order

FHA – Federal Housing Administration

GHG – Greenhouse Gas

GWP – Global Warming Potential

HFCs – Hydroflourocarbons

IPCC – International Panel on Climate Change

LGO – Local Government Operations

MPO – Metropolitan Planning Organization

MSCHP – Multiple Species Habitat Conservation Plan

MT – Metric Ton

N_2O – Nitrous Oxide

OPR – Office of Planning and Research

PACE – Property Assessed Clean Energy

PD TAC – Planning Directors' Technical Advisory Committee

PFCs – Perfluorocarbons

RCA – Regional Conservation Authority

RCHC – Riverside County Health Coalition

RCTC – Riverside County Transportation Commission

RPU – Riverside Public Utilities

RTA – Riverside Transit Agency

RTP – Regional Transportation Plan

SAFETEA-LU – Safe, Accountable, Flexible, Efficient, Transportation Equity Act: A Legacy for Users

SAR – Second Assessment Report

SB – Senate Bill

SCAG – Southern California Association of Governments

SCE – Southern California Edison

SCG – Southern California Gas Company

SCS – Sustainable Communities Strategy

SGC – Strategic Growth Council

SF_6 – Sulfur Hexafluoride

TAR – Third Assessment Report

TUMF – Transportation Uniform Mitigation Fee

TEA-21 – Transportation Equity Act for the 21st Century

VMT – Vehicle Miles Traveled

WRCOG – Western Riverside Council of Governments

WRELP – Western Riverside Energy Leader Partnership

Executive Summary

Climate change is occurring and needs to be addressed to successfully prepare for a sustainable future in which residents are healthy, businesses thrive, and communities prosper. The Western Riverside Council of Governments (WRCOG) tactic to mitigating climate change is to take a unified, collaborative approach and develop this Subregional Climate Action Plan (CAP). The objectives are to create more livable, equitable, and economically vibrant communities. By using energy more efficiently, harnessing renewable energy to power our buildings, enhancing access to sustainable transportation modes, recycling our waste, conserving water, and building local food systems, we can keep dollars in our local economy, create new green jobs, and improve public health and community quality of life. By integrating these elements, the WRCOG Subregional CAP will:

- **Create Local Jobs:** The technologies, products and services required for the shift to a low-carbon future can be provided by employers in our communities. Dollars currently spent on fossil fuels will no longer leave our economy. They will stay here to pay for home insulation; lighting retrofits; solar panels; bicycles; and engineering, design, and construction of more sustainable communities. WRCOG's adopted Sustainability Framework prioritizes sustainability as a key economic engine of the subregion, and our HERO financing program is a prime example of our success. HERO has created more than 1,000 jobs since its inception in 2011.

- **Promote Healthier Communities:** Walkable and bikeable neighborhoods, fresh foods, and clean air provide healthier, more active lifestyle options for our residents. Healthy communities are areas where public health and climate action policy priorities intersect, creating new active transportation and living options, enhancing access to nutritious foods, and improving our quality of life and environment.

- **Become More Energy Self-Sufficient:** Actions in this CAP will help reduce our reliance on fossil fuels. As energy prices continue to increase and supplies become more uncertain, reduced reliance on volatile oil supplies will diminish risks faced by everyone.

- **Enhance Social Equity:** Disparities among residents can be reduced by ensuring that communities most vulnerable to climate change effects are given priority for green jobs, healthy local food, energy-efficient homes and affordable, efficient transportation. We can also improve equity by ensuring that these communities are enabled to implement the CAP in a meaningful and engaging way.

- **Reduce Emissions, Improve Air Quality, and Protect Natural Systems:** Reducing GHG emissions from major sources helps protect and improve the air we breathe and the environment in which we live. Sustaining the values and functions of our habitat is an essential strategy that can simultaneously reduce emissions, sequester carbon and strengthen our ability to adapt to a changing climate. Healthy watersheds and ecosystems are an integral part of a sustainable Western Riverside County.

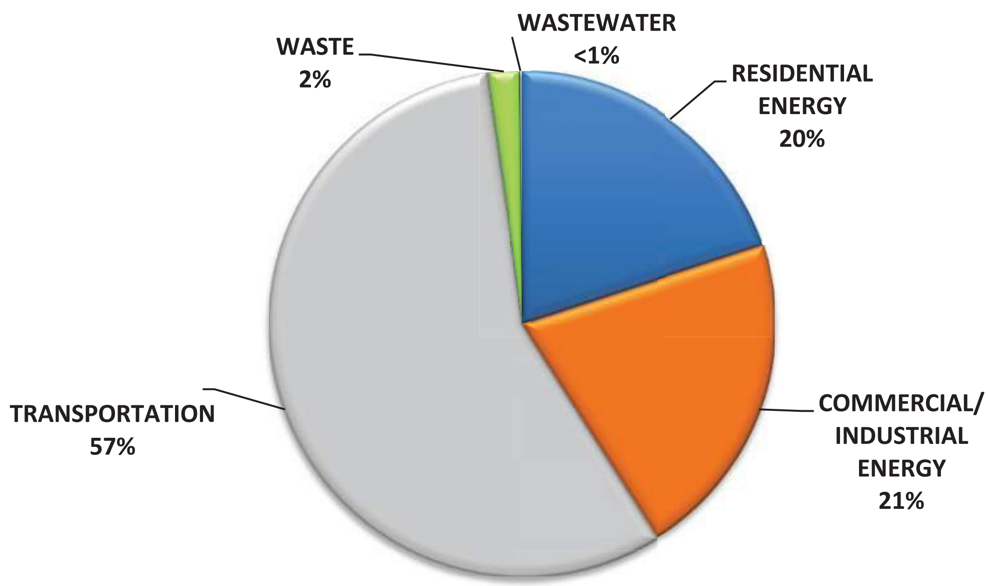
- **Save Money:** Using less energy in our homes, buildings and vehicles means lower energy and transportation bills for residents, business and government. Residents and local governments can also realize health-care cost savings inherent to a healthier, more active community.

Twelve cities in our subregion have joined efforts to develop this Subregional CAP, which sets forth a subregional emissions reduction target, emissions reduction measures, and action steps to assist each community to demonstrate consistency with California's Global Warming Solutions Act of 2006 (Assembly Bill [AB] 32).

MEASURING OUR EMISSIONS

To ensure that the subregion stays on course to meet its greenhouse gas (GHG) reduction target, it is necessary to track our progress by conducting regular, community-wide GHG emissions inventories. It helps to think of an inventory as a "snapshot" of our subregion's GHG emissions for a given year. An inventory identifies the major sources and quantity of GHG emissions produced by residents, businesses, and public institutions. In 2010, Subregional CAP cities emitted approximately 5,834,400 metric tons of GHG emissions. Figure ES-1 below illustrates these emissions by source.

Figure ES-1: Baseline Greenhouse Gas Emissions by Source

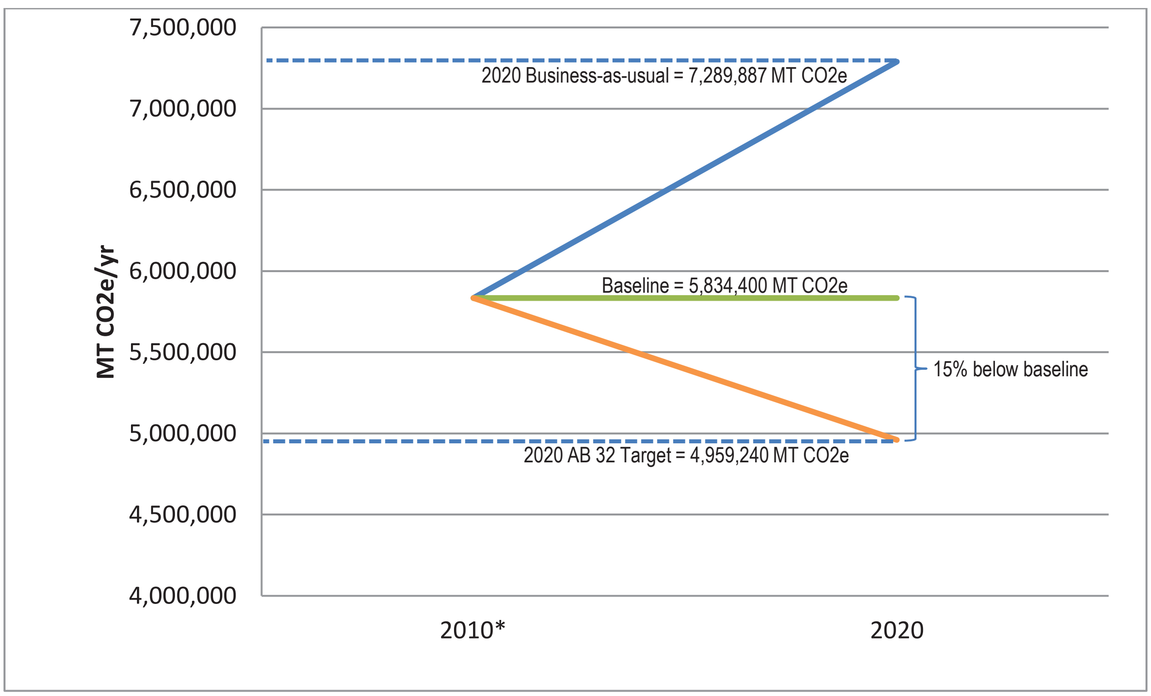


The inventory reflects the emissions that result from motor vehicles driven, electricity and natural gas consumed, waste generated, water consumed, and wastewater treated within participating jurisdictions' limits. It provides a useful tool to track community and local government emissions over time, and to target climate protection strategies to address the main emissions sources.

REDUCING OUR EMISSIONS

WRCOG's subregional emissions reduction targets are 15% below 2010 levels by 2020, and 49% below 2010 levels by 2035. This plan focuses on feasible actions Western Riverside County communities can and should take between now and 2020, as well as innovative approaches currently beyond our current reach that will be needed to achieve the 2035 target. Based on forecasted emissions levels, a 15% reduction from 2010 levels equates to a GHG emissions reduction of nearly 2,330,647 metric tons below business-as-usual (BAU) conditions by 2020, as shown in Figure ES-2. This CAP identifies objectives and actions in four categories to set the subregion on a path to meet our 2020 GHG emission target.

Figure ES-2: WRCOG Subregion–Community GHG Business as Usual Forecasts and Reduction Target for 2020



*2010 is used as baseline year for all jurisdictions except for the cities of Eastvale and Jurupa Valley, as noted in Chapter 2.

TAKING ACTION

This CAP includes feasible strategies that will help the WRCOG subregion advance toward GHG emissions reduction goals, while affording our communities other economic and environmental benefits. The Plan builds upon existing successes and encompasses a range of strategies from expanding the successful HERO program, to increasing residential and business recycling, to reducing vehicle miles traveled, and increasing energy efficiency. It offers cost-effective strategies that will support our local economy; reduce risks for energy and fuel price increases and volatility; and offer a wide range of other environmental, social, and economic benefits. Actions that reduce GHG emissions also support other local community goals and contribute to sustaining the WRCOG subregion as a vibrant community.

The CAP contains GHG reduction measures organized into four primary sectors, as follows:

ENERGY

- Energy measures will increase community-wide building and equipment efficiency and renewable energy use, and promote energy efficiency and renewable energy generation use supporting municipal operations in our communities.

TRANSPORTATION AND LAND USE

- Transportation and land use measures will reduce single-occupancy vehicle travel, increase non-motorized travel, improve public transit access, increase motor vehicle efficiency, and promote sustainable growth patterns.

SOLID WASTE

- Solid waste measures will reduce community and municipal solid waste sent to landfills.

WATER

- Water measures will increase community water conservation and reduce water consumed to support municipal operations in our communities.

If fully implemented, the CAP will exceed our 2020 goal by 2.6%, achieving an overall 17.6% reduction in GHG emissions by 2020. Annual progress reports will allow the Plan to evolve along with local budget priorities, carbon markets, and technology.

REALIZING OUR GOALS

While measuring GHG emissions, establishing reduction targets, and developing a CAP are essential steps, the most important work lies ahead: **Implementation.**

Turning this plan into action rests on more than just good ideas and intentions. It requires residents, businesses, municipal governments, and other institutions in our communities to rise to the challenge of change. Infrastructure, technology, workforce development, and our daily decisions must reflect these goals.

The CAP recommends strategies to support individuals' and businesses' efforts to consume less energy, move more efficiently, and produce less waste. Implementing the plan will, for example, increase access to public transit and make it safer to commute by foot or bicycle, provide incentives to make homes and businesses more energy efficient, and increase the convenience of recycling and composting waste.

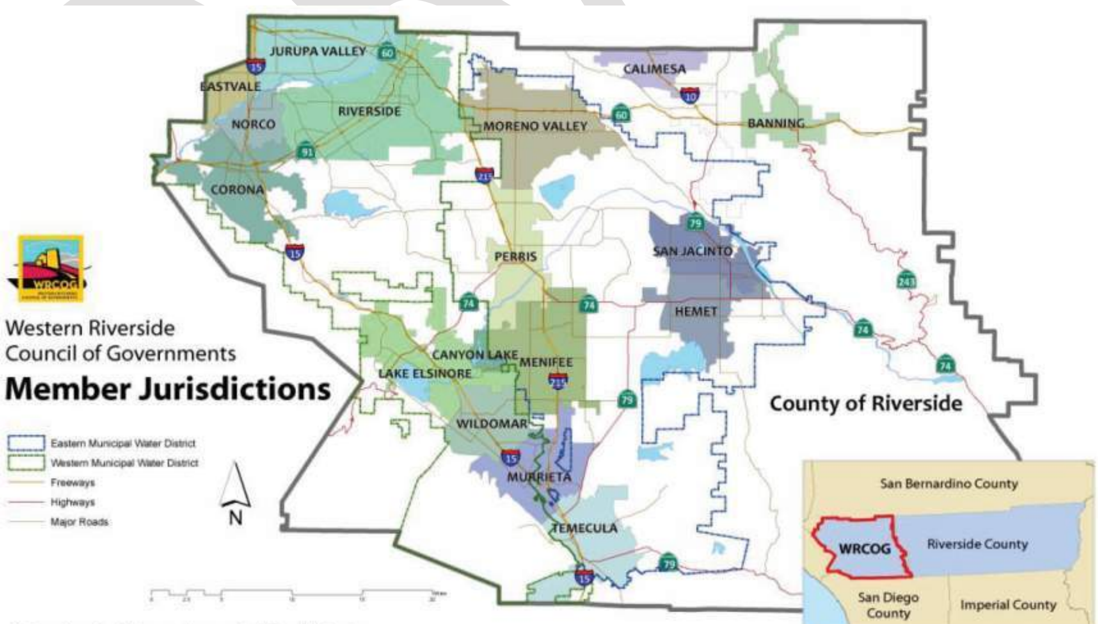
WRCOG is committed to leading the region toward a more sustainable future by realizing the goals set forth in this plan. How can ***you*** contribute?

Chapter 1 Introduction

PURPOSE

The Western Riverside Council of Governments (WRCOG) has a strong legacy of collaboration among its member agencies (see **Figure 1-1**) and innovation in implementing programs that are environmentally, economically, and socially beneficial to the subregion. WRCOG has been a leader in promoting sustainability through its adopted Sustainability Framework, Western Riverside Energy Leader Partnership (WRELP), HERO Program - an energy efficiency and water conservation financing program, and Western Riverside County Clean Cities Coalition. This Climate Action Plan (CAP) is another innovative subregional planning effort, led by WRCOG, to reduce **greenhouse gas (GHG) emissions**.

Figure 1-1: WRCOG Subregion



Notes: Areas in white are unincorporated Riverside County.
Eastern Municipal Water District and Western Municipal Water District are also members of WRCOG. The Riverside County Superintendent of Schools and the Morongo Band of Mission Indians are ex-oficio members.

Western Riverside County is establishing itself as a leader in energy efficiency and sustainability efforts and each of WRCOG's member jurisdictions are addressing climate change through different local programs. Twelve cities in Western Riverside County have joined efforts to develop this Subregional CAP, which sets forth a subregional emissions reduction target, emissions reduction measures, and action steps to assist each community to demonstrate consistency with California's Global Warming Solutions Act of 2006 (Assembly Bill [AB] 32). Several jurisdictions in the WRCOG subregion have already adopted a local CAP, or are in the process of doing so. **Table 1-1** below illustrates which jurisdictions are participating in this Subregional CAP effort, and also lists additional sustainability programs that jurisdictions participate in relevant to the subregional CAP. The WRELP Program is a collaboration between WRCOG Southern California Edison (SCE), and the Southern California Gas Company (SCG), which includes the development of Energy Action Plans for 11 communities. Several jurisdictions are participating in separate partnership efforts with SCE, also targeting energy efficiency. Four of WRCOG's member jurisdictions have municipally-owned utilities, which provide energy and/or water and wastewater services to their communities and pursue individual efficiency and sustainability efforts.

Table 1-1: WRCOG Member Participation in Sustainability Programs

	Participating in Subregional CAP	Locally Adopted, or In-Progress CAP	Participating in WRELP Energy Action Plan	Participating in other SCE Partnership	Municipally-Owned Utility
Banning	✓				✓
Calimesa	✓		✓		
Canyon Lake	✓		✓		
Corona		✓		✓	✓
Eastvale	✓				
Hemet	✓		✓		
Jurupa Valley	✓				
Lake Elsinore		✓	✓		
Menifee		✓	✓		
Moreno Valley		✓		✓	✓
Murrieta		✓	✓		
Norco	✓		✓		
Perris	✓		✓		
Riverside	✓				✓
San Jacinto	✓		✓		
Temecula	✓		✓		
Wildomar	✓		✓		
County of Riverside		✓			

AB 32 directs California to reduce statewide GHG emissions to 1990 levels by 2020. To achieve these reductions, the California Air Resources Board (CARB) recommends that local governments target their 2020 emissions at 15% below "current"[1] levels, consistent with the statewide commitment, to account for emissions growth that has occurred since 1990. Several initiatives at the state level will help the subregion reduce GHG emissions, but they alone will not be sufficient to meet the 2020 target. This CAP provides a roadmap for individual communities in the subregion to reduce GHG emissions through local actions.

The release of GHGs into the atmosphere is the direct and indirect result of everyday activities as residents and businesses use energy in their homes and offices, travel to work, generate waste, and use water. Local governments also emit GHGs as they perform essential services and operate buildings, vehicles, street lights, traffic signals, water systems, and wastewater plants. Strategies in this CAP to reduce such emissions include increasing energy efficiency in buildings and facilities, utilizing renewable energy sources, increasing vehicle fuel efficiency, supporting alternative modes of transportation, reducing waste generation, and reducing water consumption. In addition to addressing climate change, reducing GHG emissions often provides co-benefits such as reducing energy and transportation costs for residents, businesses, and local governments; creating green jobs and supporting advancement of green technologies and industries; improving air quality and the overall health of residents; and making the community a more attractive place to live and locate a business.

The WRCOG Subregional CAP is the result of an analysis of existing GHG reduction programs and policies that have already been implemented in the subregion and of applicable best practices from other regions to assist in meeting the 2020 subregional reduction target. The resulting GHG reduction measures were chosen by the subregion based on their GHG-reduction potential, cost-benefit characteristics, funding availability, and feasibility of implementation. The level of implementation of each measure was determined by each community; however, this CAP presents the results collectively, demonstrating the collaborative effort and partnership that will facilitate implementation.

This CAP is organized into four chapters:

- **Chapter 1, Introduction:** provides the framework for the CAP, places the CAP in the context of current climate change science and policy, describes existing regional and local sustainability efforts and accomplishments, and discusses the CAP's relationship to the California Environmental Quality Act (CEQA).
- **Chapter 2, Emissions Inventory, Projections, and Goals:** describes the emissions inventory process and results, forecasted business-as-usual emissions for the subregion, and the adopted subregional emissions reduction target.
- **Chapter 3, Reduction Measures and Actions:** contains the anticipated State and federal emissions reductions, and the local reduction measures and actions that will be implemented to meet the subregional reduction target.
- **Chapter 4, Implementation and Monitoring:** provides best practices and specific resources for implementing reduction measures, the role for measure-specific evaluations, periodic updates to the inventories, use of indicators to monitor the subregion's progress, and the need for future iterations of the CAP to incorporate new data and reduction measures as they become available.

[1] "Current" is a term used by CARB in its Climate Change Scoping Plan of September 2008, but is undefined. It is generally taken to mean emissions for a year between 2005 and 2008, although other years have been used by local communities.

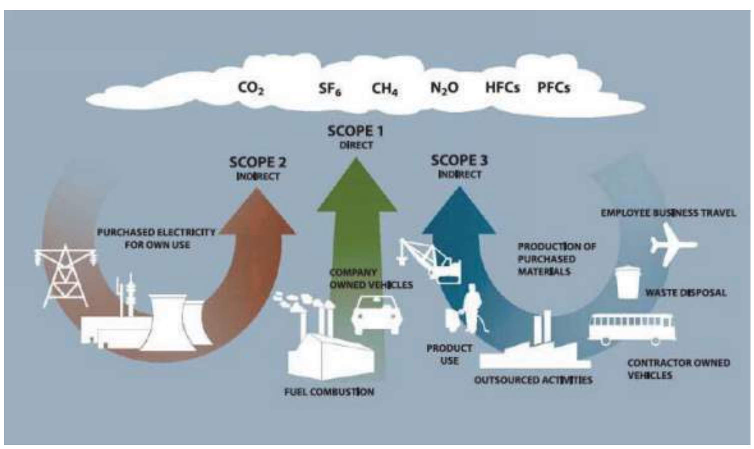
GREENHOUSE GAS EMISSIONS IMPACTS

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping infrared radiation (heat). This phenomenon is known as the greenhouse effect and without it, the Earth would be about -2°F. Overwhelming evidence shows that human activities are increasing the concentration of GHGs in the atmosphere, trapping more heat, and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation, and other purposes, which introduces large amounts of carbon dioxide and other GHGs into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise, a phenomenon known as global climate change.

The most important GHGs to reduce are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), which constitute over 98% of human-released GHGs in the U.S.[2] Other important GHGs include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). These gases are emitted through a variety of natural processes and human activities (see **Figure 1-2**), including:

- Fossil fuel combustion (CO_2, N_2O, and CH_4);
- Agricultural operations, such as fertilization of crops (N_2O), livestock production, and rice cultivation (CH_4);
- Anaerobic composting and landfill off-gassing (CH_4);
- Refrigeration and cooling (HFCs); and
- Industrial manufacturing, including aluminum production (PFCs), semi-conductor manufacturing (SF_6), and cement production (CO_2).

Figure 1-2: Greenhouse Gases Regulated Under AB 32



Global Warming Potential (GWP) is a quantitative measurement that expresses the relative warming potency of each GHG over a specific period of time. CO_2 is assigned a GWP value of 1 and the other GHGs are assigned GWPs relative to CO_2. For GHG emission inventories, the amount of each gas emitted is multiplied by its GWP and presented in units of carbon dioxide equivalents (CO_2e). **Table 1-2** lists the six primary GHGs as defined in AB 32, their chemical formula, the lifetime of the compound, and their

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[2] U.S. Environmental Protection Agency, 2011, http://www.epa.gov/climatechange/ghgemissions/gases.html

GWPs relative to CO_2. Although CO_2 has a lower GWP than other GHGs, it is the largest contributor to human-caused global warming, constituting about 84% of U.S. emissions.[3]

Table 1-2: Greenhouse Gases Regulated Under AB 32

Greenhouse Gas	Chemical Formula	Lifetime (years)	Global Warming Potential for 100-year horizon
Carbon Dioxide	CO_2	Variable	1
Methane	CH_4	12	21
Nitrous Oxide	N_2O	114	310
Sulfur Hexafluoride	SF_6	3,200	23,900
Hydrofluorocarbons	HFCs	1.4 – 270	140 – 11,700
Perfluorocarbons	PFCs	1,000 – 50,000	6,500 – 9,200

Source: International Panel on Climate Change (IPCC) Second Assessment Report: Climate Change 1995 (SAR). Available at: http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml

Note: According to the Local Government Operations Protocol (LGO Protocol) and the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (Community Protocol), the GWP values in **Table 1-2** were applied in this CAP. Since the SAR was published in 1995, the IPCC has published updated GWP values in its Third Assessment Report (TAR) and Fourth Assessment Report (AR4) that reflect new information on atmospheric lifetimes of GHGs and an improved calculation of the radiative forcing of CO_2. However, GWP values from the SAR are still used by international convention to maintain consistency in GHG reporting. For GWP values that were not quantified in the SAR, GWP values from the TAR were used.

While the anticipated effects of climate change are likely to vary regionally, it is anticipated to have the following global effects[4]:

- Higher maximum temperatures and more hot days over most land areas;
- Higher minimum temperatures, fewer cold days, and frost days over most land areas;
- Reduced diurnal temperature range over most land areas;
- Increased heat index over land areas; and
- More intense precipitation events.

Many secondary effects are anticipated to result from climate change in California, including: loss in snow pack; sea level rise and inundation of coastal areas; increased flooding of low-lying areas; more extreme heat days per year; high ozone days; increased incidence of large forest fires; and more frequent and severe drought years.

[3] Ibid.
[4] IPCC Fourth Assessment Report: Climate Change 2007 (AR4). Available at: http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm

REGULATORY CONTEXT

Many strategies for monitoring and addressing climate change have emerged at the international, national, and state levels. California remains a leader in the effort to reduce GHG emissions through mitigation and adaptation strategies. With AB 32, California is the first state in the U.S. to mandate GHG emissions reductions across its entire economy. To support AB 32, California has been developing policy and passing legislation that seeks to control emissions of gases that contribute to climate change. These have included regulatory approaches such as mandatory reporting for significant sources of GHG emissions and caps on emission levels, as well as market-based mechanisms, such as cap-and-trade. Voluntary local actions are also increasing, such as conducting emissions inventories, implementing practices to reduce emissions, and purchasing offsets and renewable energy certificates. While many local actions are currently voluntary, there is more emphasis being placed on monitoring and reporting emissions to demonstrate the effectiveness of policies and local consistency with state reduction goals. The following section highlights the primary state legislation and guidance related to this CAP.

STATE LEGISLATION AND GUIDANCE

AB 32, also known as the Global Warming Solutions Act of 2006, directs public agencies in California to support the statewide goal of reducing GHG emissions to 1990 levels by 2020. Preparing a CAP supports AB 32 at the local level. The CAP provides a policy framework for how the subregion can do its part to reduce emissions. While compliance with AB 32 is not a requirement for local jurisdictions, demonstrating consistency with statewide reduction goals can significantly assist WRCOG jurisdictions to qualify for incentives such as grant funding. Efforts to address climate change, reduce consumption of resources, and improve energy efficiency led by state legislation or programs are briefly described below and identified in **Figure 1-3**.

Executive Order S-3-05

On June 1, 2005, Governor Arnold Schwarzenegger signed Executive Order (EO) S-3-05, which established the following GHG emission reduction targets:

- by 2010, California shall reduce GHG emissions to 2000 levels;
- by 2020, California shall reduce GHG emissions to 1990 levels; and
- by 2050, California shall reduce GHG emissions to 80 percent below 1990 levels.

EO-S-3-05 created the California Climate Action Team (CAT), which is tasked with the preparation of biennial science assessment reports on climate changes and adaptation options for California. The first CAT Report to the Governor and Legislature was published in 2006, and contains recommendations and strategies to help meet the targets in EO-S-3-05. These were expanded upon in the 2009 CAT Biennial Report to the Governor and Legislature. The new information includes revised climate and sea-level projections, and an evaluation of climate change within the context of broader social changes, such as land-use changes and demographic shifts[5]. The action items in the report focus on the preparation of the Climate Change Adaptation Strategy, required by EO-S-13-08.

[5] California EPA - Climate Action Team Report to Governor Schwarzenegger and the Legislature, March 2006. Available at: http://www.climatechange.ca.gov/climate_action_team/reports/index.html

Assembly Bill 32 – California Global Warming Solutions Act of 2006

AB 32 was approved by the legislature and signed by Governor Schwarzenegger in 2006. The landmark legislation requires CARB to develop mechanisms that will reduce GHG emissions to 1990 levels by 2020. Mandatory actions under the legislation to be completed by CARB include:

- Identification of early action items that can be quickly implemented to achieve GHG reductions. These early action items were adopted by CARB in 2007 and include regulations affecting landfill operations, motor vehicle fuels, car refrigerants, and port operations, among other regulations.
- Development of a scoping plan[6] to identify the most technologically feasible and cost-effective measures to achieve the necessary emissions reductions to reach 1990 levels by 2020. The Scoping Plan identifies a variety of GHG reduction measures that include direct regulations, alternative compliance mechanisms, incentives, voluntary actions, and market-based cap-and-trade program. The Plan identifies local governments as strategic partners to achieving the state goal and translates the reduction goal to a 15% reduction of current emissions by 2020.
- Creation and adoption of regulations to require the state's largest industrial emitters of GHGs to report and verify their emissions on an annual basis.

Senate Bill 97 – California Environmental Quality Act Guideline Amendments of 2007

Senate Bill (SB) 97 was adopted in 2007 and directed the Governor's Office of Planning and Research (OPR) to amend the CEQA Guidelines to address GHG emissions. The CEQA Guidelines prepared by OPR were adopted in December 2009 and went into effect March 18, 2010. Local governments may use adopted plans consistent with the CEQA Guidelines to assess the cumulative impacts of projects on climate change, if the plan for the reduction of GHG emissions accomplishes the following:

- Quantify GHG emissions, both existing and projected over a specified time period, resulting from activities within a defined geographic area.
- Establish a level, based on substantial evidence, below which the contribution to GHG emissions from activities covered by the plan would not be cumulatively considerable.
- Identify and analyze the GHG emissions resulting from specific actions or categories of actions anticipated within the geographic area.
- Specify measures or a group of measures, including performance standards, that substantial evidence demonstrates, if implemented on a project-by-project basis, would collectively achieve the specified emissions level.
- Establish a mechanism to monitor the plan's progress toward achieving the level and to require an amendment if the plan is not achieving specified levels.
- Be adopted in a public process following environmental review.

SB 375 – Sustainable Communities and Climate Protection Act of 2008

SB 375, also known as the Sustainable Communities and Climate Protection Act of 2008, builds off of AB 32 and aims to reduce GHG emissions by linking transportation funding to land use planning. It requires the state's metropolitan planning organizations (MPO) to create a sustainable communities strategy (SCS) in their regional transportation plans (RTP) for the purpose

e of reducing urban sprawl. Under SB 375, CARB established regional targets for GHG emissions reductions from passenger vehicle use for each MPO. The regional reduction targets for the Southern California Association of Governments (SCAG) region, which is the MPO with jurisdiction over the

[6] CARB 2008 Scoping Plan. Available at http://arb.ca.gov/cc/scopingplan/scopingplan.htm

WRCOG subregion, are 8% per capita by 2020, and a conditional target of 13% per capita by 2035 from 2005 levels. In April 2012, SCAG adopted its first SCS, which demonstrates how the region will achieve the GHG emissions reduction targets set by CARB.

Figure 1-3 categorizes the applicable state regulations that provide a policy framework for addressing climate change. A more detailed description of these regulations is included in the jurisdictional Greenhouse Gas Inventory Reports (Appendix X).

Figure 1-3: Regulatory Framework for Climate Change

Climate Change	Land Use & Transportation	Energy & Renewables	Water Efficiency & Conservation	Waste & Recycling
EO-S-3-05 (2005)	*AB 1493 (2002)*	*Title 24 (2013 Update)*	*AB 1881 (2006)*	*AB 939 (1989)*
AB 32 (2006)	*EO-S-1-07 (2007)*	*SB 1078 (2002)*	*AB 1420 (2007)*	*SB 1016 (2008)*
SB 97 (2007)	*SB 375 (2008)*	*SB 1368 (2006)*	*SB X7-7 (2009)*	*AB 939 (2011)*
		AB 811 (2008)	*SB 407 (2009)*	

REGIONAL PROGRAMS

The regional initiatives described below contribute to the development and success of this CAP. Many of these programs are administered by WRCOG and several are conducted by other regional entities in partnership with WRCOG.

Southern California Association of Governments Regional Transportation Plan and Sustainable Communities Strategy

SCAG is the regional planning agency for Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura counties, and serves as a forum for regional issues relating to transportation, the economy, community development, and the environment. SCAG serves as the federally designated MPO for the Southern California region and is the largest MPO in the U.S. With respect to air quality planning, SCAG has prepared the 2012–2035 Regional Transportation Plan/Sustainable Communities Strategy (2012 RTP/SCS): Towards a Sustainable Future, to fulfill federal planning requirements contained in the Safe, Accountable, Flexible, Efficient, Transportation Equity Act: A Legacy for Users (SAFETEA-LU), which calls for regions to consider urban form and natural resources as part of the transportation planning process. Under SB 375, all of California's MPOs must prepare an SCS as a component of their RTP. The RTP serves as a long-range transportation plan that is developed and updated by SCAG every four years. The RTP provides a vision for the development of transportation facilities throughout the region based on growth forecasts and economic trends that project over a 20-year period. The SCS expands upon transportation strategies in the RTP to analyze growth patterns and establish future land use strategies that aid the region in meeting its GHG reduction targets. The SCS does not mandate future land use policies for local jurisdictions, but rather provides a foundation of regional policy upon which local governments can build. WRCOG and its member jurisdictions partner with SCAG and are active members in the development and implementation of the RTP/SCS.

HERO Program

Established under the guidance of AB 811 (2008) and AB 474 (2009), WRCOG's HERO Program is a Property Assessed Clean Energy (PACE) program that provides financing to residential and commercial property owners for the installation of energy efficient, renewable energy, and water conservation improvements on existing properties. Financing provided through the HERO Program is repaid through an assessment on property tax bills over 5-, 10-, 15-, 20-, and 25-year terms, based on the useful life of the products, and upon sale of the property, the balance generally stays with the property.

Sustainability Framework for Western Riverside County

WRCOG's Sustainability Framework (Framework) is a subregional planning effort that establishes, implements, and continuously refines an overarching sustainability plan for the communities in Western Riverside County. The Framework aims to: initiate a dialogue about the importance of sustainability in the region; provide a vision and goals to guide local action and regional collaboration; define more immediate short-term goals that can contribute to the longer-term vision of the Framework; and define indicators, benchmarks, and targets that provide a measure of the effectiveness of Framework programs and policies. The Framework acts as a "living" document and contains goals and actions applying to economic development, education, public health, transportation, water and wastewater, energy, and the environment.

Western Riverside County Clean Cities Coalition

The Western Riverside County Clean Cities Coalition (Coalition) is a voluntary local government and industry partnership that aims to reduce the consumption of petroleum fuels and improve air quality in the WRCOG subregion. The Coalition works to mobilize local stakeholders toward expanding the use of alternative fuel vehicles (AFV) and advanced technology vehicles, promoting local idle reduction measures, and strengthening local AFV fueling infrastructure. The governments of Western Riverside County have taken leadership roles in the Coalition, coordinating efforts between government and industry to recognize the value of partnership in achieving air quality, energy efficiency, economic development, and transportation goals, while advancing the clean air and energy efficiency goals of the national Clean Cities program administered by the U.S. Department of Energy.

Healthy Communities

WRCOG and its member jurisdictions are engaged in numerous efforts and initiatives to promote healthy communities, including participating in the Riverside County Health Coalition (RCHC). The RCHC is a collaboration of public and private sectors, school districts, community businesses, local and regional organizations and community members committed to policy development and advocacy, environmental change and community empowerment for healthy lifestyles in Riverside County. This initiative includes a focused partnership effort with local governments to integrate healthy communities into the local planning and policy-making process.

Multiple Species Habitat Conservation Plan

The Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP) is a comprehensive, multi-jurisdictional plan to conserve sensitive species and their associated habitats in the subregion. Created in 2004 by the Western Riverside County Regional Conservation Authority (RCA), the MSHCP provides subregional transportation and green infrastructure benefits to local agencies and allows WRCOG jurisdictions to make land use decisions and maintain a strong economy in a context that comprehensively addresses federal and state Endangered Species Acts (ESA and CESA) requirements.

Transportation Uniform Mitigation Fee

WRCOG's Transportation Uniform Mitigation Fee (TUMF) was implemented in 2003 as one of the largest multi-jurisdictional fee programs in the nation. TUMF makes improvements to the regional transportation system and provides transportation demand management through funds from new development, ensuring that development mitigates for increases in traffic volumes. TUMF is a 32-year program that provides subregional transportation and infrastructure benefits to local agencies in Western Riverside County. The program is expected to raise $4.2 billion, and 1.64% is allocated to the Riverside Transit Agency (RTA) for transit improvements. To mitigate the impacts of transportation construction projects, WRCOG allocates 1.59% of TUMF funds collected to the RCA to purchase habitat for the MSCHP.

EXISTING LOCAL SUSTAINABILITY ACCOMPLISHMENTS

Several jurisdictions within the WRCOG subregion have already adopted, or are in the process of adopting, GHG emissions reduction policies or entire CAPs independent of the Subregional CAP process. Existing policies and programs were identified that reduce GHGs through energy conservation, renewable energy development, solid waste reduction, commute reduction, and the expansion of the urban forest. Several energy programs are available throughout the subregion, which are managed by WRCOG, SCE, Southern California Gas Company (SCG), Riverside Public Utilities (RPU), Banning Electric Utility (BEU), and the County of Riverside. These programs include financing for building energy retrofits and renewable energy projects, energy efficiency retrofit rebates, smart metering and smart grid technologies, and various energy efficiency education and outreach campaigns.

Some jurisdictions have building code requirements to implement and expand upon the California Green Building Standards Code (CALGreen), or policies to streamline energy efficiency and renewable energy permitting. Many are improving the efficiency of public realm lighting, including street lights, traffic lights, parking lot lighting and outdoor commercial lighting, and their water and wastewater conveyance and treatment facilities.

Policies to reduce solid waste include waste collection billing policies through municipalities or their contracted waste haulers, food scrap and compostable paper diversion outreach, lumber scrap diversion ordinances and outreach, yard waste collection, recycling outreach campaigns and voluntary waste audits, landfill methane capture, and food waste biodigestion programs in Norco and Riverside.

Policies that reduce GHG emissions from potable water conveyance focus on reducing water demand through consumer behavior pricing, water conservation education, and landscape irrigation efficiency. Some jurisdictions have adopted ordinances requiring the installation of certain water conservation measures at properties before selling or renovating properties. While many jurisdictions are seeking to expand recycled water deliveries, fewer promote rainwater collection or graywater system use at this time.

Existing transportation policies focus on enhancing pedestrian and bicycle amenities and facilities alongside the expansion and improvement of transit systems, but also include various transportation demand management programs to reduce single-occupancy vehicle miles traveled (VMT) during commute hours. Several jurisdictions have policies supporting the expansion of the urban forest, and some have mandatory shade tree planting requirements that also reduce building energy. Finally, many jurisdictions are actively expanding mixed-use developments and transit-oriented developments to encourage people to drive less, and enrich the character and economic vitality of their communities.

WESTERN RIVERSIDE ENERGY LEADER PARTNERSHIP

The WRELP Program builds upon the existing policies and programs in the region to analyze energy-sector emissions and propose energy conservation and renewable energy measures that reduce GHG emissions within Energy Action Plans (EAPs) for 11 WRCOG jurisdictions served by SCE. The WRELP partners include Calimesa, Canyon Lake, Hemet, Lake Elsinore, Menifee, Murrieta, Norco, Perris, Temecula, San Jacinto, and Wildomar (see **Table 1-1**). The WRELP effort uses funding provided by SCE to implement within the region the California Long-Term Energy Efficiency Strategic Plan (CEESP), developed by the California Energy Commission (CEC) as a collaborative effort in response to California's need for a long-term strategic energy efficiency plan. Following CEESP Goal 4, individual EAPs were developed for each participating jurisdiction, creating a comprehensive program to address energy efficiency, sustainability, and climate change through the years 2020 and 2035. The EAPs informed the development of the energy efficiency measures in this CAP.

RELATIONSHIP TO THE CALIFORNIA ENVIRONMENTAL QUALITY ACT

In 2007, state lawmakers identified the need to analyze GHG emissions in the CEQA process through the adoption of SB 97. The bill required OPR to develop, for adoption by the Natural Resources Agency, amendments to the CEQA Guidelines that clarified several points about the analysis and mitigation of GHG emissions. Aside from establishing the need for lead agencies to analyze and mitigate for a project's potentially significant impacts relating to GHG emissions, the amendments also provided that a lead agency may streamline the analysis of GHG emissions for projects that follow a programmatic GHG emissions reduction plan, or climate action plan, meeting certain criteria. The amendments to the CEQA Guidelines became effective on March 18, 2010. OPR is currently developing a Technical Advisory that will further describe, among other climate action planning topics, how plans for reducing GHGs can be used in CEQA analyses.

Chapter 2
Emissions Inventory

A jurisdiction's greenhouse gas (GHG) inventory serves multiple purposes. It quantifies the GHG emissions resulting from activities taking place throughout the community by residents, businesses, and local governments, and creates an emissions baseline against which the jurisdiction can set emissions reduction targets and measure future progress. It also provides an understanding of where GHG emissions originate and allows a jurisdiction to develop effective policies, strategies, and programs to reduce emissions.

As part of the Subregional Climate Action Plan (CAP) process for Western Riverside County, baseline inventories were prepared for each participating jurisdiction to quantify GHG emissions resulting from the community and government operations (Appendix X). Community-wide inventories encompass the GHG emissions resulting from activities taking place within each jurisdiction's boundaries, where the local government has jurisdictional authority, in addition to some activities taking place outside the boundaries that support activities in the jurisdiction (for example, solid waste sent to landfill areas outside the boundaries). The baseline inventories include emissions from the following sectors: residential energy, commercial/industrial energy, transportation, waste, and wastewater.

2010 is the inventory base year for 10 of the 12 participating jurisdictions within the WRCOG subregion (the cities of Banning, Calimesa, Canyon Lake, Hemet, Norco, Perris, Riverside, San Jacinto, Temecula, and Wildomar). For the cities of Eastvale and Jurupa Valley, which incorporated in October 2010 and July 2011, respectively, the most recent available data were used. The baseline inventory summary presented in this chapter describes the cumulative GHG emissions generated by the jurisdictions participating in the WRCOG Subregional CAP effort, as determined from individual jurisdictional inventories.

BASELINE EMISSIONS INVENTORY

INVENTORY PROCESS

The emissions inventory for each participating jurisdiction was developed using guidance from two standards for emissions accounting and reporting: the Local Government Operations Protocol (LGO Protocol) and the U.S. Community Protocol for Accounting and Reporting of GHG Emissions (Community

Protocol). The LGO Protocol was developed through a partnership between CARB, The Climate Registry, and ICLEI USA. The Community Protocol was released by ICLEI USA in October 2012 and represents the first comprehensive U.S. standard for community-wide inventories.

The emissions inventory is intended to represent emissions sources in each jurisdiction with greatest influence on community-wide activities and government operations. As communities provide different services to their residents and businesses, the scale of the services and resulting emissions are highly dependent upon the size and purview of the local government. For these reasons, comparisons among community or local government inventories should not be made without also describing the municipal services provided by each jurisdiction or presenting community-level indicators such as population or socioeconomic factors.

Furthermore, the inventory estimates current emissions using the best available data and methods at the time the inventory was completed. As data collection and estimation methodologies evolve, future inventories may incorporate emission sources that were not captured previously, or may use newer approaches to estimating emissions.

INVENTORY CATEGORIES

In the community inventory, baseline emissions are categorized into sectors based on their source(s), as follows:

- Residential Energy: Residences consume electricity and natural gas for daily operations and heating/cooling.
- Commercial/Industrial Energy: Commercial and industrial buildings consume electricity and natural gas for daily operations and heating/cooling. This sector includes all non-residential building energy use, including municipal government buildings, industrial buildings, and commercial buildings.
- Transportation: On-road passenger and freight vehicle use results in combustion of gasoline and diesel fuels.
- Waste: Disposal of solid waste in landfills causes anaerobic decomposition, which results in GHG emissions (CH_4).
- Wastewater: Emissions in this sector are associated with the treatment of community industrial, residential, and commercial wastewater.

The LGO inventory is a subset of the community inventory, and represents what the municipality owns or operates and has operational control over, such as government buildings, vehicles, and other municipally-owned equipment and services. While the overall community inventory is important to focus GHG reduction efforts, the LGO inventory provides a closer look at what changes a local jurisdiction can make to improve efficiency and reduce emissions.

INVENTORY RESULTS

The baseline GHG inventory for the 12 WRCOG subregion jurisdictions participating in the CAP totals 5,834,400 metric tons (MT) of carbon dioxide equivalents (CO_2e). **Figure 2-1** and **Table 2-1** provide a breakdown of these emissions by sector. Emissions from the transportation sector accounted for 3,317,387 MT CO_2e, or 57% of the total emissions in the subregion, followed by the commercial/industrial energy sector, which generated 1,226,479 MT CO2e, or 21% of the total. The residential energy sector produced 1,167,843 MT CO2e, or 20% of the total.

Figure 2-1: WRCOG Subregion – Baseline Community Emissions by Sector

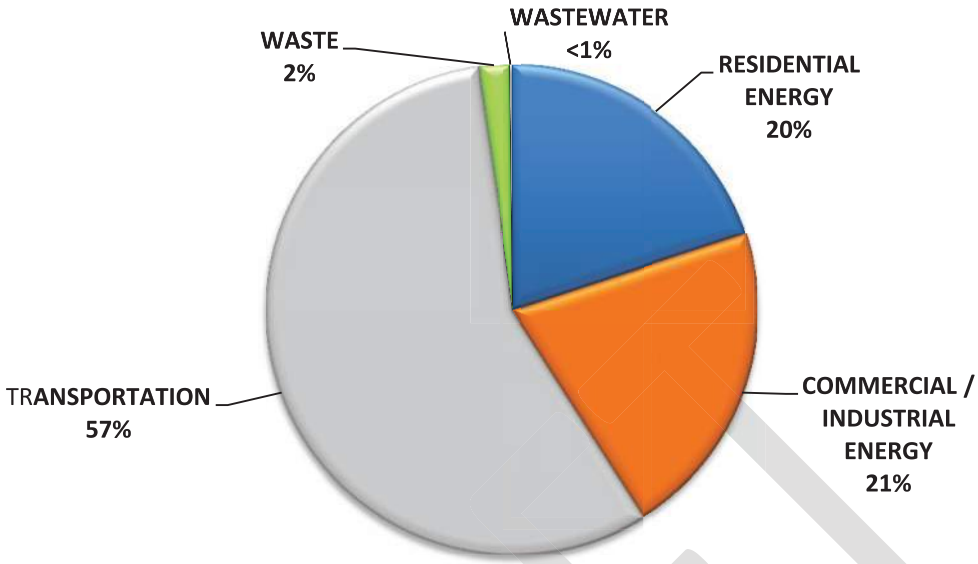


Table 2-1: WRCOG Subregion – Baseline Community Emissions by Sector (MT CO_2e)

Sector	Total Emissions (MT CO_2e)	% of Total
Transportation	3,317,387	56.9%
Commercial/Industrial Energy	1,226,479	21.0%
Residential Energy	1,167,843	20.0%
Waste	112,161	1.9%
Wastewater	10,531	0.2%
TOTAL INVENTORY	**5,834,400**	**100%**

Note: Totals may not add up due to rounding.

The baseline total GHG inventory for each participating jurisdiction is shown in **Figure 2-2** below, sorted by greatest to smallest total emissions. **Figure 2-3** shows baseline community emissions by service population for each jurisdiction. Service population is the number of residents and jobs in each community, and can be useful for measuring progress per-unit reduction of GHGs and comparing emissions between jurisdictions. Per capita emissions ranged from 3.6 MT CO_2e emissions per service population in Eastvale to 7.2 MT CO_2e in Calimesa.

Figure 2-2: Baseline Total Community Emissions by Jurisdiction (MT CO_2e)

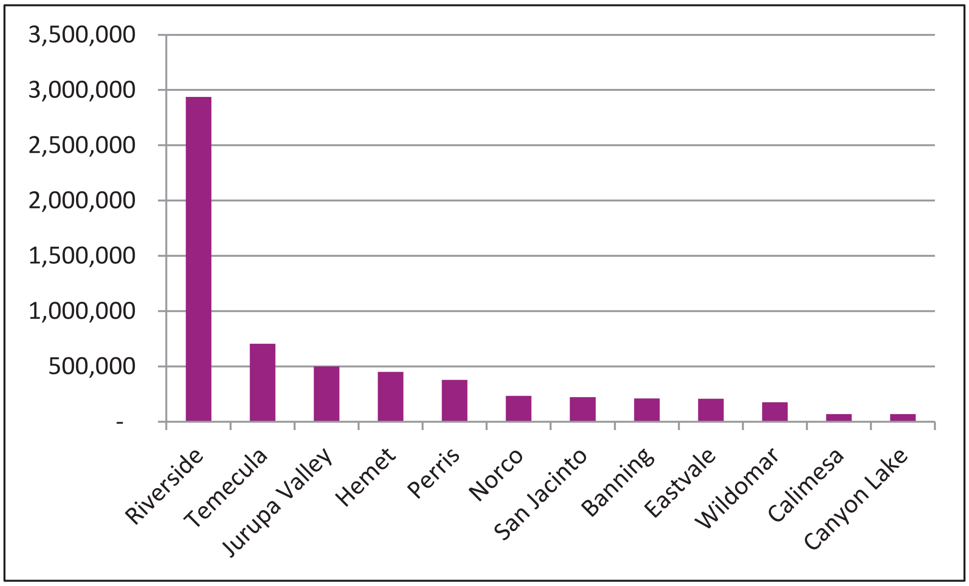
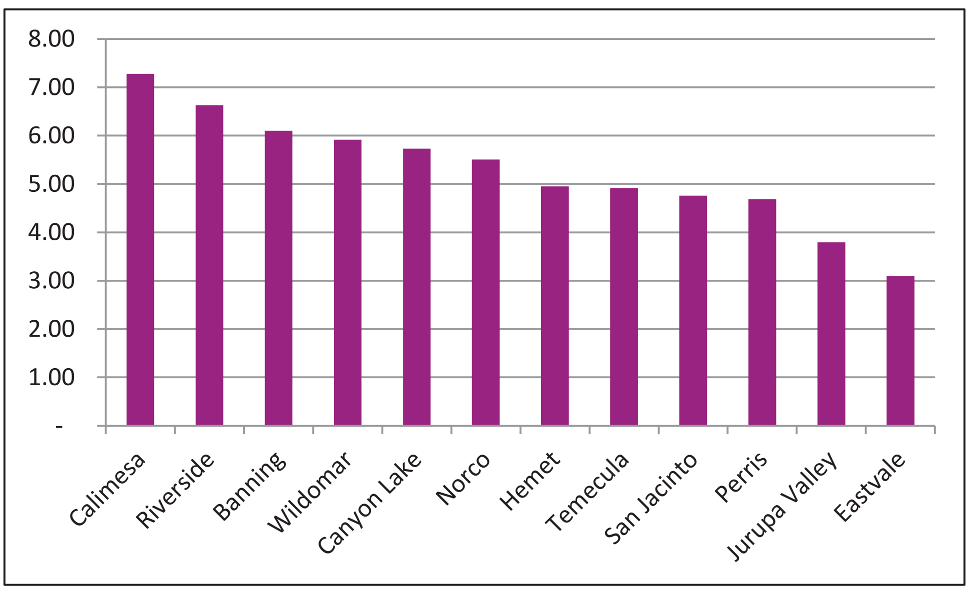
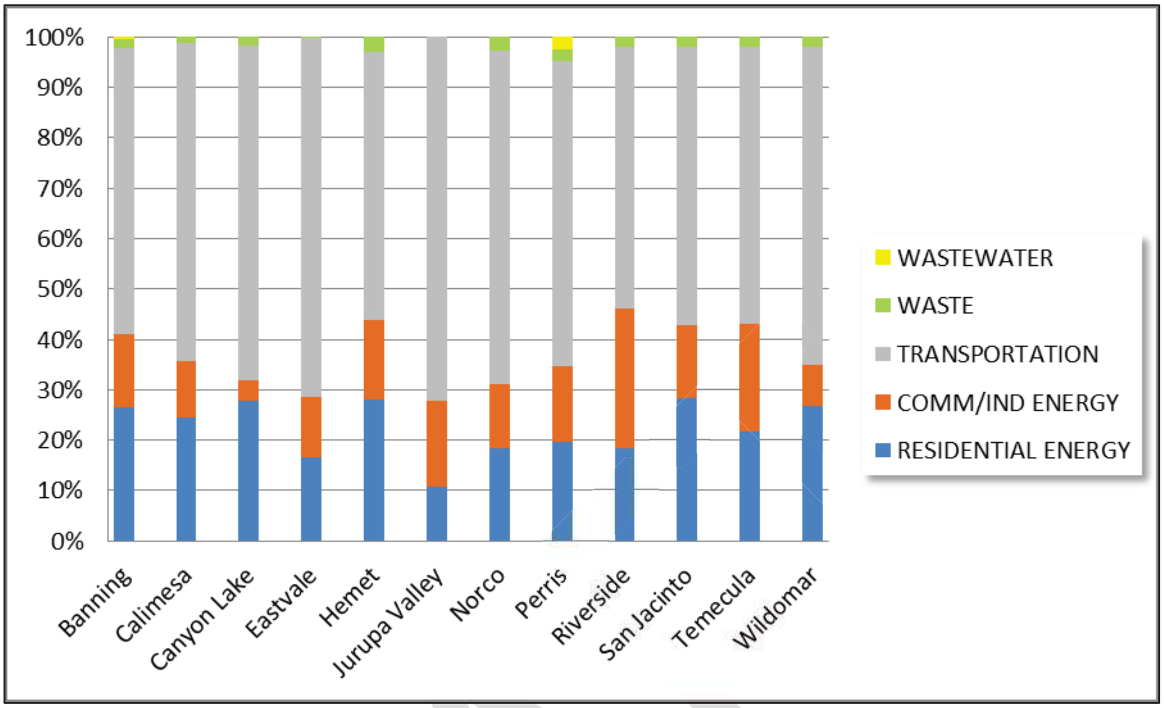


Figure 2-3: Baseline Community Emissions per Service Population by Jurisdiction (MT CO_2e/SP)



The baseline GHG Inventory by sector for each participating region is shown in **Figure 2-4** below. The transportation sector is the largest emissions source in each jurisdiction, followed by residential energy, commercial/industrial energy, and waste for most jurisdictions. For the communities of Jurupa Valley and Riverside, commercial/industrial energy takes up a larger share of emissions than residential energy, due to a more developed commercial and industrial building infrastructure. Perris is the only jurisdiction for which wastewater emissions are included, because they are the only community containing a wastewater treatment plant within its boundaries for which emissions data could be calculated, and they make up a larger share of the Perris inventory than waste-related emissions.

Figure 2-4: Baseline Community Emissions by Jurisdiction by Sector



EMISSIONS FORECASTS

The emissions forecasts establish projections for future-year 2020 and 2035 emissions under "business-as-usual" (BAU) conditions. If the WRCOG subregion were to continue historic patterns of vehicular travel, energy consumption, and waste/wastewater generation and disposal, the resulting emissions would be considered business-as-usual. BAU emissions are GHG emissions that would take place in the absence of state, regional, and local strategies designed to reduce emissions over time.

Future BAU emissions projections have been developed using regionally-adopted estimates for population and employment growth within each city under BAU conditions. Reduction goals were established for 2020 and 2035 using guidance from the California Air Resources Board (CARB).

Annual community emissions in participating WRCOG subregion jurisdictions are projected to increase over time. In 2020, subregional emissions are expected to be approximately 7,289,887 MT CO_2e, which represents an approximate 25% increase from baseline conditions. In 2035, subregional emissions are projected to increase to about 9,113,087 MT CO_2e, which represents an increase of approximately 56% from baseline conditions.

Table 2-2 presents community GHG emissions BAU forecasts by sector for 2020 and 2035. Transportation is expected to contribute the largest share of emissions through 2035. **Figure 2-5** illustrates 2020 BAU community emissions by sector. The percentage contributions from each sector in 2035 are expected to be similar to those in 2020. **Figure 2-6** shows community emissions BAU forecasts by jurisdiction for 2020 and 2035.

Table 2-2: WRCOG Subregion – Projected Business-As-Usual Community Emissions by Sector (MT CO_2e)

Sector	2020 Emissions (MT CO_2e)	% of Total	2035 Emissions (MT CO_2e)	% of Total
Transportation	4,057,626	55.7%	5,399,600	59.3%
Commercial/Industrial Energy	1,655,925	22.7%	1,953,137	21.4%
Residential Energy	1,368,126	18.8%	1,729,452	19.0%
Waste	138,326	1.9%	169,107	1.9%
Wastewater	13,740	0.2%	18,797	0.2%
TOTAL INVENTORY	**7,289,887**	**100%**	**9,113,087**	**100%**

Note: Totals may not add up due to rounding.

Figure 2-5: WRCOG Subregion – 2020 Community Emissions Business as Usual Forecast by Sector

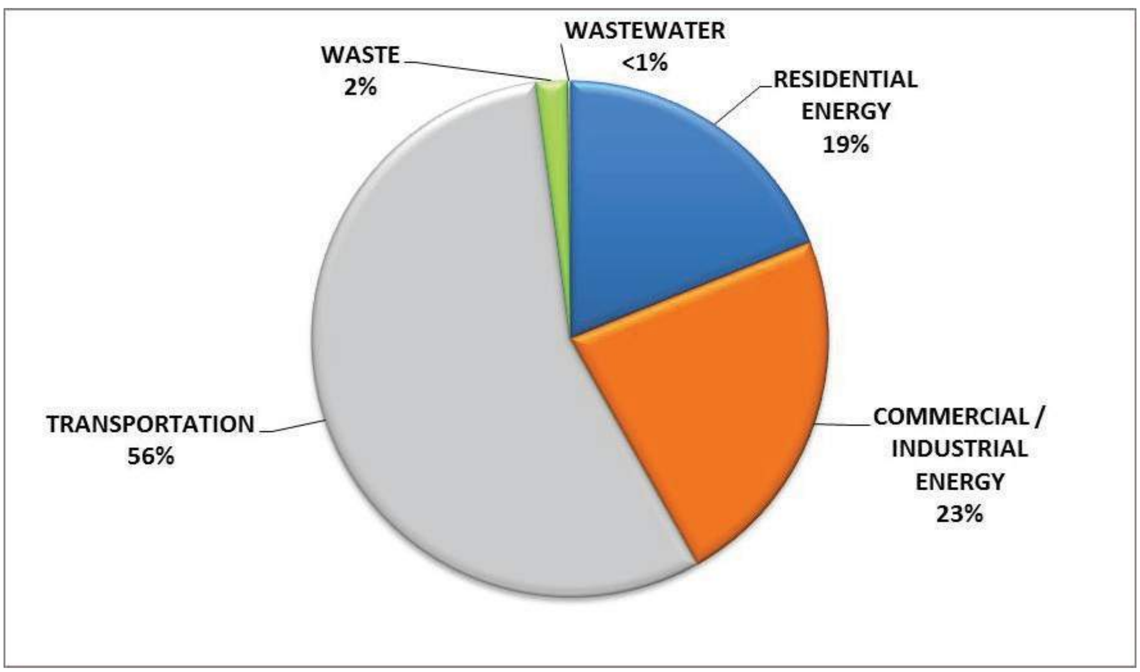
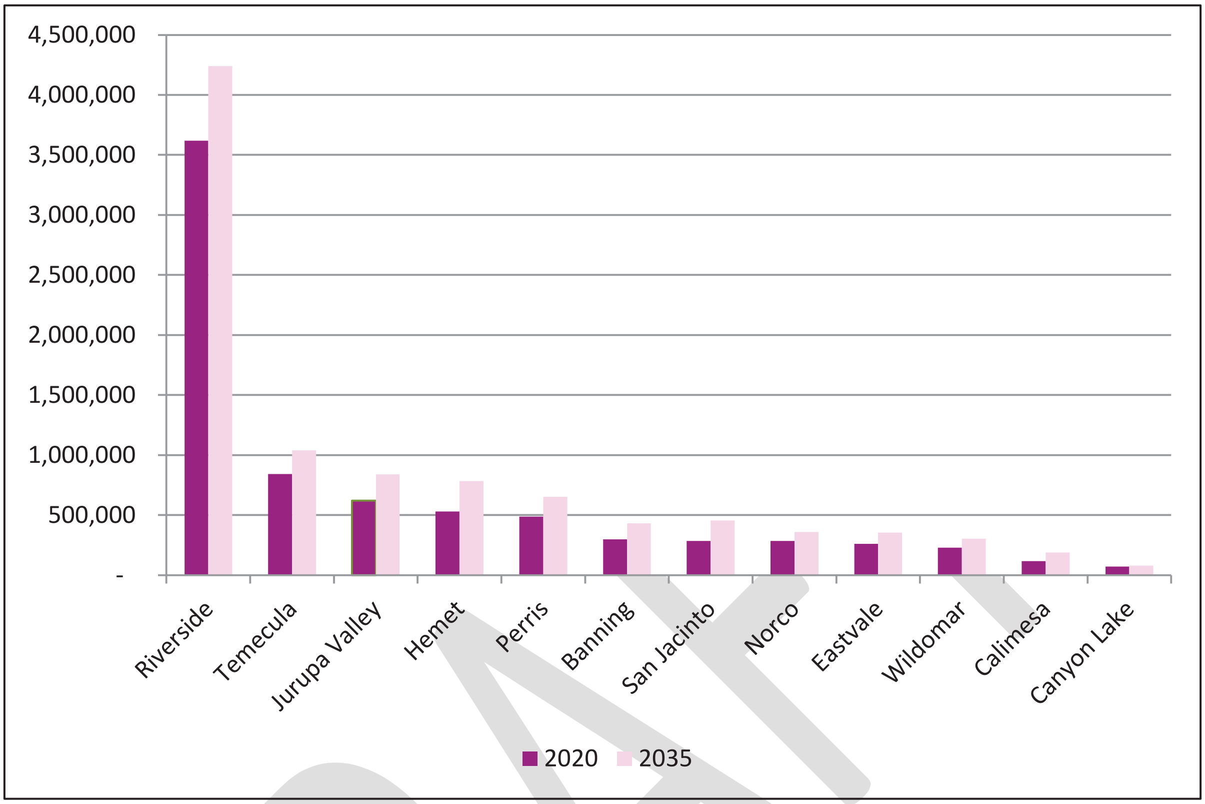


Figure 2-6: 2020 and 2035 Community Emissions Business as Usual Forecast by Jurisdiction ($MT\ CO_2e$)



EMISSIONS REDUCTION TARGET

The WRCOG Subregional CAP establishes a community-wide emissions reduction target of 15% below 2010, following guidance from CARB and the Governor's Office of Planning and Research. CARB and the California Attorney General have determined this approach to be consistent with the state-wide AB 32 goal of reducing emissions to 1990 levels.[1] The Subregional CAP does not establish a reduction target for 2035 or future years; however the CAP identifies a reduction goal of 49% below baseline emissions levels to set the WRCOG subregion on a trajectory to meet targets identified in SB 375 and Executive Order (EO) S-3-05, recognizing that information, methodologies, and data availability may change between now and 2035.

As further described in Chapter 4, progress toward achieving the 2020 emissions reduction target will be monitored over time through preparation of an annual memorandum documenting program implementation and performance. Following each annual report, WRCOG and the participating jurisdictions may adjust or otherwise modify the strategies to achieve the reductions needed to reach the target. Such adjustments could include more prescriptive measures, reallocation of funding to more

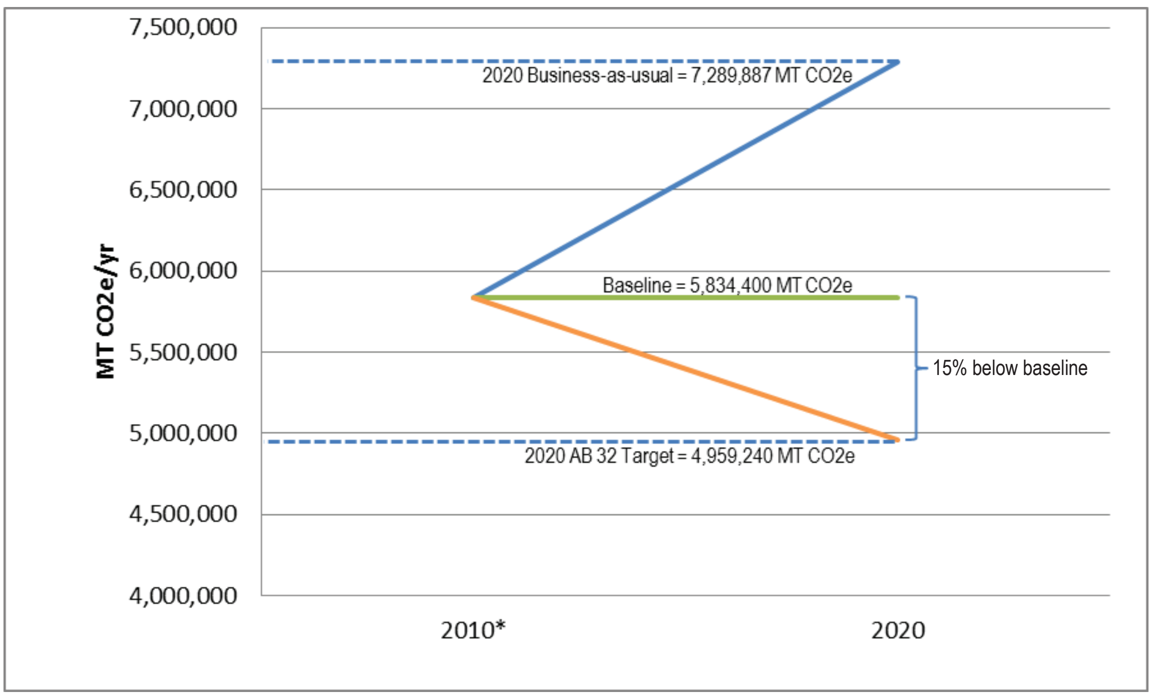
[1] In its Climate Change Scoping Plan of September 2008, CARB recommends that local governments adopt a GHG reduction target consistent with the State's commitment to reach 1990 levels by 2020. This is identified as equivalent to either 15% below 2005 levels by 2020 or a 28% reduction below BAU forecasts by 2020.

successful programs, and modifications to the 2020 BAU emissions projection and reduction target based on revised population, housing, and employment growth estimates. Additionally, there will be a comprehensive inventory update prior to 2020 to track overall progress toward meeting the GHG reduction target.

COMMUNITY EMISSIONS TARGET

The Subregional CAP target for community emissions in 2020 is 4,959,240 MT CO_2e equivalent to a 15% reduction from 2010 baseline emissions of 5,834,400 MT CO_2e. This is a net a reduction of 2,330,647 MT CO_2e from the 2020 BAU emissions forecast of 7,289,887 MT CO_2e. The community-wide emissions reduction target is shown in **Figure 2-7**. As outlined in the next chapter, CAP strategies are expected to reduce community-wide emissions by 2,480,559 MT CO_2e by 2020, exceeding the target by approximately 2.6% (for a total 17.6% reduction).

Figure 2-7: WRCOG Subregion–Community GHG Business as Usual Forecasts and Reduction Target for 2020



*2010 is used as baseline year for all jurisdictions except for the cities of Eastvale and Jurupa Valley, as noted previously.

Chapter 3
Reduction Measures

The emissions projections described in Chapter 2 illustrate the need for the subregion to implement strategies to reduce greenhouse gas (GHG) emissions by 2020 and beyond. Western Riverside County jurisdictions have a long history of working collectively through WRCOG toward common objectives, and have successfully demonstrated commitment to reduce energy and water consumption, solid waste, and vehicle miles traveled (VMT) through existing programs like the HERO Program, the Western Riverside County Clean Cities Coalition, and the Transportation Unified Mitigation Fee (TUMF).

This chapter discusses how participating jurisdictions are uniting to meet shared GHG emissions reduction goals. The approach offers flexibility to jurisdictions to participate at a level that is feasible and practical for each community.

PROCESS AND OVERVIEW

The process of developing this Subregional Climate Action Plan (CAP) included ongoing coordination and information sharing among participating jurisdictions. The WRCOG Planning Directors' Technical Advisory Committee (PD TAC) served as the primary technical working group. The PD TAC met regularly over the course of three years to discuss the CAP and provide feedback. Perspectives from jurisdictions participating in this CAP and those in the subregion who had already prepared a CAP were shared. In addition, WRCOG staff met individually with each participating jurisdiction to review emissions inventories, discuss potential emissions reduction measures and participation levels, and review the Draft CAP. Regular presentations were made to the WRCOG Public Works Committee, Technical Advisory Committee, and Executive Committee to keep jurisdictional staff, management officials, and elected leaders informed.

The following stakeholder agencies and organizations served as advisors throughout the process:

- American Lung Association
- Building Industry Association – Riverside County Chapter
- California Apartment Association – Apartment Association of the Greater Inland Empire
- California Air Resources Board

- Caltrans, District 8
- The Governor's Office of Planning & Research
- Riverside County Department of Public Health
- Riverside County Transportation Commission
- Riverside Transit Agency
- Safe Routes to School – Southern California Regional Network
- Southern California Edison
- South Coast Air Quality Management District
- Southern California Association Governments
- Southern California Gas Company
- TransForm

Why a "subregional" Climate Action Plan?

Developing a subregional CAP encourages input and coordination among participating jurisdictions. A subregional CAP uses consistent methodologies and allows jurisdictions to collaboratively implement regionally-effective measures. This creates economies of scale and may lead to lower administrative costs and greater publicity of incentives. It also demonstrates that WRCOG member jurisdictions can continue to work effectively towards common goals.

REDUCTIONS ACHIEVED

To meet emissions reduction targets, the CAP considers existing programs and policies in the subregion that achieve GHG emissions reductions in addition to new GHG reduction measures. Several proposed measures apply to participating jurisdictions uniformly, because they respond to adoption of a state law (e.g., the Low Carbon Fuel Standard) or result from programs administered at the discretion of a utility serving multiple jurisdictions (e.g. utility rebates). For other, more discretionary measures, participating jurisdictions have voluntarily committed to a participation level that could be implemented in their community. These levels—categorized and referred to for the purposes of this CAP as Silver, Gold, and Platinum—generally range from programs that a jurisdiction may promote through its website or outreach campaigns (Silver level), to programs that could be codified through local ordinances (Platinum level). Gold and Platinum levels have the benefit of achieving higher GHG reductions using fewer programs and often with less administrative burden to the jurisdiction. However, Silver level programs offer greater flexibility to determine how GHG reduction measures best fit individual projects.

MEASURE DEVELOPMENT

The GHG emissions reduction potential of each measure was estimated for jurisdictions participating at each level. Maximum participation in GHG reduction measures was encouraged, but jurisdictions were also encouraged to participate at a level that could be realistically achieved by 2020. As a result of the subregion's efforts, the 2020 reduction goal is achieved through implementation of the measures described below. Implementation of the CAP will result in a 15% reduction from the subregion's baseline (2010) emissions, consistent with State-recommended goals for local jurisdictions. Considering the large amount of anticipated growth in Western Riverside County, this equates to a 32% reduction below a business-as-usual (BAU) scenario. The CAP also looks beyond 2020 and demonstrates an ongoing commitment to reducing GHG emissions aligned with State-established goals included in SB 375 and Executive Order (EO) S-3-05. Continued implementation of the CAP beyond 2020 will place the subregion on a trajectory to reduce GHG emissions 49% below baseline emissions by 2035.

FEDERAL, STATE, AND REGIONAL EMISSIONS REDUCTIONS

Emissions reductions are achieved through the efforts of federal, State, and regional programs, in addition to local measures that jurisdictions will implement in their community. State and federal emissions reductions are primarily achieved through regulations, such as efficiency standards for passenger vehicles (e.g., the Corporate Average Fuel Economy standards), reduction in carbon content of transportation fuels (e.g., the Low Carbon Fuel Standard), and minimum renewable energy supply requirements for utilities (e.g., the Renewables Portfolio Standard). Measures regulated and implemented by the State and federal government achieve reductions without additional action by local communities. That is, even if vehicle miles traveled within the subregion remain constant over time, resulting GHG emissions would decrease because as new vehicles are purchased, they would in general be more GHG-efficient than those they replace.

Some State and federal programs also require local action within communities. The California Green Building Standards Code (CALGreen) requires, at a minimum, that new buildings and renovations in California meet certain design standards. New residential and commercial buildings must meet certain baseline efficiency and sustainability standards. These baselines are established through locally-adopted building codes and will result in GHG reductions. Additional voluntary building code provisions, known as Tier 1 and Tier 2 requirements, can be adopted locally, providing even greater energy savings and emissions reductions.

The Water Conservation Bill, known as SB X7-7, requires the State to reduce urban per capita water use 20% by 2020. Regional Urban Water Management Plans provide strategies and create incentives to achieve these targets, but local implementation strategies vary, and consumer participation is necessary to realize water use reductions. Local implementation strategies typically include tiered pricing or water budget-based (i.e., pricing water according to the amount consumed); water-efficient landscape requirements for water and irrigation management, planting location, and plant materials; and incentives where some utilities pay for turf grass removal and replacement with efficiently-irrigated landscaping.

Regional programs are those developed or administered at a level of government above the local jurisdiction but below the State. These programs often are more responsive to local context than statewide programs. They require local participation but do not require local administration to achieve GHG reductions.

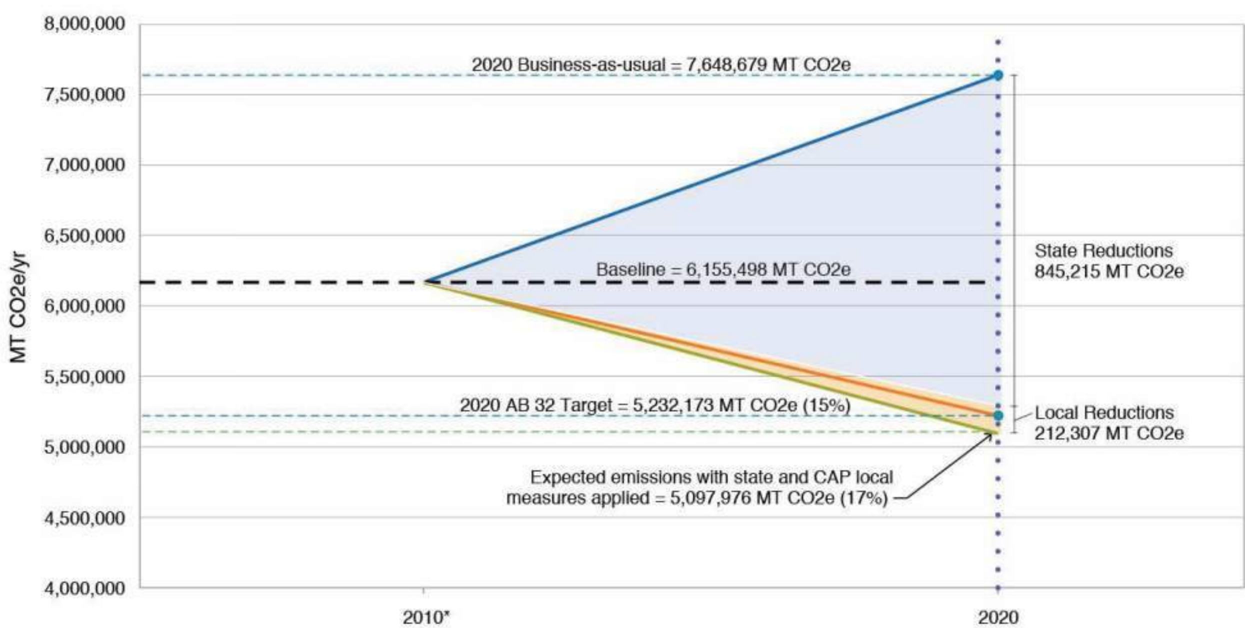
The WRCOG HERO Program, described in Chapter 1, is a regionally-administered program that offers financing options for home and business owners to retrofit or install energy-efficient, water conservation, and/or renewable energy generating products. This program is voluntary and therefore also up to individuals to implement, but regional administration lowers the burden to local governments and has already led to demonstrable reductions in the subregion since the HERO Program's inception in 2011.

WRCOG also administers the TUMF Program. The TUMF Program establishes a funding source to mitigate the cumulative regional transportation impacts of new development on regional arterials. TUMF fees are collected locally, and WRCOG works with its member agencies to identify priority projects to fund using fee revenues in order to reduce subregional transportation impacts caused by development. Facilitating movement on roads, by encouraging non-motorized transportation, increasing access to transit, or easing congestion on critical roadways may lead to GHG reductions. Therefore, TUMF can fund projects that meet this objective. Because the project relies on locally-collected fees, available funding depends on the economic vitality and development opportunities in the region.

A number of other transportation-related programs and projects under the primary control of the Riverside Transit Agency (RTA), Riverside County Transportation Commission (RCTC), California Department of Transportation (Caltrans), and other transportation entities can be implemented to reduce GHG emissions. The long-term planning of major transportation infrastructure is not under the participating jurisdictions' direct control; however, subregional jurisdictions participate in transportation planning decisions in a way that benefits the subregion. Local jurisdictions are in direct control of land uses, which can dictate how future transit is shaped. Individuals also play an important role in how they choose to move throughout the subregion; therefore, while individual jurisdictions do not implement these programs, local input is critical to the success of these programs. Additional projects anticipated to result in GHG reductions include California High Speed Rail, Metrolink expansion, express lanes, congestion pricing, goods movement, high frequency transit service, and electric vehicle infrastructure implementation.

Through federal, state, and regional measures implemented at the subregion level, participating jurisdictions can reduce 2020 emissions by 1,980,815 $MTCO_2e$, representing 78% of the subregion's 2020 reductions, as illustrated in **Figure 3-1**.

Figure 3-1: WRCOG Subregion–GHG Reductions Achieved through State, Regional, and Local Measures



*2010 is used as baseline year for all jurisdictions except for the cities of Eastvale and Jurupa Valley, as noted previously.

LOCAL EMISSIONS REDUCTIONS

While federal, state, and regional measures are critical to meet emission reduction goals, choices made by each local government, resident, and business owner will determine the subregion's ability to achieve the overall emissions reduction target. Through outreach campaigns, incentives, zoning changes, and ordinances, local communities can achieve additional reductions identified in this CAP.

Reduction measures are organized into major economic sectors, similar to the emissions inventory:

- Energy – including electricity and natural gas consumption
- Transportation and Land Use
- Water
- Waste

Each measure is described using the following information.

MEASURE DESCRIPTION

A general description of each measure is provided along with the implementing actions that constitute the Silver, Gold, or Platinum level that each participating jurisdiction will take to implement the measure. Jurisdictions are listed by level of participation.

What is a metric ton of CO_2e?

GHG emissions are reported as metric tons (MT) of CO_2e. Emitting 1 MT CO_2e is equal to the following:

- **102 gallons of gasoline**
- **41 propane cylinders used for home barbecues**
- **One month's worth of energy used in a house**

In contrast, reducing 1 MT CO_2e would require:

- **Growing 25 tree seedlings for 10 years**
- **Recycling 600 pounds of waste instead of throwing it away**

Note: Equivalencies are approximate and are adapted from: http://www.epa.gov/cleanenergy/energy-resources/calculator.html

GHG REDUCTIONS

The GHG reduction potential of each measure is quantified based on the assumption that past trends would continue into the future (e.g., energy consumption, VMT) and standard methods and assumptions recommended by the State (e.g., CAPCOA 2010)[1]. For voluntary programs, the level of participation anticipated by each jurisdiction was developed using case studies and evidence of success with similar programs.

PROGRESS METRICS

Monitoring emissions and reporting reductions will be necessary to validate the success of the measures or to identify measures that are not achieving anticipated reductions. Metrics for monitoring progress are provided for individual measures, although jurisdictions are also encouraged to work with WRCOG to re-inventory local government and community-wide emissions to demonstrate progress.

[1] California Air Pollution Control Officers Association Report titled Quantifying Greenhouse Gas Mitigation Measures (CAPCOA), 2010

COMMUNITY BENEFITS

CAP measures often have benefits that go beyond reducing GHG emissions. Many measures will improve public health by encouraging walking and biking or reducing air pollution; increase economic potential of the subregion by providing development and retrofitting incentives; reduce energy use and lower utility bills; preserve natural resources by consuming and wasting less; and increase mobility through alternative transportation measures. The following icons are used to identify co-benefits that jurisdictions can achieve by implementing local GHG reduction measures.

STATE AND REGIONAL MEASURES

Table 3-1 lists the state and regional measures included in the Subregional CAP and provides a breakdown of the GHG reduction potential for these measures.

Table 3-1: 2020 Reductions Achieved Through State and Regional Measures

State and Regional Measures by Sector		2020 (MT CO_2e/yr)
SR-1	Renewables Portfolio Standard	434,606
SR-2	2013 California Building Energy Efficiency Standards (Title 24, Part 6)	30,923
SR-3	HERO Residential Program	71,649
SR-4	HERO Commercial Program	10,079
SR-5	Utility Programs	9,182
SR-6	Pavley & Low Carbon Fuel Standard	1,095,555
SR-7	Metrolink Expansions	23,074
SR-8	Express Lanes	60,864
SR-9	Congestion Pricing	3,246
SR-10	Telecommuting	40,576
SR-11	Goods Movement	22,688
SR-12	Electric Vehicle Plan and Infrastructure	81,152
SR-13	Construction and Demolition Waste Diversion	3,574
SR-14	Water Conservation and Efficiency	23,192
TOTAL STATE AND REGIONAL REDUCTIONS		**1,910,361**

Note: Total may not add up due to rounding.

STATE AND REGIONAL ENERGY MEASURES

The following are state and regional measures that are expected to reduce GHG emissions associated with the energy sector.

Measure SR-1: Renewables Portfolio Standard

Utilities must secure 33% of their power from renewable sources.

2020 GHG Reduction Potential: 434,606 MT CO_2e/yr

Through a series of increasingly stringent bills first enacted in 2002, California has placed requirements on electric utilities to procure a portion of their energy from renewable sources. The standard, known as the Renewables Portfolio Standard (RPS), applies to investor-owned utilities, publicly-owned utilities, electricity service providers, and community choice aggregators. Therefore, all electricity-providing utilities in Western Riverside (SCE, Riverside Utility and Banning Utility) must meet these targets:

- 20% of retail sales from renewables by 2013
- 25% of retail sales from renewables by 2016
- 33% of retail sales from renewables by 2020

Meeting these goals will likely lead to reduced emissions associated with electricity, as more electricity will be generated by less carbon-intensive sources.

Community Benefits

Measure SR-2: 2013 California Building Energy Efficiency Standards (Title 24, Part 6)

Mandatory energy efficiency standards for buildings.

2020 GHG Reduction Potential: 30,923 MT CO_2e/yr

Building energy efficiency standards are designed to ensure new and existing buildings achieve energy efficiency and preserve outdoor and indoor environmental quality. These measures (Title 24, Part 6) are listed in the California Code of Regulations. These standards began in 1978 and are updated every 5 years. The 2013 standards differ from the 2008 standards by requiring usage of less energy for lighting, heating, cooling, ventilation, and water heating. Buildings are also required to be solar-ready, allowing for easier and less expensive installation of photovoltaic or solar thermal panels in the future. The California Energy Commission estimates that the 2013 standards will result in residential construction that is 25% more efficient and nonresidential construction that is 30% more efficient than the 2008 standards. The new standards go into effect on July 1, 2014 and as the industry moves toward the goal of net-zero energy, even greater energy and GHG savings may be achieved over time.

Community Benefits

Measure SR-3: HERO Residential Program

Financing for homeowners to make energy efficient, renewable energy, and water conservation improvements.

2020 GHG Reduction Potential: 71,649 MT CO_2e/yr

The HERO Program is a public-private partnership administered by WRCOG, offering financing to homeowners in the subregion for the installation of energy efficient, renewable energy, and water conservation improvements. This property assessed clean energy (PACE) financing program offers a continually expanding list of eligible products for financing and an ever-growing cadre of trained contractors who can assist property owners with selecting and installing eligible products. Products eligible for HERO Financing include, but are not limited to:

- Energy audits
- Insulation of attics, floors, walls, and home perimeter
- Lighting upgrades
- Drip and weather-based irrigation systems
- Rainwater catchment systems
- Pool pumps and heaters
- Energy-efficient windows
- Solar PV panels
- Air sealing and weatherization
- Cool roof system
- Cool wall coatings

This award-winning program is offered to eligible property owners in the WRCOG subregion who wish to participate.

WRCOG's Residential Program partner, Renovate America, collects data regarding participation, energy savings, renewable energy installation, job creation, and economic development by jurisdiction in the subregion. WRCOG will continue to partner with Renovate America to track ongoing participation and energy savings on a monthly or annual basis. Emissions reduction estimates for this CAP were calculated based on program participation assumptions developed by Renovate America. Since its inception in 2011, the HERO program has funded more than $135 million worth of eligible projects, and created more than 1,000 jobs. The program's growth has led to energy savings, GHG reductions, water conservation, and local job creation in each of its participating communities. The HERO program has also been an award-winning model for other PACE programs, earning recognition from various industry organizations including the Southern California Association of Governments, the U.S. Green Building Council, the Urban Land Institute, and the Governor of California.

Community Benefits

Measure SR-4: HERO Commercial Program

Financing for business owners to make energy efficient, renewable energy, and water conservation improvements.

2020 GHG Reduction Potential: 10,079 MT CO_2e/yr

The HERO Program is a public-private partnership administered by WRCOG, offering financing to business owners in the subregion for the installation of energy efficient, renewable energy, and water conservation improvements. This PACE financing program offers a continually expanding list of eligible products for financing and an ever-growing cadre of trained contractors who can assist property owners with selecting and installing eligible products. Products eligible for HERO Financing include, but are not limited to:

- Energy audits
- Insulation of attics, floors, walls, and home perimeter
- Lighting upgrades
- Drip and weather-based irrigation systems
- Rainwater catchment systems
- Pool pumps and heaters
- Energy-efficient windows
- Solar PV panels
- Air sealing and weatherization
- Cool roof system
- Cool wall coatings

This award-winning program is offered to eligible property owners in the WRCOG subregion who wish to participate.

Community Benefits

Measure SR-5: Utility Programs

Financing for business owners to make energy efficient, renewable energy, and water conservation improvements.

2020 GHG Reduction Potential: 9,182 MT CO_2e/yr

Southern California Edison (SCE), Southern California Gas Company (SCG), Riverside Public Utilities (RPU), and the Banning Electric Utility (BEU) provide energy to customers in the subregion. Each utility offers rebate programs to reduce energy consumption, which in turn, reduces local GHG emissions. The utilities offer a selection of rebates and other incentives to assist property owners (residential and commercial) with the installation of energy- and water-saving products. The following list provides a sample of programs and indicates which utilities are currently offering:

- ENERGY STAR™ appliance rebates – SCE, SCG, RPU, BEU
- Light bulb discounts – SCE
- Solar rebates – SCE, RPU
- Low-income programs – SCE, SCG, RPU, BEU
- Shade trees – RPU, BEU

Note: Some programs may have funding cycle and annual rebate limits; check with your local utility for up-to-date information regarding specific rebates.

These utility programs are provided to customers throughout the subregion and are managed at the discretion of each participating utility. Therefore, they do not have tiered implementation actions.

Community Benefits

STATE AND REGIONAL TRANSPORTATION MEASURES

The following are state and regional measures that are expected to reduce GHG emissions associated with the transportation sector.

Measure SR-6: Pavley and Low Carbon Fuel Standard

Requirements for vehicles to use cleaner fuels.

2020 GHG Reduction Potential: 1,095,555 MT CO_2e/yr

In 2002, California adopted AB 1493, referred to as "Pavley I", which directed CARB to develop fuel-efficiency standards for passenger vehicles in California by 2005. Through a series of rulings, CARB and the federal government agreed on federal standards that began in 2009 and increase through 2016. CARB and the federal government are currently finalizing fuel-efficiency standards that continue to become increasingly-stringent from 2017 through 2025. Building from Pavley 1, Executive Order S-1-07, known as the Low Carbon Fuel Standard (LCFS), requires the carbon-intensity of California's transportation fuel to be reduced by at least 10% by 2020.

Community Benefits

Measure SR-7: Metrolink Expansion

Additional Metrolink transit service provided to Western Riverside County.

2020 GHG Reduction Potential: 23,074 MT CO_2e/yr

Identified in SCAG's 2012 RTP/SCS, the Metrolink Perris Valley Line will be extended from Riverside to Perris in Western Riverside County, allowing for alternative transportation, reducing VMT and GHG emissions in Western Riverside County. Service along this route is expected to begin in 2015.

Community Benefits

Measure SR-8: Express Lanes

Additional express lanes added along major freeways in Western Riverside County.

2020 GHG Reduction Potential: 60,864 MT CO_2e/yr

SCAG's analysis of critical corridors found inter-county trips account for over 50% of all trips. Ongoing congestion issues—and therefore increased idle time and GHG emissions—have led to SCAG proposing increasing the network of express lanes that connect counties, including Riverside County. Extension of express lanes along State Route-91 (SR-91) and Interstate-15 (I-15) would be operational by 2017 and 2020 respectively, and would lead to reduced congestion according to regional transportation modeling. The SR-91 extension project is currently under construction. The I-15 Toll Express Lanes from State Route-60 (SR-60) to Cajalco Road has entered the preliminary engineering phase, and the anticipated opening year is 2020.

Community Benefits

Measure SR-9: Congestion Pricing

Additional express lanes added along major freeways in Western Riverside County.

2020 GHG Reduction Potential: 3,246 MT CO_2e/yr

Transportation demand management (TDM) consists of methods used to encourage transportation other than single-occupancy vehicle travel at peak traffic times. TDM strategies and are generally categorized as "soft" or "hard" strategies. Soft mechanisms are incentive-based and include:

- Increasing the availability and use of carpooling, vanpooling, transit, bicycling, and walking;
- Shifting work schedules to non-peak periods or locations; and
- Using telecommuting.

Congestion pricing is a TDM tool examined by SCAG through its Express Travel Choices Study. Pricing mechanisms may include toll lanes/roads or mileage-based user fees, which discourage automobile traveling by increasing travel costs. Currently an expansion of the toll lanes on SR-91 is planned to continue these toll lanes through Corona and into Riverside.

The effectiveness of congestion pricing reflects the regional share of VMT reduction associated with this strategy, in addition to local actions. This approach accounts for the high degree of out-commuting that currently occurs in Western Riverside County as residents travel to jobs in Los Angeles, San Bernardino, and Orange Counties. Since many TDM strategies will be implemented at employment locations instead of residential locations, a separate accounting is needed in addition to the jurisdiction-specific TDM strategies identified in this Subregional CAP.

Community Benefits

Measure SR-10: Telecommuting

Additional express lanes added along major freeways in Western Riverside County.

2020 GHG Reduction Potential: 40,576 MT CO_2e/yr

Telecommuting is a soft TDM mechanism that has increased considerably over the past decade. According to SCAG, telecommuting could increase even more by 2020 (to 5% of workers in the region) and 2035 (to 10% of workers), from the current 2.6% that currently telecommute. By telecommuting, GHG emissions associated with vehicles no longer on the road are reduced, as are idling or congestion-related emissions from vehicles remaining on the road. Similar to **Measure SR-9: Congestion Pricing**, this strategy reflects the regional share of TDM strategies that may be implemented on a regional level given the high degree of out-commuting that occurs in Western Riverside County.

Community Benefits

Measure SR-11: Goods Movement

Efficient movement of goods through inland Southern California.

2020 GHG Reduction Potential: 22,688 MT CO_2e/yr

Southern California is a major hub for importing and exporting goods. SCAG estimates that over $2 trillion in cargo was moved across the region in 2010 alone, much of which travels through inland Southern California, including Western Riverside County. However, the many warehouses and distribution facilities employ non-passenger vehicles that contribute to GHG emissions. At the state level, more standards are being implemented to increase vehicle efficiencies and the 2012 RTP/SCS and AQMD are supporting greater penetration of low-emission trucks in the region. While goods will continue to be moved to support local and regional economies, electrification and other low-emission technologies installed in vehicles can reduce the GHG emissions of goods movement. The GHG reductions estimated here account for the region's "share" of SCAG and AQMD's anticipated investments and the effect of the investment on GHG emissions. These investments include both policies as well as physical improvements such as "truck climbing" lanes on State Route-60 (SR-60), funded by RCTC.

Community Benefits

Measure SR-12: Electric Vehicle Plan and Infrastructure

Facilitate electric vehicle use by providing necessary infrastructure.

2020 GHG Reduction Potential: 81,152 MT CO_2e/yr

SCAG has developed a regional plug-in electric vehicle (PEV) readiness plan, and WRCOG has a similar subregional plan for PEV readiness. Together, these plans identify viable locations for charging stations, changes to development codes, and other strategies to encourage the purchase and use of electric vehicles. PEV chargers are already being installed in the WRCOG subregion. Through these plans and outreach efforts, alternative-fuel vehicles will be promoted as one strategy to reduce GHG emissions associated with passenger vehicles. This measure is anticipated to reduce nearly 82,000 MT CO_2e in participating jurisdictions by 2020.

Community Benefits

STATE SOLID WASTE MEASURE

The following state measure is expected to reduce GHG emissions associated with the solid waste sector.

Measure SR-13: Construction & Demolition Waste Diversion

Mandatory requirement to divert 50% of construction and demolition waste from the landfill waste stream.

2020 GHG Reduction Potential: 3,574 MT CO_2e/yr

Recycling construction and demolition materials reduces GHG emissions by removing material from landfills that would otherwise generate methane. Construction and demolition (C&D) waste recycling also may reduce the need to harvest and transport new raw construction materials, as recycled materials can be locally repurposed and reused. For growing areas like the WRCOG subregion, C&D waste accounts for a significant portion of the waste stream.

Effective July 1, 2012, CALGreen, the state's Green Building Standards Code, requires jurisdictions to divert a minimum of 50% of their nonhazardous C&D waste from landfills.

Community Benefits

STATE AND REGIONAL WATER MEASURES

The following state measure is expected to reduce GHG emissions associated with the water sector.

Measure SR-14: Water Conservation and Efficiency

State requirement to reduce urban per capita water use.

2020 GHG Reduction Potential: 23,192 MT CO_2e/yr

SB X7-7 is part of a California legislative package passed in 2009 that requires urban retail water suppliers to reduce per-capita water use by 10% from a baseline level by 2015, and to reduce per-capita water use by 20% by 2020. In Southern California, energy costs and GHG emissions associated with the transport, treatment, and delivery of water from outlying regions are high. Therefore, the region has extra incentive to reduce water consumption. While this is considered a state measure, it will be up to the local water retailers, jurisdictions, and water users to meet these targets. A number of policies have been established at the local level within the subregion requiring more efficient use of water, including landscape ordinances that require native or low-irrigation landscaping. Water retailers also offer resources that incentivize purchase of high-efficiency appliances and provide information on best management practices, landscaping, and the use of recycled and gray water systems.

Community Benefits

LOCAL REDUCTION MEASURES

Table 3-2 lists the local measures included in the Subregional CAP and provides a breakdown of the GHG reduction potential for these local measures.

Table 3-2: 2020 Reductions Achieved from Local Measures

Local Measures by Sector		2020 Reductions Achieved (MT CO_2e/yr)
E-1	Energy Action Plans	357,581
E-2	Traffic and Street Lights	4,697
E-3	Shade Trees	2,014
Energy Subtotal		***364,292***
T-1	Bicycle Infrastructure Improvements	29,255
T-2	Bicycle Parking	6,290
T-3	End of Trip Facilities	1,836
T-4	Promotional Transportation Demand Management	1,831
T-5	Transit Service Expansion	704
T-6	Transit Frequency Expansion	2,723
T-7	Traffic Signal Coordination	94,600
T-8	Density	2,857
T-9	Mixed-Use Development	4,069
T-10	Design/Site-Planning	912
T-11	Pedestrian Only Areas	2,812
T-12	Limited Parking Requirements for New Development	28,423
T-13	High Frequency Transit Services	1,801
T-14	Voluntary Transportation Demand Management	2,464
T-15	Accelerated Bike Plan Implementation	5,340
T-16	Fixed Guideway Transit	10,489
T-17	Neighborhood Electric Vehicle Programs	4,707
T-18	Subsidized Transit	3,628
Transportation Subtotal		***204,744***
SW-1	Yard Waste Collection	1,007
SW-2	Food Scrap and Paper Diversion	155
Solid Waste Subtotal		***1,162***
TOTAL LOCAL ACTION REDUCTIONS		**570,199**

LOCAL ENERGY MEASURES

The following are local measures that can be implemented to reduce GHG emissions associated with the energy sector. As described in Chapter 1, at the time this CAP was developed 11 jurisdictions were participating in the Western Riverside Energy Leader Partnership (WRELP) Program, which includes the development of municipal and community-wide Energy Action Plans (EAPs) for these jurisdictions (**Table 1-1**). Measure E-1 includes the aggregate total GHG reduction potential for the 11 WRELP jurisdictions implementing the EAPs, while Measures E-2 and E-3 describe the GHG reduction potential from energy strategies implemented by the 4 jurisdictions included in this Subregional CAP that were not WRELP jurisdictions at the time of this CAP development.

Measure E-1: Energy Action Plans

Improve municipal and community-wide energy efficiency and reduce energy consumption through the adoption of local Energy Action Plans (EAP).

2020 GHG Reduction Potential: 357,581 MT CO_2e/yr

In 2011, Southern California Edison (SCE) provided funding to WRCOG to implement the California Long-Term Energy Efficiency Strategic Plan (CEESP) developed by the California Energy Commission. WRCOG and 11 participating jurisdictions established the WRELP Program and adopted energy efficiency targets and programs to meet those targets, which will reduce utility costs and GHG emissions associated with the energy use at the municipal and community level (**Table 1-1**). These targets and actions are captured in each jurisdiction's EAP. The EAPs use a similar approach to that described in this CAP, but only address emissions and GHG reductions associated with the energy sector. The CAP contains similar energy-efficiency actions for non-EAP jurisdictions.

By implementing the proposed efficiency measures, jurisdictions demonstrate the potential economic, social, and environmental benefits of increasing energy efficiency and providing environmental stewardship within the community.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
This measure does not include tiered implementation actions. Each WRELP jurisdiction has individual energy-conserving measures and actions in its EAP. Energy sector reductions anticipated in each jurisdiction's EAP are captured within this local CAP measure, and will be tracked and reported in conjunction with the measures proposed within the CAP for non-WRELP jurisdictions.		357,581
PROGRESS INDICATORS		**YEAR**
1	Each WRELP jurisdiction has received a tracking and monitoring tool, which identifies the jurisdiction's energy usage projections and goals, and provides a user-friendly workbook to evaluate emissions annually. Each jurisdiction has its own monitoring tool, but the assumptions used are consistent across all tools in the subregion and can be aggregated for subregional monitoring and reporting.	2020

Measure E-2: Traffic and Street Lights

Replace traffic and street lights with high-efficiency bulbs.

2020 GHG Reduction Potential: 4,697 MT CO_2e/yr

Similar to many household light fixtures, traffic lights are typically illuminated with inefficient incandescent bulbs. Street lights commonly use high-pressure sodium (HPS) bulbs, which also produce light inefficiently. Newer lighting technology, such as light-emitting diodes (LEDs), last significantly longer than traditional incandescent or HPS bulbs, and use much less energy to perform the same task. Jurisdictions can install LEDs in their traffic signals and upgrade street light fixtures to accommodate LEDs or other high-efficiency bulbs to lower municipal utility costs and reduce maintenance costs associated with bulb replacement.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	100% of traffic and street lights converted to high-efficiency bulbs by 2020. Banning, Jurupa Valley, Riverside	4,697
GOLD LEVEL	75% of traffic and street lights converted to high-efficiency bulbs by 2020. No jurisdictions participating at this level.	0
SILVER LEVEL	50% of traffic and street lights converted to high-efficiency bulbs by 2020. No jurisdictions participating at this level.	0

	PROGRESS INDICATORS	YEAR
1	Banning: 1.02 million kWh/year in savings from Freeway Lighting and Streetlights subsectors of Local Government GHG Inventory. (Appendix X)	2020
2	Jurupa Valley: 11,000 kWh/year in savings from Streetlights subsector of Local Government GHG Inventory. (Appendix X)	2020
3	Riverside: 1.26 million kWh/year in savings from Streetlights and Traffic Signals/Controllers subsector of Local Government GHG Inventory. (Appendix X)	2020

Community Benefits

Measure E-3: Shade Trees

Strategically plant trees to reduce the urban heat island effect.

2020 GHG Reduction Potential: 2,014 MT CO_2e/yr

Planting additional trees in urban environments has a number of benefits, including lowering peak-load energy demands during the hottest months, enhancing the visual aesthetic of a community, and naturally sequestering carbon dioxide. Properly selected and located shade trees can help keep indoor temperatures low, thereby reducing air conditioner demands and utility costs. Trees can also provide shade for parking lots and other paved areas, reducing the urban heat island effect communitywide.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Shade trees are required for all new development or redevelopment. Eastvale, Jurupa Valley	638
GOLD LEVEL	Subsidized program to support planting jurisdiction-identified shade tree species. Banning, Riverside	1,376
SILVER LEVEL	Outreach program to promote the benefits of planting additional trees in urban environments. No jurisdictions participating at this level.	0

	PROGRESS INDICATORS	YEAR
1	Banning: 4,300 new shade trees by 2020	2020
2	Eastvale: 12,400 new shade trees by 2020	2020
3	Jurupa Valley: 20,000 new shade trees by 2020	2020
4	Riverside: 62,900 new shade trees by 2020	2020

Community Benefits

LOCAL TRANSPORTATION MEASURES

The following are local measures that can be implemented to reduce GHG emissions associated with the transportation sector.

Measure T-1: Bicycle Infrastructure Improvements

Expand on-street and off-street bicycle infrastructure, including bicycle lanes and bicycle trails.

2020 GHG Reduction Potential: 29,255 MT CO_2e/yr

By providing more bicycle lanes and better connections between existing bicycle lanes, WRCOG jurisdictions can increase the viability of bicycling as an emission-free commute option. Several WRCOG jurisdictions have adopted or are preparing bicycle master plans. Implementing these plans will increase alternative transportation options in the sub-region and can reduce vehicle miles traveled and congestion for vehicles. Community health benefits from increased bicycling include improved air quality and exercise.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Implement a 50% increase in bicycle lane mileage from baseline levels. Riverside	15,905
GOLD LEVEL	Implement a 25% increase in bicycle lane mileage from baseline levels. No participating jurisdictions at this level.	0
SILVER LEVEL	Implement a 10% increase in bicycle lane mileage from baseline levels. Banning, Canyon Lake, Eastvale, Hemet, Jurupa Valley, Norco, Perris, San Jacinto, Temecula, Wildomar	13,350
PROGRESS INDICATORS		**YEAR**
1	Annual percentage increase in bicycle lane mileage from baseline levels.	2020

Community Benefits

Measure T-2: Bicycle Parking

Provide additional options for bicycle parking.

2020 GHG Reduction Potential: 6,290 MT CO_2e/yr

Safe and convenient bicycle parking is a relatively low-cost action that leads to a demonstrated shift from automobile use to bicycle use. Helping business owners understand the potential benefits of bicycle parking and requiring new development projects to include bike racks as a condition of approval can facilitate implementation of this measure.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Amend zoning to require provision of bike parking for all multi-family or mixed-use projects consisting of a mix of residential, retail, and office space. Calimesa, Canyon Lake, Eastvale, Hemet, Jurupa Valley, Norco, Perris, Riverside, San Jacinto, Temecula, Wildomar	6,152
GOLD LEVEL	Amend zoning to require provision of bike parking for multi-family projects consisting of more than 50 dwelling units, and mixed-use projects greater than 50,000 square feet consisting of a mix of residential, retail, and office space. Banning	138
SILVER LEVEL	Provide information to applicants for large development projects describing the benefits of bike parking. No jurisdictions participating at this level.	0

PROGRESS INDICATORS		YEAR
1	Annual number of new bike parking spaces installed.	2020

Community Benefits

Measure T-3: End of Trip Facilities

Encourage use of non-motorized transportation modes by providing appropriate facilities and amenities for commuters.

2020 GHG Reduction Potential: 1,836 MT CO_2e/yr

End-of-trip commuter facilities further incentivize alternative transportation modes, such as walking and biking. Such facilities commonly include showers, changing rooms, lockers, and bike racks.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Amend zoning to require installation of end-of-trip facilities for new commercial buildings greater than 50,000 square feet. Riverside	1,119
GOLD LEVEL	Amend zoning to require installation of end-of-trip facilities for new commercial buildings greater than 100,000 square feet. Banning, Jurupa Valley, Perris	391
SILVER LEVEL	Provide information to commercial project applicants describing the benefits of installing end-of-trip facilities. Calimesa, Canyon Lake, Eastvale, Hemet, San Jacinto, Temecula, Wildomar	326

PROGRESS INDICATORS	YEAR
1 Annual number of development projects installing end-of-trip facilities.	2020

Community Benefits

Measure T-4: Promotional Transportation Demand Management

Encourage Transportation Demand Management strategies.

2020 GHG Reduction Potential: 1,831 MT CO_2e/yr

Transportation demand management (TDM) describes strategies to reduce demand for roadway travel, particularly in single-occupancy vehicles. TDM strategies can include both “carrot” and “stick” approaches to change travel behavior patterns. Specific examples include preferential parking for carpoolers and parking pricing.

While SCAG offers regional approaches such as high-occupancy vehicle lanes, this measure focuses on efforts by individual existing business owners in the WRCOG sub-region to develop TDM strategies, such as parking “cash out” programs and allowing telecommuting. Several TDM strategies can be offered; often, multiple programs can enhance one another rather than being redundant. In addition to reducing GHG emissions, TDM strategies often ease congestion and improve air quality.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Allocate a full-time staff person to promote TDM strategies to existing businesses. No jurisdictions participating at this level.	0
GOLD LEVEL	Allocate the equivalent of ½ of a full- time staff person to promote TDM strategies to existing businesses. No jurisdictions participating at this level.	0
SILVER LEVEL	Train an existing staff person to promote TDM strategies to existing business. Eastvale, Hemet, Jurupa Valley, Norco, Riverside	1,831

	PROGRESS INDICATORS	YEAR
1	Number of jurisdictions with full-time or part-time staff promoting TDM programs to be established through an annual survey conducted by WRCOG.	2020

Community Benefits


Measure T-5: Transit Service Expansion

Collaborate with local and regional transit providers to increase transit service provided in the subregion.

2020 GHG Reduction Potential: 704 MT CO_2e/yr

It will be crucial for jurisdictions anticipating growth to coordinate with the Riverside Transit Agency (RTA) and Banning Pass Transit to appropriately expand service. Several jurisdictions have identified a need for additional transit service and are working with RTA to identify critical investments to maximize ridership. Increased transit ridership improves air quality as fewer single-occupancy vehicles use the roadways, improves traffic flow for remaining vehicles, and offers mobility to low-income and other disadvantaged communities. Information related to this measure may be updated upon completion of the RTA Forward 10-Year Transit Plan, a comprehensive operational analysis that will guide RTA's bus route and service decisions in future years.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Work with RTA to increase fixed-route service miles by 20% by 2020. No jurisdictions participating at this level.	0
GOLD LEVEL	Work with RTA to increase fixed-route service miles by 10% by 2020. Eastvale, Norco	324
SILVER LEVEL	Work with RTA to increase fixed-route service miles by 5% by 2020. Banning, Jurupa Valley, Temecula, Wildomar	380

PROGRESS INDICATORS		YEAR
1	Annual miles of fixed-route service provided by RTA	2020

Community Benefits

Measure T-6: Transit Frequency Expansion

Collaborate with local and regional transit providers to provide more frequent transit in the subregion.

2020 GHG Reduction Potential: 2,723 MT CO_2e/yr

Future annual transit ridership is expected to grow by 3.5% across the nation, and many transportation systems are already operating beyond their capacity (APTA 2010). In addition to expanding service, transit agencies will need to increase service frequency by reducing headways or the time between buses on existing routes. . WRCOG jurisdictions are working with RTA and Banning Pass Transit to share information regarding anticipated land development patterns and to maximize service frequency investments. Similar to transit service expansion, this measure provides air quality and mobility co-benefits by reducing the number of single-occupancy vehicles on the road. Information related to this measure may be updated upon completion of the RTA Forward 10-Year Transit Plan, a comprehensive operational analysis that will guide RTA's bus route and service decisions in future years. This measure differs from T-5 in that it considers service improvements along existing routes.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL ($MT\ CO_2e/yr$)
PLATINUM LEVEL	Work with RTA to increase fixed-route service frequency by 20% over baseline levels in transit priority areas as defined by SCAG in the RTP/SCS. Perris	698
GOLD LEVEL	Work with RTA to increase fixed-route service frequency by 10% over baseline levels in transit priority areas as defined by SCAG in the RTP/SCS. Eastvale	241
SILVER LEVEL	Work with RTA to increase fixed-route service frequency by 5% over 2010 levels in transit priority areas as defined by SCAG in the RTP/SCS. Banning, Jurupa Valley, Norco, Temecula, Wildomar	1,784

	PROGRESS INDICATORS	YEAR
1	Percentage change in average annual fixed-route service frequency in transit priority areas compared to baseline levels.	2020

Community Benefits

Measure T-7: Traffic Signal Coordination

Incorporate technology to synchronize and coordinate traffic signals along local arterials.

2020 GHG Reduction Potential: 94,600 MT CO_2e/yr

Traffic signal coordination describes a method of timing groups of traffic signals along an arterial to provide smooth movement of traffic with minimal stops. This technique reduces motorist stops and delays, lowers the amount of fuel need to move a certain distance, and reduces GHG emissions. Signal coordination also lessens congestion and resulting tail pipe emissions, which reduces GHG emissions and improves air quality.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Coordinate traffic signals on an additional 50% of arterial roads which were not coordinated in the base year. Canyon Lake, Perris, Riverside, Temecula	78,318
GOLD LEVEL	Coordinate traffic signals on an additional 25% of arterial roads which were not coordinated in the base year. Banning, Hemet, San Jacinto	10,131
SILVER LEVEL	Coordinate traffic signals on an additional 10% of arterial roads which were not coordinated in the base year. Eastvale, Jurupa Valley, Wildomar	6,151

PROGRESS INDICATORS		YEAR
1	Annual percentage of arterial roads with signal coordination which were not coordinated in the base year.	2020

Community Benefits

Measure T-8: Density

Improve jobs-housing balance and reduce vehicle miles traveled by increasing household and employment densities.

2020 GHG Reduction Potential: 2,857 MT CO_2e/yr

Density describes the number of people, jobs, or housing units in a given area. Increasing density generally results in shorter distances between locations, making transit and non-motorized transportation options such as walking and biking more viable. GHG emissions associated with vehicle miles traveled (VMT) are reduced as more individuals choose alternative transportation modes. Increases in density must generally fit within assumptions of a jurisdiction's General Plan, although amendments can be made to increase density in certain areas.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Achieve a 25% increase in community-wide household and employment density over baseline conditions by 2020. No jurisdictions participating at this level.	0
GOLD LEVEL	Achieve a 10% increase in community-wide household and employment density over baseline conditions by 2020. Perris, Riverside, Temecula	2,054
SILVER LEVEL	Achieve a 5% increase in community-wide household and employment density over baseline conditions by 2020. Eastvale, Hemet, Jurupa Valley, Norco, San Jacinto, Wildomar	803

PROGRESS INDICATORS	YEAR
1 Annual percentage change in community-wide household and employment density compared to baseline conditions	2020

Community Benefits

Measure T-9: Mixed-Use Development

Provide for a variety of development types and uses.

2020 GHG Reduction Potential: 4,069 MT CO_2e/yr

Development can occur in many forms, ranging from single-family homes on large plots of land to multi-family housing with high vertical construction for residential areas, and single-use to multi-use zoning for commercial properties. While land development choices are typically made at the household or business level, recent studies show that individuals are more frequently demanding higher-density, multi-use regions that are more walkable. Most WRCOG jurisdictions have identified portions of their communities where future higher-density development is desirable. Such development reduces both VMT and GHGs, as individuals can accomplish many tasks in a single mixed-use area. This also can improve community health by encouraging bicycling and walking, improve air quality by reducing tailpipe emissions, and increase the community's sense of place.

For the WRCOG subregion, mixed-use development is classified as having at least three of the following features either on-site or within ¼ mile:

- Residential development;
- Retail development;
- Park;
- Open space; or
- Office.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL ($MT\ CO_2e/yr$)
PLATINUM LEVEL	Achieve a 25% jobs/housing ratio improvement over baseline conditions. Eastvale, Jurupa Valley	1,897
GOLD LEVEL	Achieve a 10% jobs/housing ratio improvement over baseline conditions. Hemet, Perris	764
SILVER LEVEL	Achieve a 5% jobs/housing ratio improvement over baseline conditions Banning, Norco, Riverside, Temecula, Wildomar	1,408
PROGRESS INDICATORS		**YEAR**
1	Annual percentage change in jobs/housing ratio within new development areas compared to baseline conditions.	2020

Community Benefits

Measure T-10: Design/Site Planning

Design neighborhoods and sites to reduce VMT.

2020 GHG Reduction Potential: 912 MT CO_2e/yr

The design of projects affects travel behavior. Typical suburban development patterns feature longer blocks which often discourage walking and biking. Conversely, projects with shorter blocks and more frequent intersections have higher levels of walking, biking, and transit use. This higher use of non-motorized and alternative modes leads to a reduction in automobile use, VMT, and GHG emissions.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	25% increase in intersection density and reduction in block length in new development compared to the baseline countywide average. No jurisdictions participating at this level.	0
GOLD LEVEL	10% increase in intersection density and reduction in block length in new development compared to the baseline countywide average. No jurisdictions participating at this level.	0
SILVER LEVEL	5% increase in intersection density and reduction in block length in new development compared to the baseline countywide average. Hemet, Perris, Temecula	912

PROGRESS INDICATORS		YEAR
1	Annual percentage of neighborhood streets with traffic calming treatments installed.	2020

Community Benefits

Measure T-11: Pedestrian-Only Areas

Encourage walking by providing pedestrian-only community areas.

2020 GHG Reduction Potential: 2,812 MT CO_2e/yr

Also referred to as an urban non-motorized zone, a pedestrian-only area restricts certain portions of a central business district or major activity center to non-motorized transportation.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Designate one additional major activity center in the community as a permanent pedestrian-only area over baseline conditions. Perris, Riverside	1,747
GOLD LEVEL	Designate one additional pedestrian-only area during weekends over baseline conditions. No jurisdictions participating at this level.	0
SILVER LEVEL	Designate one additional pedestrian-only area during weekends tied to a special event (e.g. farmer's market) over baseline conditions. Banning, Hemet, Jurupa Valley, Norco, San Jacinto, Temecula	1,065

PROGRESS INDICATORS	YEAR
1 Annual number of temporary or permanent pedestrian-only zones compared to baseline conditions.	2020

Community Benefits

Measure T-12: Limit Parking Requirements for New Development

Reduce requirements for vehicle parking in new development projects.

2020 GHG Reduction Potential: 28,423 MT CO_2e/yr

Limiting parking requirements for new development in certain areas may encourage alternative individual transportation choices, but caution should be taken to minimize the resulting incentive to travel to more distant locations with plenty of parking. This can be accomplished by:

- Eliminating (or reducing) minimum parking requirements;
- Creating maximum parking requirements; and
- Implementing shared parking.

Limiting parking requirements would encourage modes of transportation other than single-occupancy vehicles, thereby reducing VMT and GHG emissions. If these alternative transportation modes include walking and biking, mobility and health benefits would also be realized.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Amend zoning to reduce parking requirements for new non-residential development by 25% over baseline conditions. Riverside	17,482
GOLD LEVEL	Amend zoning to reduce parking requirements for new non-residential development by 10% over baseline conditions Jurupa Valley, Perris	6,093
SILVER LEVEL	Amend zoning to reduce parking requirements for new non-residential development by 5% over baseline conditions. Canyon Lake, Hemet, Norco, Temecula, Wildomar	4,848

PROGRESS INDICATORS		YEAR
1	Number of jurisdictions which have amended their parking requirements to reduce parking spaces required within new development or redevelopment areas.	2020

Community Benefits

Measure T-13: High Frequency Transit Service

Implement high frequency transit service in the subregion to provide alternative transportation options.

2020 GHG Reduction Potential: 1,801 MT CO_2e/yr

The WRCOG subregion is one of the fastest growing areas in California. As more residents and employees occupy the area, there will be increased need to move people efficiently in and out of the area. A high frequency transit system such as bus rapid transit (BRT) would provide an alternative to constructing more roadways and allow commuters and residents additional transportation options. Jurisdictions participating in this measure have an objective to work with RTA to identify corridors where BRT service would provide an effective and logical transportation option.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Work with RTA to offer high frequency transit service within three (3) corridors No jurisdictions participating at this level.	0
GOLD LEVEL	Work with RTA to offer high frequency transit service within two (2) corridors Eastvale, Riverside	1,640
SILVER LEVEL	Work with RTA to offer high frequency transit service within one (1) corridor Hemet	161

	PROGRESS INDICATORS	YEAR
1	Number of corridors in which high frequency transit service has been implemented.	2020

Community Benefits

Measure T-14: Voluntary Transportation Demand Management

TDM describes strategies to reduce demand for roadway travel, particularly in single-occupancy vehicles. TDM strategies can include both "carrot" and "stick" approaches to change travel behavior patterns. Specific examples include preferential parking for carpoolers and parking pricing.

While SCAG offers regional approaches such as high-occupancy vehicle lanes, this measure focuses on efforts by individual existing business owners in the WRCOG subregion to develop TDM strategies, such as parking "cash out" programs and allowing telecommuting. Several TDM strategies can be offered; often, multiple programs can enhance one other rather than being redundant. In addition to reducing GHG emissions, TDM strategies often ease congestion and improve air quality.

2020 GHG Reduction Potential: 2,464 MT CO_2e/yr

Body text.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	50% of employees within the jurisdiction participate in voluntary TDM programs No jurisdictions participating at this level.	0
GOLD LEVEL	25% of employees within the jurisdiction participate in voluntary TDM programs Riverside	2,185
SILVER LEVEL	12.5% of employees within the jurisdiction participate in voluntary TDM programs Perris	279

PROGRESS INDICATORS		YEAR
1	Percentage of employees in each jurisdiction participating in voluntary TDM programs.	2020

Community Benefits

Measure T-15: Accelerated Bike Plan Implementation

Accelerate the implementation of all or specified components of a jurisdiction's adopted bike plan.

2020 GHG Reduction Potential: 5,340 MT CO_2e/yr

Several jurisdictions within WRCOG are currently implementing existing Bicycle Master Plans and/or Trails Plans. These plans outline a series of on-street and off-street facilities to increase bicycle use within the community. This measure addresses accelerated implementation of these Master Plans to provide additional facilities by 2020 beyond those identified in Measure T-1.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Install 75% of all bicycle facility miles identified in jurisdiction's Bike Plan by 2020 Riverside	3,496
GOLD LEVEL	Install 50% of all bicycle facility miles identified in jurisdiction's Bike Plan by 2020 No jurisdictions participating at this level.	0
SILVER LEVEL	Install 25% of all bicycle facility miles identified in jurisdiction's Bike Plan by 2020 Hemet, Perris, Temecula, Wildomar	1,844

NOTE: Reductions are assumed to be 1/2 of total reduction for bicycle infrastructure measure.

PROGRESS INDICATORS		YEAR
1	Annual % of bicycle facility miles identified in jurisdiction's Bike Plan installed	2020

Community Benefits

Measure T-16: Fixed Guideway Transit

Introduce a fixed-route transit service in the jurisdiction.

2020 GHG Reduction Potential: 10,489 MT CO_2e/yr

This measure applies specifically to the City of Riverside's efforts to conduct a preliminary engineering and economic study for a proposed Streetcar. This Streetcar would provide fixed-route transit service through the City of Riverside, providing access to major destinations such as the University of California, Riverside, Downtown Riverside, and other major destinations throughout the city. The City would plan, design, construct, and operate the streetcar.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Implement a fixed-guideway transit system. Riverside	10,489
GOLD LEVEL	N/a No jurisdictions participating at this level.	0
SILVER LEVEL	N/a No jurisdictions participating at this level.	0

PROGRESS INDICATORS		YEAR
1	Annual community-wide fixed guideway transit ridership.	2020

Community Benefits

Measure T-17: Neighborhood Electric Vehicle Programs

Implement development requirements to accommodate Neighborhood Electric Vehicles and supporting infrastructure.

2020 GHG Reduction Potential: 4,707 MT CO_2e/yr

Neighborhood electric vehicles (NEVs) emit fewer GHGs than traditional passenger vehicles and reduce local air pollution. NEVs generally are used in areas with speed limits of 35 miles per hour or less for relatively short (less than 30 miles) trips. This measure introduces development requirements for signage and educational programs related to the use of NEVs consistent with state regulations.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Provide dedicated NEV facilities within the community. No jurisdictions participating at this level.	0
GOLD LEVEL	Adopt a comprehensive NEV program including signage for NEVs and an educational program related to the use of NEVs. Riverside	3,496
SILVER LEVEL	Adopt an educational program related to the use of NEVs. Hemet	1,211

PROGRESS INDICATORS		YEAR
1	Number of jurisdictions which have implemented NEV plans.	2020

Community Benefits

Measure T-18: Subsidized Transit

Increase access to transit by providing free or reduced passes.

2020 GHG Reduction Potential: 3,628 MT CO_2e/yr

One approach to increase transit use within a jurisdiction is lowering the cost of using transit. Within Western Riverside County, the typical approach has been to provide reduced cost transit passes such as those provided by several universities. This approach is generally targeted at groups such as students or seniors who may lack access to vehicles.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Provide subsidized or discounted transit passes to 3% of residents, students, and employees living, working, or going to school in the community. Riverside	3,496
GOLD LEVEL	Provide subsidized or discounted transit passes to 2% of residents, students, and employees living, working, or going to school in the community. No jurisdictions participating at this level.	0
SILVER LEVEL	Provide subsidized or discounted transit passes to 1% of residents, students, and employees living, working, or going to school in the community. Norco	132

	PROGRESS INDICATORS	YEAR
1	Annual number of discounted transit passes provided per total of residents, students, and employees living, working, or going to school in the community.	2020

Community Benefits

LOCAL SOLID WASTE MEASURES

The following are local measures that can be implemented to reduce GHG emissions associated with the solid waste sector.

Measure SW-1: Yard Waste Collection

Provide green waste collection bins community-wide.

2020 GHG Reduction Potential: 1,007 MT CO_2e/yr

All jurisdictions in the subregion offer green waste collection bins for residential yard waste. Diverting yard waste from landfills helps to extend the life of area landfills. In addition, grass clippings and leaves can be composted into nutrient-rich topsoil amendments, and branches can be chipped into mulch for reuse in landscaping. Removing beneficial organic materials from landfills also helps avoid the creation of landfill methane, a potent GHG.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Adopt an ordinance prohibiting deposit of yard waste in the solid waste stream. No jurisdictions participating at this level.	0
GOLD LEVEL	Provide residential green waste bins for collection and transport to an organic waste processing facility. Banning, Calimesa, Canyon Lake, Eastvale, Hemet, Jurupa Valley*, Norco, Perris, Riverside, San Jacinto, Temecula, Wildomar	1,007
SILVER LEVEL	Conduct an outreach campaign promoting the benefits of yard waste collection, without provision of green waste bins. No jurisdictions participating at this level.	0

*Jurupa Valley offers yard waste collection bins, however waste emissions were not quantified within the jurisdiction's inventory due to lack of available data. Therefore, yard waste reductions for Jurupa Valley are not included within this CAP.

	PROGRESS INDICATORS	YEAR
1	Achievement of 95% diversion of residential yard waste from landfill waste stream.	2020

Community Benefits

Measure SW-2: Food Scrap and Compostable Paper Diversion

Divert food and paper waste from landfills by implementing collection system.

2020 GHG Reduction Potential: 155 MT CO_2e/yr

Food scraps are unwanted cooking preparation and table scraps, such as banana peels, apple cores, vegetable trimmings, bones, egg shells, meat, and pizza crusts. Compostable paper, sometimes called food-soiled paper, usually comes from the kitchen and is not appropriate for paper recycling due to contamination. Materials such as stained pizza boxes, uncoated paper cups and plates, used coffee filters, paper food cartons, napkins, and paper towels are all compostable paper. Food scraps alone represent nearly 20% of total landfilled solid waste statewide. Diverting these organic items from landfills helps to reduce landfill methane gas generation, and can help prolong the lifespan of area landfills.

PARTICIPATION LEVEL	ACTIONS + PARTICIPATING CITIES	GHG REDUCTION POTENTIAL (MT CO_2e/yr)
PLATINUM LEVEL	Accept food scraps and compostable paper within residential green waste bins; establish a commercial food scrap collection program. No jurisdictions participating at this level.	0
GOLD LEVEL	Accept food scraps and compostable paper within residential green waste bins or provide separate food scrap collection bins. Riverside, Temecula	155
SILVER LEVEL	Provide community outreach about benefits of food scrap and compostable paper collection with information about at-home composting. Banning, Calimesa, Canyon Lake, Eastvale, Jurupa Valley, Norco, Perris	0

PROGRESS INDICATORS	YEAR
1 Temecula - 20% of commercial businesses divert 90% of their waste	2020

Community Benefits

Chapter 4
Next Steps

PREPARING THE SUBREGION FOR CLIMATE CHANGE

A key next step, and important to the success of WRCOG's sustainability planning efforts including the Subregional Climate Action Plan (CAP), is the evaluation, analysis, and integration of climate adaptation and resiliency strategies. The WRCOG subregion is expected to experience impacts due to projected changes in the climate, and jurisdictions should begin preparing for them. The effects of climate change will cumulatively affect all sectors, including: water supply and wastewater management, agriculture, public infrastructure (pipelines, wastewater treatment plants, bridges, and roads), public health and public services (fire protection, emergency preparedness), and ecosystem health (diversity and connectivity of habitats), among others.

Despite significant efforts by the subregion and the State of California to reduce GHG emissions, changes in our climate cannot be avoided entirely over the long term. Even if GHG emissions were reduced to pre-industrial levels today, the GHG emissions that have already been added to the atmosphere will continue to warm the planet for centuries. While mitigation is still the most cost-effective approach to preventing long-term catastrophic impacts of climate change, adaptation efforts are needed to increase the resilience of communities and natural resources to changes expected over the next few decades.

In California, anticipated climate change impacts include sea level rise; increased periods of drought; and more frequent extreme weather events, including heat waves and severe storms. Secondary effects include projected inundation of the shoreline; more frequent and severe flooding; more frequent and severe wildfires on the urban fringe; a less reliable water supply; altered agricultural productivity, increased incidence of disease and mortality (both from effects of heat waves and from changing patterns of disease distribution); and disruption of local ecosystems.

The *California Planning Adaptation Planning Guide: Understanding Regional Characteristics (July 2012)*[1] designates climate impact regions based on county boundaries in combination with projected climate impacts, existing environmental setting, socioeconomic factors, and regional designations. The WRCOG subregion falls within the Desert climate impact region, which includes Imperial, Riverside, and San Bernardino Counties, and the *Adaptation Planning Guide* identifies the following climate change impacts to this area:

- Temperature increases
- Reduced precipitation
- Flooding
- Reduced agricultural productivity
- Reduced water supply
- Wildfires
- Public health and heat

ADAPTATION PLANNING APPROACH

Effective adaptation planning and management entails dealing with uncertainty. Adaptation is likely to be a long-term process, including immediate action when necessary and allowing adjustments to changing conditions and new knowledge. Effective public engagement and education is critical, along with an inclusive planning process that ensures the resulting actions are feasible and widely accepted. Five important steps to effective adaptation planning are summarized below:

- **Increase Public Awareness; Engage and Educate the Community:** Local outreach campaigns to build awareness of the dangers of heat exposure and to promote low-cost and low-GHG emitting adaptation strategies. It is critical that the public understand the magnitude of the challenge and why action is needed. The planning process should be inclusive of all stakeholders. These efforts should leverage similar efforts undertaken at the regional, state, and federal levels.
- **Assess Vulnerability:** Perform a detailed vulnerability analysis to assess potential climate change impacts to infrastructure and natural systems. Both short-term and long-term adaptation strategies should be identified. Level of risk can be categorized in terms of likelihood of damage within the forecasting period and the severity of the damages. Understanding vulnerability to climate change impacts is critical to developing effective adaptation strategies. The vulnerability assessment can also provide a framework for agency and community education and participation, inform other planning documents, and identify funding needs. WRCOG intends to initiate a vulnerability/risk assessment in Spring 2014 that will inform not only the CAP, but member jurisdictions' General Plan Safety Elements and Local Hazard Mitigation Plans. It will incorporate the diversity of needs and integrate climate adaptation strategies with existing and proposed programs and initiatives to make the best use of limited resources.
- **Establish Goals, Criteria and Planning Principles:** Engage with stakeholders to establish planning priorities, decision criteria, and build community support for taking action. Rank physical and natural assets for preservation efforts. Where possible, look for situations where a mitigation

[1] California Climate Planning Adaptation Guide, July 2012. Available at http://resources.ca.gov/climate_adaptation/docs/1APG_Planning_for_Adaptive_Communities.pdf

action has adaptation co-benefits (e.g., planting trees to reduce urban heat islands while sequestering carbon and providing habitat).

- **Develop Adaptation Plan:** Identify specific strategies, develop cost estimates, and prioritize actions to increase local resilience of public infrastructure and critical assets, including natural systems like wetlands and urban forests. Look for synergies between natural processes and engineering solutions. An adaptation plan should include a prioritized list of actions (e.g. projects), with a timeline, capital expenditure plan, and a framework for monitoring and adaptive management.
- **Ongoing Monitoring and Adaptive Management:** Reassess climate change vulnerabilities on a regular basis and modify actions accordingly. This includes monitoring the effectiveness of current policies, strategies and actions, and keeping up with changing science, funding opportunities, and regulatory actions.

IMPLEMENTATION OF THE SUBREGIONAL CLIMATE ACTION PLAN

Implementation of the Subregional CAP, including meeting the subregional reduction targets and achieving GHG reduction benefits, will require collaboration between WRCOG, local governments, and the communities at large. Meaningful implementation of the CAP would require the following components, described in more detail below:

- Administration
- Schedule of implementation
- Potential funding sources
- Monitoring and reporting

These steps are not specific to WRCOG or any individual jurisdiction, but are basic steps that WRCOG or any jurisdiction might take, or that other California communities have taken to implement a CAP. These are suggested, not required, and are intended to guide WRCOG and its members in implementation planning for the future.

ADMINISTRATION

WRCOG will continue to provide staffing and administrative support at the subregional level, particularly in implementing subregional programs such as the Transportation Uniform Mitigation Fee (TUMF), HERO Program, Western Riverside Energy Leader Partnership (WRELP) and Clean Cities Coalition. WRCOG will also work to align these programs, and future subregional initiatives, with the goals established in this CAP, where applicable. WRCOG recommends that participating jurisdictions appoint a "CAP coordinator" to oversee the successful implementation and tracking of local GHG reduction strategies. The local CAP coordinator would primarily be responsible for coordinating across municipal departments to gather data, report on progress, track completed projects, and ensure that scheduling and funding of upcoming projects is discussed at key meetings. Some jurisdictions may wish to have the coordinator work primarily as part of the development review process for new projects (i.e., Planning Department staff). The coordinator may be existing staff and does not necessarily require a dedicated full-time position. **Table 4-1** describes the potential responsibilities for WRCOG staff and local CAP coordinators.

In general, the goal in implementing the CAP is not to create new administrative tasks or new staff positions, but rather to leverage existing programs and staff to the maximum extent feasible. Local governments should seek to incorporate GHG planning and long-term reductions into their existing procedures, institutional organization, reporting and long-term planning; this is a process that will be unique to each jurisdiction.

Table 4-1: Climate Action Plan Implementation Responsibilities

WRCOG	Jurisdictions/CAP Coordinators
Secure financing to implement GHG reduction measures (i.e., grants)	Secure long-term financing to implement GHG reduction measures
Coordinate meetings among member jurisdictions, regional partners and stakeholders	Coordinate meetings amongst local community stakeholders
Serve as the external communication hub to regional climate action organizations including California Air Resources Board (CARB), South Coast Air Quality Management District (SCAQMD), Southern California Association of Governments (SCAG)	Serve as the communication hub to the community and local stakeholders
Conduct public outreach to inform the community of the subregion's reduction planning efforts	Submit annual reports to governing bodies
Develop a protocol for monitoring the effectiveness of emissions reduction programs	Utilize tool developed by WRCOG to report and document emission reduction progress
Establish guidelines and develop a tool for reporting and documenting emissions reduction progress	
Submit annual reports to the WRCOG Executive Committee and member agency governing bodies	
Develop a protocol for utilizing the real-time information collected through the verification process to modify and revise existing reduction programs	
Track state and federal legislation and its applicability to member jurisdictions	

SCHEDULE OF IMPLEMENTATION

WRCOG will track State measures, facilitate implementation of the regional measures and will coordinate with each participating jurisdiction to implement local measures. When feasible, WRCOG will act as the convener and assist in identifying funding, establishing partnerships, and track and monitor progress. Ultimately, each participating jurisdiction will be responsible for initiating the local actions to reduce emissions, but success for many measures will ultimately depend on public participation. Tasks that require active promotion may require updates to the WRCOG and jurisdictions' websites, distribution of physical promotional materials, and other active outreach activities. WRCOG and its members will develop programs to reach the public, including public forums, workshops, and meetings; these programs will be administered with the intent to foster an open public input and commenting process. Collaboration and coordination with transportation agencies (e.g., Riverside Transit Agency [RTA], Banning Pass Transit, and Riverside County Transportation Commission [RCTC]) will be essential to improving and increasing transit ridership, and enhancing mobility and transportation efficiency through better planning.

Further, coordination with external agencies and the private sector is critical for the success of many strategies, including utility companies for energy conservation and renewable energy programs, waste haulers for waste reduction actions, local water purveyors for water saving actions, and other local jurisdictions for work-sharing partnerships designed to take advantage of the common goals across Western Riverside County. Dependence on outside agency participation is mentioned explicitly in the strategy descriptions; WRCOG, its member jurisdictions, and partner stakeholders will continue to explore strategies for collaboration.

Table 4-2 provides a summary of the state, regional, and local measures included in this Subregional CAP and the emissions reductions associated with these measures anticipated by 2020. Chapter 3 provides a detailed description of each measure, jurisdictional participation, progress indicators, and community benefits.

Table 4-2: Implementation Summary

Measure	2020 Annual GHG Reductions (MT CO_2e/yr)	Objectives
SR-1: Renewables Portfolio Standard	434,606	• 20% of retail sales from renewables by 2013. • 25% of retail sales from renewables by 2016. • 33% of retail sales from renewables by 2020.
SR-2: 2013 California Building Energy Efficiency Standards (Title 24, Part 6)	30,923	• Residential construction 25% more efficient and nonresidential construction 30% more efficient than the 2008 standards.
SR-3: HERO Residential Program	71,649	• Expanding list of eligible products for financing. • Increase in funded applications and completed projects. • Increased energy savings, renewable energy installation, job creation, and economic development.
SR-4: HERO Commercial Program	10,079	• Expanding list of eligible products for financing. • Increase in funded applications and completed projects. • Increased energy savings, renewable energy installation, job creation, and economic development.
SR-5: Utility Programs	9,182	• Increased participation in programs.

Measure	2020 Annual GHG Reductions ($MT\ CO_2e/yr$)	Objectives
SR-6: Pavley & Low Carbon Fuel Standards	1,095,555	• Increasingly-stringent fuel-efficiency standards for passenger vehicles 2017 through 2025. • The carbon-intensity of California's transportation fuel to be reduced by at least 10% by 2020.
SR-7: Metrolink Expansion	23,074	• Extension of service to Perris by 2015.
SR-8: Express Lanes	60,864	• Extended express lanes along SR-91 and I-15 operational by 2020.
SR-9: Congestion Pricing	3,246	• Congestion pricing on the SR-91 and I-15 by 2020.
SR-10: Telecommuting	40,576	• Increasing the availability and use of carpooling, vanpooling, transit, bicycling, and walking. • Shifting work schedules to non-peak periods or locations. • Using telecommuting. • 5% of workers in the region telecommuting by 2020.
SR-11: Goods Movement	22,688	• Penetration of electric and low-emission trucks. • Physical improvements on freeways such as truck climbing lanes.
SR-12: E-Vehicle Plan and Infrastructure	81,152	• Charging stations, changes to development codes, and other strategies to encourage purchase and use of electric vehicles.
SR-13: Construction and Demolition Waste Diversion	3,574	• 50% of scrap lumber diverted from landfill waste stream.
SR-14: Water Conservation	23,192	• Urban retail water suppliers to reduce per-capita water use by 10% from a baseline level by 2015. • Reduce per-capita water use by 20% by 2020.
E-1: Energy Action Plans	357,581	• Implement programs to meet energy efficiency targets.
E-2: Traffic & Street Lights	4,697	• Platinum Level: 100% of traffic & street lights converted to high-efficiency bulbs by 2020. • Gold Level: 75% of traffic & street lights converted to high-efficiency bulbs by 2020. • Silver Level: 50% of traffic & street lights converted to high-efficiency bulbs by 2020.

Measure	2020 Annual GHG Reductions (MT CO_2e/yr)	Objectives
E-3: Shade Trees	2,014	• Platinum Level: Shade trees required for all new developments. • Gold Level: Subsidized program to support planting city-identified tree species. • Silver Level: Outreach program promoting the benefits of planting additional trees in urban environments.
T-1: Bicycle Infrastructure	29,255	• Platinum Level: 50% increase in bicycle lane mileage from 2010 levels. • Gold Level: 25% increase in bicycle lane mileage from 2010 levels. • Silver Level: 10% increase in bicycle lane mileage from 2010 levels.
T-2: Bicycle Parking	6,290	• Platinum Level: Amend zoning to require provision of bike parking for all multi-family or mixed-use projects. • Gold Level: Amend zoning to require provision of bike parking for multi-family projects consisting of more than 50 dwelling units, and mixed-use projects greater than 50,000 sf. • Silver Level: Provide information to applicants for large development projects describing the benefits of bike parking.
T-3: End of Trip Facilities	1,836	• Platinum Level: Amend zoning code to require installation of end-of-trip facilities for new commercial buildings greater than 50,000 sf. • Gold Level: Amend zoning to require installation of end-of-trip facilities for new commercial buildings greater than 100,000 sf. • Silver Level: Provide information to commercial project applicants describing the benefits of installing end-of-trip facilities.
T-4: Promotional Transportation Demand Management	1,831	• Platinum Level: Allocate a full-time staff person to promote TDM strategies to existing businesses. • Gold Level: Allocate the equivalent of ½ of a full-time staff person to promote TDM strategies to existing businesses. • Silver Level: Train an existing staff person to promote TDM strategies to existing businesses.

Measure	2020 Annual GHG Reductions (MT CO_2e/yr)	Objectives
T-5: Transit Service Expansion	704	• Platinum Level: 20% increase in fixed-route service miles. • Gold Level: 10% increase in fixed-route service miles. • Silver Level: 5% increase in fixed-route service miles.
T-6: Transit Frequency Expansion	2,723	• Platinum Level: 20% increase in fixed-route service frequency over 2010 levels in transit priority areas (TPAs) as determined by the latest available SCAG SCS/RTP. • Gold Level: 10% increase in fixed-route service frequency over 2010 levels in TPAs. • Silver Level: 5% increase in fixed-route service frequency over 2010 levels in TPAs.
T-7: Traffic Signal Coordination	94,600	• Platinum Level: Coordinate traffic signals on an additional 50% of arterial roads. • Gold Level: Coordinate signals on an additional 25% of arterial roads. • Silver Level: Coordinate signals on an additional 10% of arterial roads.
T-8: Density	2,857	• Platinum Level: Achieve a 25% increase in community-wide household and employment density over 2010 baseline conditions by 2020. • Gold Level: Achieve a 10% increase in density by 2020. • Silver Level: Achieve a 5% increase in density by 2020.
T-9: Mixed-Use Development	4,069	• Platinum Level: Achieve a 25% jobs/housing ratio improvement Citywide over 2010 baseline conditions. • Gold Level: Achieve a 10% jobs/housing ratio improvement. • Silver Level: Achieve a 5% jobs/housing ratio improvement.

Measure	2020 Annual GHG Reductions (MT CO_2e/yr)	Objectives
T-10: Design/Site Planning	912	• Platinum Level: 25% increase in intersection density and reduction in block-length in new development. • Gold Level: 10% increase in intersection density and reduction in block-length in new development. • Silver Level: 5% increase in intersection density and reduction in block-length in new development.
T-11: Pedestrian Only Areas	2,812	• Platinum Level: Designate one additional major activity center in the community as a permanent pedestrian-only area. • Gold Level: Designate one additional pedestrian-only area during weekends. • Silver Level: Designate one additional pedestrian-only area during weekends tied to a special event such as a Farmer's market.
T-12: Limiting Parking Requirements for New Development	28,423	• Platinum Level: Amend zoning to reduce parking requirements for new non-residential development by 25%. • Gold Level: Reduce parking requirements for new non-residential development by 10%. • Silver Level: Reduce parking requirements for new non-residential development by 5%.
T-13: High Frequency Transit Service	1,801	• Platinum Level: Work with RTA to offer high frequency transit service within 3 corridors • Gold Level: Offer high frequency transit service within 2 corridors • Silver Level: Offer high frequency transit service within 1 corridor
T-14: Voluntary Transportation Demand Management	2,464	• Platinum Level: 50% of employees within the jurisdiction participation in voluntary TDM programs. • Gold Level: 25% of employees within jurisdiction participate in voluntary TDM programs. • Silver Level: 12.5% of employees within the jurisdiction participate in voluntary TDM programs.
T-15: Accelerated Bike Plan Implementation	5,340	• Install 75% of all bicycle facility miles identified in City's Bike Plan by 2020 • Install 50% of all bicycle facility miles • Install 25% of all bicycle facility miles

Measure	2020 Annual GHG Reductions (MT CO_2e/yr)	Objectives
T-16: Fixed Guideway Transit	10,489	• Implementation of streetcar could potentially double existing transit mode split within City, which equates to 1.5% reduction in VMT.
T-17: Neighborhood Electric Vehicle Programs	4,707	• Adopt comprehensive NEV programs including signage and designated facilities.
T-18: Subsidized Transit	3,628	• Platinum Level: Provide subsidized or discounted transit passes to 3% of residents, students, and employees living, working, or going to school in the community. • Gold Level: Provide subsidized or discounted transit passes to 2%. • Silver Level: Provide subsidized or discounted transit passes to 1%.
SW-1: Yard Waste Collection	1,007	• Platinum Level: Adopt an ordinance prohibiting deposit of yard waste in the solid waste stream. • Gold Level: Provide residential green waste bins for collection and transport to organic waste processing facility. • Silver Level: Conduct an outreach campaign promoting the benefits of yard waste collection, without provision of green waste bins.
SW-2: Food Scrap and Paper Diversion	155	• Platinum Level: Accept food scraps and compostable paper within residential green waste bins; establish a commercial food scrap collection program • Gold Level: Accept food scraps and compostable paper within residential green waste bins or provide separate food scrap collection bins • Silver Level: Provide community outreach about benefits of food scrap and compostable paper collection with information about at-home composting

POTENTIAL FUNDING SOURCES

Funding Mechanisms

The GHG reduction strategies in this document were formulated with an understanding that WRCOG and member jurisdictions have limited staff time and financial resources to implement them. The costs for implementation include the creation or promotion of voluntary programs, continuing administration of those programs, coordination and outreach with other government agencies and businesses, and—in some cases—exploration or study of potential legislative or regulatory mechanisms not yet codified. A few strategies require up-front capital expenditures by local agencies. WRCOG and member jurisdictions will use a combination of staff time, grant funding, direct spending, and collaboration with other agencies and organizations to achieve CAP goals. This section presents a summary of funding and financing options (Table 4-3) available at the time this document was prepared.

Some funding sources are not necessarily directed towards a jurisdiction, but to a larger regional agency such as WRCOG, SCAG, a Joint Powers Authority (JPA), or a waste services provider serving multiple jurisdictions. WRCOG and its members should continually monitor private and public funding sources for new grant and rebate opportunities and to better understand how larger agencies are accessing funds that can be used for GHG reductions at the local level. Leveraging financing sources is one of the most important roles WRCOG and a local government can play in helping the community to implement many of the GHG reduction measures.

Table 4-3: Potential Funding Sources to Support CAP Implementation

Federal Funds	
Energy Efficient Mortgages	▪ The Federal Housing Administration (FHA) offers an Energy Efficient Mortgage Loan program that assists current or future homeowners with lowering their utility bills. This would be accomplished by enabling homeowners to incorporate the cost of adding energy-efficient improvements into their home mortgage. Energy efficient upgrades could be chosen that would allow owners to realize net monthly savings. The goal is to provide owners additional financing for energy efficiency upgrades at a discounted interest rate.
Moving Ahead for Progress in the 21st Century (MAP-21)	▪ Federal funding through the MAP-21 program is administered through the state and regional governments. MAP-21 funding is administered through Caltrans, MPOs (SCAG in Southern California) and RTPAs (RCTC in Riverside County). Most of the funding programs are transportation versus recreation oriented, with an emphasis on reducing auto trips and providing an intermodal connection. In most cases, MAP-21 provides matching grants of 50 to 100%.
Safe Routes to Schools	▪ Safe Routes to Schools is an international movement focused on increasing the number of children who walk or bike to school by funding projects that remove barriers to doing so. These barriers include a lack of infrastructure and non-infrastructure projects, safety, and limited programs that promote walking and bicycling. In California, two separate Safe Routes to School programs are available at both the state and federal level, and both programs fund qualifying infrastructure projects.

American Recovery and Reinvestment Act (ARRA) Community Partnerships	▪ Federal funding for local energy efficiency programs is available. Funding for energy efficiency has been provided to the California Department of Community Services and Development, which has dispersed funds locally through the Community Action Partnership of Riverside County. The Partnership provides free home weatherization and other energy assistance resources to low-income and elderly citizens of Riverside County. Programs include the Low-Income Home Energy Assistance Program and the Weatherization Assistance Program.
State Funds	
California Air Resources Board (CARB)	▪ CARB offers several grants, incentives, and credits programs to reduce on-road and off-road transportation emissions. Residents, businesses, and fleet operators can receive funds or incentives depending on the program. ○ The following programs can be utilized to fund local measures: ○ Air Quality Improvement Program (AB 118) ○ Carl Moyer Program – Voucher Incentive Program ○ Goods Movement Emission Reduction Program (Prop 1B Incentives) ○ Loan Incentives Program ○ Lower-Emission School Bus Program/School Bus Retrofit and ○ Replacement Account (Prop 1B and EPA Incentives)
California Energy Efficiency Financing	▪ For years, the California Energy Commission (CEC) has provided a loan program that supports local government energy retrofits and some new construction projects. Since 1979, more than $272 million has been allocated to more than 773 recipients, as of 2012. The program provides low interest loans for feasibility studies and the installation of cost-effective energy projects in schools, hospitals, and local government facilities. The loans are repaid out of the energy cost savings and the program will finance lighting, motors, drives and pumps, building insulation, heating and air conditioning modifications, streetlights and traffic signal efficiency projects, and certain energy generation projects, including renewable energy projects and cogeneration. Loans can cover up to 100% of project costs and there is a maximum loan amount of $3 million.
California Department of Resources Recycling and Recovery (CalRecycle)	▪ CalRecycle grant programs allow jurisdictions to assist public and private entities in management of waste streams. ▪ Incorporated cities and counties in California are eligible for funds. ▪ Program funds are intended to: ○ Reduce, reuse, and recycle all waste. ○ Encourage development of recycled-content products and markets. ○ Protect public health and safety and foster environmental sustainability.
Strategic Growth Council (SGC)	▪ In September 2008, California Senate Bill 732 created the Strategic Growth Council, which is a cabinet level committee whose tasks include coordinating the activities of member state agencies to assist state and local entities in the planning of sustainable communities and meeting AB 32 goals, including coordination of Planning Grants and Urban Greening Grants.

State Funding for Infrastructure	▪ The state's Infill Infrastructure Grant Program may potentially be used to help fund measures that promote infill housing development. ▪ Grants can be used for gap funding for infrastructure improvements necessary for specific residential or mixed-use infill development projects.
Existing Capital Improvement Program	▪ State and federal funds would most likely continue to local governments, builders, and homeowners in the following forms: ○ Grants ○ Transportation and transit funding ○ Tax credit and rebate programs ○ The Capital Improvement Program can be utilized for measures relating to traffic or transit.
Private and Non-Governmental Support	
▪ Community-based non-profits, local businesses, and investor owned utilities should be considered as resources for direct and indirect support, including funding, for program activation and operations. ▪ Private investors may provide funding to local governments. For example, energy service companies can finance the up-front investments in energy efficiency, reimbursed by the local government over a contract period. Private companies may finance solar power installations, and then recoup their investment by selling the resulting power to the building owner.	

Additional Considerations

In addition to pursuing the funding options above and monitoring the availability of others, WRCOG and its member jurisdictions may take the following steps to inform decisions related to the cost of GHG reduction measures.

- **Perform and refine cost estimates:** Cost estimates for local reduction measures should be performed to identify the cost-effectiveness of each measure to inform and guide the implementation process. This analysis will likely be based on a variety of participation, per-unit and other assumptions. As programs are developed, cost estimates should be refined an updated over time with more precise implementation-level data.
- **Integrate GHG measures into existing city budget and Capital Improvement Plan (CIP):** Certain capital improvements, particularly those identified in Energy and Land Use/Transportation Measures, may need to be added to the city's CIP and facility master plan programs, as well as those of the city utility enterprises and other public agencies (such as transit agencies) that have control for project implementation. For CIPs completely under the city's control, new projects would need to be assessed for consistency with a city's local CAP or adherence to some minimum energy efficiency standard similar to that achieved by the local plan.
- **Adopt or update ordinances and/or codes:** Some local reduction measures may represent a continuation of recently enacted ordinances, while others would require new ordinances. WRCOG will develop a "plug and play" implementation toolkit of model general plan, zoning and building code amendments and other programs to help facilitate the GHG reduction and climate adaptation measures outlined in the Subregional CAP. The model "best practices and programs" aspect of the toolkit will include, but not be limited to, those related to energy, water, land use, transportation, stormwater management, building reuse, and waste reduction. The policies and model codes of the toolkit will be drafted so they can be easily integrated into a jurisdiction's planning process.
- **Pursue outside funding sources:** A range of funding from state and federal agencies has been identified. WRCOG and local jurisdictions should pursue these and other emerging funding sources as a part of implementation efforts.

- **Implement and direct preferred city funding sources.** While city funding sources are limited in most cities, the city, when financially able, as a part of its budget process, could appropriate funding from general sources or make changes in its fee schedules, utility rates, and other sources as needed to support funding the implementation of the GHG reduction measures.
- **Create monitoring/tracking processes:** Local reduction measures will usually require program development, tracking, and/or monitoring. WRCOG will develop a tool to enable member jurisdictions to report their progress on a regular basis. GHG emissions reduction and adaptation measures could be sorted based on implementation timing, responsible agency, and level of success/completion. By allowing specific tasks to be checked off once each phase of the CAP is completed, jurisdictions will be able to save time reviewing reports, tracking data manually, and verifying that measures are fully completed. Each proposed measure included in the CAP will be built-in the database with information such as:
  - Program;
  - Responsibility;
  - Cost;
  - Potential Funding Sources;
  - Priority; and
  - Time Frame
- **Identify economic and health indicators to consider future funding options:** Identification and monitoring of economic and health indicators and trends, such as home prices, energy prices cost per kWh on solar installations, unemployment rates, or real wage increases, can guide the potential for funding local reduction measures through different financing mechanisms. WRCOG will work with the County of Riverside and other regional agencies to identify and develop measurable health outcome indicators for each CAP measure. Indicators will be used to identify health co-benefits of the CAP, establish priorities, develop target resources, create benchmarks, and track progress towards community objectives.

MONITORING AND REPORTING

Regular monitoring is important to ensure programs are functioning as they were originally intended. Early identification of effective strategies and potential issues would enable WRCOG and its member jurisdictions to make informed decisions on future priorities, funding, and scheduling. Moreover, monitoring provides concrete data to document the subregion's progress in reducing GHG emissions. WRCOG will work with local jurisdictions to develop a protocol for monitoring the effectiveness of emissions reduction programs as well as for undertaking emissions inventory updates.

- **Update GHG Inventory**: It is recommended that emissions be inventoried on a regular basis, including regular data collection in each of the primary inventory sectors (utility, regional VMT, waste, wastewater, and water), and compare to the baseline GHG emissions in 2010. A combined inventory effort could be conducted through WRCOG similar to the inventory preparation that was done for this Subregional CAP.
- **Track State Progress**: The Subregional CAP relies heavily on state-level measures. WRCOG may be responsible for tracking the state's progress on implementing state-level programs. Close monitoring of the real gains being achieved by state programs would allow WRCOG and participating jurisdictions to adjust its CAP, if needed.
- **Track Completion of GHG Reduction Measures**: Tracking of measures implemented as scheduled in the CAP, including progress reports on each measure, funding, and Savings will allow at least a rough attribution of gains when combined with regular GHG inventory updates.

- **Regular Progress Reports**: WRCOG will develop a formal framework for monitoring performance and tracking the progress of CAP implementation, including health and economic indicators. The framework may take the form of an annual report card, progress report, or similar type of tool that will help monitor the achievements, effectiveness and appropriateness of each performance measure. If annual reports, periodic inventories, or other information indicates that the GHG reduction measures are not as effective as originally anticipated, the CAP may need to be adjusted, amended, or supplemented. The report card (or similar) will be periodically (i.e., annually) presented to WRCOG's Executive Committee and various technical committees (Technical Advisory Committee, Planning Directors' Technical Advisory Committee, and Public Works Committee) as well as member jurisdictions and will focus on the status of agreed upon performance measures.

REDUCING GHG EMISSIONS AFTER 2020

In order to assess whether implementing this CAP achieves the state's long-term climate goals, one must look beyond 2020 to see whether the emissions reduction measures included for the 2020 milestone set the subregion on the trajectory toward future greater reductions in the post-2020 period. To date, there is no state or federal mandate requiring local action to reduce GHG emissions after 2020. AB 32 contains no post-2020 reduction target nor provides CARB with the authority to mandate compliance with a post-2020 target. SB 375, while it contains requirements for SCAG to promote reductions in the passenger and light duty vehicle sector, does not contain mandatory requirements for local jurisdictions to reduce their GHG emissions overall.

Governor Schwarzenegger's Executive Order (EO) S-3-05 calls for an 80% reduction below 1990 GHG emissions levels by 2050. However, an executive order is only binding on state agencies, and does not represent a legal mandate for local governments or the private sector. Nevertheless, S-03-05 contains a 2050 reduction target that is based on current scientific understanding of the reductions needed to avoid the effects of climate change that could result from unabated rise in anthropogenic GHG emissions. The 2050 target in EO-S-03-05 is equivalent to a 2050 statewide target of about 85 million metric tons of carbon dioxide equivalent (MT CO_2e) (total emissions), as compared to the 1990 level of 427 million MT CO2e.

The state is on track to achieve significant reductions by 2020 and has made some advancement towards deeper reductions by 2050, however, it is clear that our energy-intensive economy cannot achieve long-term growth unless we find greater efficiencies and low-carbon alternatives to powering our industries, homes, businesses, and transportation systems.Climate protection must be compatible with economic growth for successful implementation of GHG reduction strategies in California. The AB 32 Scoping Plan emphasizes clean energy, end-use efficiencies and clean vehicle standards to lower the state's emissions, outlining a mix of incentives and programs designed to smooth California's transition to a low-carbon economy. The 2013 update to the Scoping Plan points to the critical need for rapid market penetration of new technologies that reduce energy demand, electrify our vehicle fleets, and decarbonize electricity and fuel supplies.

Meanwhile, the Governor's Office of Planning and Research (OPR) recently released its first draft Environmental Goals and Policy Report (EGPR) in almost 35 years, entitled *California @ 50 Million:*

California's Climate Future[2] The central theme of that document is "growth in the context of climate change," emphasizing the massive challenge the state faces in meeting its long-term (2050) GHG emissions goal. As the report states, achieving the 2020 target is just one step toward long-term stabilization of the climate. Significant GHG reductions by 2050 can only be achieved through a low-carbon transformation of our economy and its supporting infrastructure and mobility systems, which in turn must be driven by focused investments and strong policy signals. This is the direction the state is headed, calling for commitments that will "send a strong signal of support for the innovators and entrepreneurs to drive technology and development to tackle the challenge of climate change." The EGPR indicates that climate change will influence nearly every aspect of the state's next phase of planning and investment for the future.

Full implementation and expansion of CARB's Scoping Plan to increase efforts beyond 2020 and expansion of the strategies studied in this CAP could put the subregion on a path toward achieving these required long-term reductions. While the specific measures needed to meet the 2050 goal are too far in the future to define in detail, one can examine the level of achievement that would be needed to keep the region on track through 2035. The measures needed to achieve longer-term targets are logical extensions of the programs recommended in the CARB Scoping Plan at the state level and the measures included in this CAP at the local level. By building on planned state efforts during this period and ramped up efforts in the local building energy and transportation (and other) sectors on the part of local governments, the subregion can be on track to reach a 2035 goal.

This CAP has not assumed any benefit from a cap-and-trade system by 2020, but when implemented, such a system may result in reductions beyond those currently anticipated in the CAP for 2020, and in additional reductions for 2030. The California Cap-and-Trade Program will particularly affect large stationary sources, which are excluded from local measures in this CAP to avoid duplication of state and federal regulatory efforts. In addition, the Cap-and-Trade Program will also affect electricity generation and transportation fuels, which may change energy prices, in turn potentially altering energy use and transportation behavior beyond that assumed for the various local measures included in this CAP.

WRCOG will continue to monitor developments at the national and state levels regarding implementation of GHG emissions reductions beyond 2020.

CEQA PROJECT REVIEW

Under the California Environmental Quality Act (CEQA), the effects of GHG emissions are considered a potentially significant environmental impact. In addressing climate change, CEQA provides a useful mechanism for local agencies to evaluate the environmental effects of new development, but may also create inefficiencies for both agency staff and applicants through repetitive assessments of small projects on an individual basis, rather than considering cumulative effects of future development and determining needed mitigation up front. The CEQA Guidelines recognize this, and include a provision for streamlining the analysis of projects that are consistent with a comprehensive plan for the reduction of GHG emissions (CEQA Guidelines, Section 15183.5).

[2] California @ $50 Million, September 2013. Available at opr.ca.gov/docs/EGPR_ReviewDraft.pdf.

To meet the requirements of CEQA Guidelines Section 15183.5(b)(1) a qualified CAP must:

1. Quantify existing and projected GHG emissions within the plan area
2. Establish a reduction target based on AB 32's provisions (a level where GHG emission are not cumulatively considerable)
3. Identify and analyze sector specific GHG emissions from Plan activities
4. Specify policies and actions (measures) that local jurisdictions will enact and implement over time to achieve specified reduction target
5. Establish a tool to monitor progress and amend if necessary
6. Adopt in a public process following environmental review

WRCOG is seeking funding to prepare the required environmental document in order for jurisdictions to adopt the Subregional CAP and utilize streamlining benefits. A Program EIR specifically for the Subregional CAP will be prepared explicitly with tiering in mind, by developing mitigation measures that are tailored to the WRCOG subregion environment, and will set performance metrics for future project impacts that cannot be analyzed at the program level.

A development project would demonstrate consistency with the CAP if it is consistent with the CAP assumptions regarding the amount and type of future development, and is consistent with the GHG reduction measures identified in the CAP. Projects consistent with the CAP, including conformance with any performance measures applicable to the project, would not require additional GHG emissions analysis and mitigation under CEQA Guidelines Sections 15064(h) and 1513.5(b)(2).[3] However, a project applicant can always choose to demonstrate compliance with the AB 32 target by preparing an individual project analysis that calculates GHG emissions as part of their CEQA documentation.

In a future phase of the work program, WRCOG will develop a checklist to assist with determining project consistency with the CAP. The checklist is intended to provide individual projects the opportunity to demonstrate that they are minimizing GHG emissions, while ensuring that new development achieves a proportion of emissions reduction consistent with what is assumed in the CAP. The project review checklist will screen projects for important GHG reduction measures that, when implemented, will facilitate and not impede the subregion's ability to meet its 2020 GHG emissions target. The checklist will apply to all projects subject to CEQA.

[3] If there is substantial evidence that the effects of a particular project may be cumulatively considerable, notwithstanding the project's compliance with the CAP, CEQA requires that an EIR be prepared.

Exhibit X

Exhibit X

Table 8. **Farms, Land in Farms, Value of Land and Buildings, and Land Use: 2012 and 2007**

[For meaning of abbreviations and symbols, see introductory text.]

Item	California	Alameda	Alpine	Amador	Butte	Calaveras	Colusa
FARMS AND LAND IN FARMS							
Farms ... number, 2012	77,857	452	3	461	2,056	663	782
2007	81,033	525	7	479	2,048	631	814
Land in farms ... acres, 2012	25,569,001	177,798	(D)	155,187	381,019	212,140	453,061
2007	25,364,695	204,633	1,810	163,482	373,786	201,026	474,092
Average size of farm ... acres, 2012	328	393	(D)	337	185	320	579
2007	313	390	259	341	183	319	582
Estimated market value of land and buildings ... farms, 2012	77,857	452	3	461	2,056	663	782
2007	81,033	525	7	479	2,048	631	814
$1,000, 2012	160,524,953	980,960	5,400	610,549	2,895,258	692,061	2,460,439
2007	162,533,390	793,469	12,400	778,896	2,808,308	736,816	1,886,574
Average per farm ... dollars, 2012	2,061,792	2,170,266	1,800,000	1,324,402	1,408,200	1,043,832	3,146,342
2007	2,005,768	1,511,370	1,771,429	1,626,088	1,371,244	1,167,695	2,317,659
Average per acre ... dollars, 2012	6,278	5,517	4,289	3,934	7,599	3,262	5,431
2007	6,408	3,878	6,851	4,764	7,513	3,665	3,979
2012 farms by value group:							
$1 to $49,999 ...	3,768	32	-	12	93	37	9
$50,000 to $99,999 ...	2,993	21	-	7	81	32	14
$100,000 to $199,999 ...	6,849	21	-	18	208	97	70
$200,000 to $499,999 ...	22,324	86	-	138	737	238	169
$500,000 to $999,999 ...	17,939	111	-	126	440	145	124
$1,000,000 to $1,999,999 ...	9,621	95	1	87	192	49	137
$2,000,000 to $4,999,999 ...	8,056	62	2	52	183	41	149
$5,000,000 to $9,999,999 ...	3,283	5	-	10	74	13	59
$10,000,000 or more ...	3,024	19	-	11	48	11	51
Approximate land area ... acres, 2012	99,698,909	472,974	472,524	380,529	1,047,337	652,808	736,466
Proportion in farms ... percent, 2012	25.6	37.6	(D)	40.8	36.4	32.5	61.5
2012 size of farm:							
1 to 9 acres ... farms	24,637	168	-	68	635	145	63
acres	95,670	546	-	305	2,761	607	310
10 to 49 acres ... farms	25,811	104	-	152	738	253	152
acres	584,643	2,267	-	4,158	16,352	5,592	3,416
50 to 69 acres ... farms	3,700	18	-	50	96	48	34
acres	212,480	970	-	2,847	5,373	2,909	2,028
70 to 99 acres ... farms	3,601	18	-	29	88	25	57
acres	294,439	1,533	-	2,327	7,318	2,072	4,641
100 to 139 acres ... farms	3,222	35	2	45	67	45	53
acres	369,985	3,805	(D)	5,091	7,995	5,223	5,846
140 to 179 acres ... farms	2,533	15	-	19	71	25	44
acres	398,520	2,378	-	2,978	10,917	3,879	6,896
180 to 219 acres ... farms	1,477	9	-	16	53	4	39
acres	292,751	1,819	-	3,208	10,561	810	7,654
220 to 259 acres ... farms	1,189	3	-	3	35	14	24
acres	282,281	695	-	694	8,298	3,385	5,774
260 to 499 acres ... farms	3,983	27	-	27	129	38	136
acres	1,428,792	9,397	-	9,576	45,640	13,224	48,264
500 to 999 acres ... farms	3,230	18	-	27	84	25	93
acres	2,244,264	11,903	-	18,023	56,278	18,480	61,562
1,000 to 1,999 acres ... farms	2,040	15	1	14	34	19	33
acres	2,800,180	22,217	(D)	21,576	45,723	26,171	47,471
2,000 acres or more ... farms	2,434	22	-	11	26	22	54
acres	16,564,996	120,268	-	84,404	163,803	129,788	259,199
2007 size of farm:							
1 to 9 acres ... farms	25,278	161	-	70	613	148	64
acres	100,816	675	-	348	2,782	673	322
10 to 49 acres ... farms	28,080	156	1	193	707	227	190
acres	637,914	3,316	(D)	5,138	15,536	5,425	4,208
50 to 69 acres ... farms	3,776	21	-	36	88	35	31
acres	217,567	1,144	-	1,991	4,983	2,106	1,847
70 to 99 acres ... farms	3,678	22	-	27	75	37	40
acres	300,943	1,839	-	2,272	6,090	3,096	3,321
100 to 139 acres ... farms	3,067	40	2	28	85	28	38
acres	353,529	4,388	(D)	3,211	9,781	3,304	4,322
140 to 179 acres ... farms	2,418	10	1	27	56	26	28
acres	381,684	1,615	(D)	4,375	8,788	4,039	4,342
180 to 219 acres ... farms	1,626	10	2	15	55	10	36
acres	321,033	2,009	(D)	2,859	10,899	2,022	7,031
220 to 259 acres ... farms	1,305	12	-	7	48	11	42
acres	310,154	2,825	-	1,644	11,421	2,635	9,908
260 to 499 acres ... farms	4,083	30	-	31	159	31	126
acres	1,461,559	10,589	-	10,998	56,022	11,102	42,938
500 to 999 acres ... farms	3,267	27	1	19	105	34	115
acres	2,280,819	19,858	(D)	12,668	73,249	24,873	76,619
1,000 to 1,999 acres ... farms	2,194	14	-	10	37	23	61
acres	2,999,788	17,995	-	12,170	50,987	30,663	85,316
2,000 acres or more ... farms	2,261	22	-	16	20	21	43
acres	15,998,889	138,380	-	105,808	123,248	111,088	233,918
LAND IN FARMS ACCORDING TO USE							
Total cropland ... farms, 2012	57,731	228	3	236	1,606	280	711
2007	61,215	316	4	236	1,574	298	743
acres, 2012	9,591,783	20,347	563	16,022	227,279	6,059	285,689
2007	9,464,647	30,549	490	15,593	222,713	12,097	298,996
Harvested cropland ... farms, 2012	53,372	194	3	217	1,510	235	654
2007	53,000	237	4	189	1,460	193	661
acres, 2012	8,007,461	9,901	(D)	8,521	203,573	4,165	263,675
2007	7,633,173	10,759	490	7,457	200,943	2,872	276,588
Other pasture and grazing land that could have been used for crops without additional improvements (see text) ... farms, 2012	2,879	28	-	15	54	37	32
2007	10,890	87	-	77	201	120	85
acres, 2012	492,270	7,584	-	5,947	3,176	794	3,397
2007	800,204	15,864	-	6,418	8,821	9,034	6,398

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Table 8. **Farms, Land in Farms, Value of Land and Buildings, and Land Use: 2012 and 2007** (continued)

[For meaning of abbreviations and symbols, see introductory text.]

Item	Contra Costa	Del Norte	El Dorado	Fresno	Glenn	Humboldt	Imperial
FARMS AND LAND IN FARMS							
Farms ....number, 2012	602	121	1,358	5,683	1,311	930	421
2007	634	85	1,268	6,081	1,242	852	452
Land in farms .... acres, 2012	127,670	(D)	128,365	1,721,202	668,784	593,597	515,783
2007	146,993	18,168	107,080	1,636,224	489,186	597,477	427,349
Average size of farm .... acres, 2012	212	(D)	95	303	510	638	1,225
2007	232	214	84	269	394	701	945
Estimated market value of land and buildings .... farms, 2012	602	121	1,358	5,683	1,311	930	421
2007	634	85	1,268	6,081	1,242	852	452
$1,000, 2012	1,075,682	179,244	1,056,228	14,261,398	3,071,619	1,534,054	3,611,281
2007	970,838	123,550	1,088,011	12,970,248	2,359,392	1,468,721	2,260,463
Average per farm ....dollars, 2012	1,786,848	1,481,355	777,782	2,509,484	2,342,959	1,649,521	8,577,864
2007	1,531,291	1,453,524	858,053	2,132,914	1,899,672	1,723,851	5,001,024
Average per acre ....dollars, 2012	8,425	8,716	8,228	8,286	4,593	2,584	7,002
2007	6,605	6,800	10,161	7,927	4,823	2,458	5,290
2012 farms by value group:							
$1 to $49,999	41	2	50	271	74	63	18
$50,000 to $99,999	20	8	67	196	60	66	15
$100,000 to $199,999	34	3	127	449	107	70	48
$200,000 to $499,999	96	45	539	1,864	397	216	65
$500,000 to $999,999	214	21	363	1,068	250	235	34
$1,000,000 to $1,999,999	77	24	134	648	125	133	30
$2,000,000 to $4,999,999	85	9	55	640	170	83	55
$5,000,000 to $9,999,999	10	7	16	269	79	37	50
$10,000,000 or more	25	2	7	278	49	27	106
Approximate land area .... acres, 2012	458,940	644,085	1,093,055	3,813,676	840,926	2,283,509	2,673,027
Proportion in farms .... percent, 2012	27.8	(D)	11.7	45.1	79.5	26.0	19.3
2012 size of farm:							
1 to 9 acres ....farms	285	33	435	969	225	253	53
acres	1,053	115	1,998	4,245	984	1,015	217
10 to 49 acres ....farms	156	39	630	2,425	447	249	72
acres	3,520	746	12,888	60,454	10,881	5,728	1,884
50 to 69 acres ....farms	20	4	80	380	92	41	6
acres	1,210	262	4,610	21,809	5,344	2,291	378
70 to 99 acres ....farms	14	9	61	336	78	60	24
acres	1,150	700	5,042	27,420	6,431	4,973	1,900
100 to 139 acres ....farms	36	5	51	299	59	32	14
acres	4,087	520	6,094	34,043	6,785	3,571	1,688
140 to 179 acres ....farms	10	10	12	189	44	32	19
acres	1,482	1,541	1,912	29,381	6,963	5,114	2,961
180 to 219 acres ....farms	2	7	15	85	21	28	15
acres	(D)	1,300	3,065	16,629	4,225	5,540	2,984
220 to 259 acres ....farms	2	2	7	72	30	27	9
acres	(D)	(D)	1,713	17,048	7,080	6,361	2,092
260 to 499 acres ....farms	29	4	26	290	114	64	38
acres	10,351	1,514	8,735	106,226	41,712	22,802	14,050
500 to 999 acres ....farms	14	4	21	296	101	37	37
acres	8,922	2,542	15,064	212,852	70,242	24,390	27,947
1,000 to 1,999 acres ....farms	11	3	10	194	58	43	45
acres	14,187	4,690	12,110	260,674	79,934	57,821	71,267
2,000 acres or more ....farms	23	1	10	148	42	64	89
acres	80,803	(D)	55,134	930,421	428,203	453,991	388,415
2007 size of farm:							
1 to 9 acres ....farms	263	28	393	964	211	191	54
acres	1,064	144	1,827	4,193	965	746	198
10 to 49 acres ....farms	205	17	610	2,766	402	255	73
acres	4,731	373	12,425	69,144	10,029	6,133	1,851
50 to 69 acres ....farms	25	7	76	351	74	40	15
acres	1,469	454	4,348	20,302	4,291	2,338	834
70 to 99 acres ....farms	11	4	50	355	62	46	27
acres	957	339	4,069	28,983	5,043	3,855	2,163
100 to 139 acres ....farms	22	4	36	253	50	48	20
acres	2,490	498	4,206	28,965	5,644	5,455	2,396
140 to 179 acres ....farms	18	8	24	189	46	29	15
acres	2,751	1,213	3,710	29,612	7,205	4,573	2,306
180 to 219 acres ....farms	8	2	9	104	37	20	22
acres	1,500	(D)	1,805	20,460	7,406	4,027	4,225
220 to 259 acres ....farms	11	2	19	88	25	20	10
acres	2,654	(D)	4,477	20,893	5,996	4,692	2,326
260 to 499 acres ....farms	14	6	31	355	145	62	38
acres	5,015	2,261	11,022	127,911	51,774	22,326	14,216
500 to 999 acres ....farms	26	3	5	311	91	37	54
acres	17,055	2,156	3,425	230,175	64,250	24,259	38,918
1,000 to 1,999 acres ....farms	11	2	4	198	60	48	58
acres	15,177	(D)	4,646	266,780	83,156	66,104	82,169
2,000 acres or more ....farms	20	2	11	147	39	56	66
acres	92,130	(D)	51,120	788,806	243,427	452,969	275,747
LAND IN FARMS ACCORDING TO USE							
Total cropland .... farms, 2012	365	63	828	4,816	1,058	575	361
2007	360	43	794	5,234	1,015	492	393
acres, 2012	46,531	8,609	11,130	1,153,351	274,310	20,936	487,892
2007	35,853	7,986	15,275	1,102,163	250,279	33,867	396,663
Harvested cropland .... farms, 2012	330	53	769	4,480	999	547	337
2007	289	29	645	4,736	924	389	365
acres, 2012	33,420	6,321	5,898	992,479	244,761	12,253	466,877
2007	23,876	3,244	5,930	978,948	228,533	13,358	375,904
Other pasture and grazing land that could have been used for crops without additional improvements (see text) .... farms, 2012	20	5	74	110	27	57	11
2007	84	25	222	654	166	183	30
acres, 2012	2,993	(D)	2,521	31,720	11,628	6,511	(D)
2007	9,048	4,543	6,871	30,804	9,131	17,478	4,546

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Table 8. **Farms, Land in Farms, Value of Land and Buildings, and Land Use: 2012 and 2007** (continued)

[For meaning of abbreviations and symbols, see introductory text.]

Item	Inyo	Kern	Kings	Lake	Lassen	Los Angeles	Madera
FARMS AND LAND IN FARMS							
Farms ..... number, 2012	125	1,938	1,056	838	448	1,294	1,507
2007	94	2,117	1,129	845	459	1,734	1,708
Land in farms ..... acres, 2012	330,840	2,330,233	673,634	150,721	482,680	91,689	653,584
2007	292,552	2,361,765	680,662	124,199	459,126	108,463	679,729
Average size of farm ..... acres, 2012	2,647	1,202	638	180	1,077	71	434
2007	3,112	1,116	603	147	1,000	63	398
Estimated market value of land and buildings ..... farms, 2012	125	1,938	1,056	838	448	1,294	1,507
2007	94	2,117	1,129	845	459	1,734	1,708
$1,000, 2012	257,872	10,334,478	4,062,689	917,777	930,019	1,142,385	4,976,164
2007	278,151	10,925,379	3,720,124	1,140,453	634,890	1,521,391	4,610,431
Average per farm ..... dollars, 2012	2,062,977	5,332,548	3,847,243	1,095,200	2,075,936	882,832	3,302,033
2007	2,959,058	5,160,784	3,295,061	1,349,648	1,383,204	877,388	2,699,315
Average per acre ..... dollars, 2012	779	4,435	6,031	6,089	1,927	12,459	7,614
2007	951	4,626	5,465	9,182	1,383	14,027	6,783
2012 farms by value group:							
$1 to $49,999	13	70	57	21	17	170	36
$50,000 to $99,999	4	56	32	50	15	104	44
$100,000 to $199,999	25	212	99	89	55	173	120
$200,000 to $499,999	16	408	285	318	173	389	408
$500,000 to $999,999	28	306	132	205	74	286	299
$1,000,000 to $1,999,999	11	205	131	71	47	87	204
$2,000,000 to $4,999,999	19	321	112	51	29	57	194
$5,000,000 to $9,999,999	4	127	109	19	23	8	102
$10,000,000 or more	5	233	99	14	15	20	100
Approximate land area ..... acres, 2012	6,515,800	5,204,448	889,229	804,141	2,906,358	2,597,181	1,367,729
Proportion in farms ..... percent, 2012	5.1	44.8	75.8	18.7	16.6	3.5	47.8
2012 size of farm:							
1 to 9 acres ..... farms	43	375	240	220	59	886	165
acres	85	1,224	986	958	263	2,341	696
10 to 49 acres ..... farms	20	411	301	356	123	264	510
acres	519	10,106	6,775	8,124	3,083	4,912	14,213
50 to 69 acres ..... farms	-	55	48	52	28	17	93
acres	-	3,185	2,814	2,906	1,670	1,012	5,328
70 to 99 acres ..... farms	4	97	63	53	21	27	177
acres	353	8,072	5,028	4,253	1,645	2,163	14,473
100 to 139 acres ..... farms	3	93	44	28	18	20	83
acres	368	10,725	5,082	3,256	2,127	(D)	9,808
140 to 179 acres ..... farms	9	128	40	26	21	19	67
acres	1,476	20,163	6,243	4,038	3,274	2,985	10,435
180 to 219 acres ..... farms	4	56	37	20	17	2	55
acres	788	11,183	7,290	3,839	3,371	(D)	10,955
220 to 259 acres ..... farms	3	41	15	8	10	11	39
acres	720	9,761	3,608	1,938	2,345	2,572	9,235
260 to 499 acres ..... farms	-	167	72	32	38	10	102
acres	-	60,346	27,050	10,904	14,704	3,819	36,016
500 to 999 acres ..... farms	11	186	83	22	40	15	98
acres	8,071	133,295	60,390	16,395	29,545	10,312	66,539
1,000 to 1,999 acres ..... farms	-	139	56	11	26	15	57
acres	-	195,948	76,022	15,192	34,756	22,171	76,668
2,000 acres or more ..... farms	28	190	57	10	47	8	61
acres	318,460	1,866,225	472,346	78,918	385,897	36,756	399,218
2007 size of farm:							
1 to 9 acres ..... farms	20	384	247	237	67	1,141	189
acres	(D)	1,270	1,007	1,043	328	3,271	811
10 to 49 acres ..... farms	21	527	355	324	98	365	603
acres	645	12,579	8,252	7,895	2,621	7,525	15,700
50 to 69 acres ..... farms	-	56	54	58	34	30	130
acres	-	3,225	3,082	3,415	2,000	1,720	7,536
70 to 99 acres ..... farms	4	133	54	49	46	39	170
acres	348	10,699	4,381	3,949	3,743	3,149	13,710
100 to 139 acres ..... farms	1	86	45	48	20	28	77
acres	(D)	10,068	5,465	5,574	2,208	3,230	8,828
140 to 179 acres ..... farms	5	114	33	33	26	19	73
acres	763	17,887	5,304	5,191	3,959	2,979	11,467
180 to 219 acres ..... farms	8	36	37	9	13	21	60
acres	1,646	7,152	7,236	1,808	2,585	4,187	11,969
220 to 259 acres ..... farms	3	48	26	16	14	11	54
acres	730	11,408	6,268	3,834	3,353	2,522	12,650
260 to 499 acres ..... farms	5	211	78	30	36	32	129
acres	1,612	78,067	28,259	10,975	13,219	10,548	47,030
500 to 999 acres ..... farms	9	174	87	22	33	21	111
acres	(D)	122,332	61,049	14,650	21,690	(D)	75,174
1,000 to 1,999 acres ..... farms	1	156	60	10	27	15	55
acres	(D)	216,632	81,304	12,619	36,003	19,922	75,335
2,000 acres or more ..... farms	17	192	53	9	45	12	57
acres	278,214	1,870,446	469,055	53,246	367,417	(D)	399,519
LAND IN FARMS ACCORDING TO USE							
Total cropland ..... farms, 2012	44	1,263	841	712	252	814	1,145
2007	43	1,449	928	707	275	940	1,288
acres, 2012	18,670	899,395	501,500	29,106	70,870	59,556	304,248
2007	8,261	942,827	512,870	28,997	82,567	49,158	290,683
Harvested cropland ..... farms, 2012	37	1,115	767	641	199	718	1,066
2007	25	1,169	805	638	197	632	1,123
acres, 2012	(D)	740,061	415,706	24,175	40,182	40,796	289,693
2007	(D)	764,929	419,964	18,800	46,908	25,829	264,767
Other pasture and grazing land that could have been used for crops without additional improvements (see text) ..... farms, 2012	7	71	21	40	40	48	38
2007	15	222	151	111	100	268	162
acres, 2012	(D)	31,537	(D)	1,216	14,445	4,698	5,356
2007	(D)	41,081	7,256	4,092	25,614	4,533	9,213

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Table 8. **Farms, Land in Farms, Value of Land and Buildings, and Land Use: 2012 and 2007** (continued)

[For meaning of abbreviations and symbols, see introductory text.]

Item	Marin	Mariposa	Mendocino	Merced	Modoc	Mono	Monterey
FARMS AND LAND IN FARMS							
Farms ....number, 2012	323	364	1,220	2,486	437	72	1,179
2007	255	302	1,136	2,607	448	84	1,199
Land in farms .... acres, 2012	170,876	283,611	770,257	978,667	523,522	56,386	1,268,144
2007	133,275	212,524	608,674	1,041,115	597,740	44,610	1,327,972
Average size of farm .... acres, 2012	529	779	631	394	1,198	783	1,076
2007	523	704	536	399	1,334	531	1,108
Estimated market value of land and buildings .... farms, 2012	323	364	1,220	2,486	437	72	1,179
2007	255	302	1,136	2,607	448	84	1,199
$1,000, 2012	1,064,419	596,586	3,090,747	7,571,804	900,917	158,819	6,205,157
2007	673,654	350,351	3,233,377	7,506,920	872,190	137,739	6,167,962
Average per farm ....dollars, 2012	3,295,414	1,638,972	2,533,399	3,045,778	2,061,595	2,205,825	5,263,068
2007	2,641,781	1,160,104	2,846,283	2,879,524	1,946,852	1,639,748	5,144,255
Average per acre ....dollars, 2012	6,229	2,104	4,013	7,737	1,721	2,817	4,893
2007	5,055	1,649	5,312	7,210	1,459	3,088	4,645
2012 farms by value group:							
$1 to $49,999	16	8	52	124	11	3	34
$50,000 to $99,999	5	7	62	85	18	-	37
$100,000 to $199,999	11	55	48	189	57	7	108
$200,000 to $499,999	38	122	272	615	114	20	220
$500,000 to $999,999	52	57	346	525	94	13	240
$1,000,000 to $1,999,999	78	46	178	323	58	11	166
$2,000,000 to $4,999,999	69	40	160	301	53	4	149
$5,000,000 to $9,999,999	40	17	46	168	16	12	84
$10,000,000 or more	14	12	56	156	16	2	141
Approximate land area .... acres, 2012	333,108	927,245	2,244,068	1,238,376	2,505,857	1,951,323	2,099,585
Proportion in farms .... percent, 2012	51.3	30.6	34.3	79.0	20.9	2.9	60.4
2012 size of farm:							
1 to 9 acres ....farms	61	39	251	374	35	7	234
acres	(D)	217	898	1,650	213	(D)	895
10 to 49 acres ....farms	68	99	344	1,035	63	16	261
acres	1,640	2,575	8,635	25,385	1,874	384	6,586
50 to 69 acres ....farms	10	7	64	125	16	3	50
acres	577	387	3,622	7,217	954	168	2,887
70 to 99 acres ....farms	20	30	53	139	37	5	62
acres	1,689	2,436	4,404	11,564	2,881	437	4,993
100 to 139 acres ....farms	15	14	90	123	29	1	58
acres	1,763	1,682	10,540	14,109	3,428	(D)	6,911
140 to 179 acres ....farms	5	24	103	103	11	5	63
acres	770	3,851	16,514	16,103	1,725	804	10,008
180 to 219 acres ....farms	15	13	34	63	13	1	22
acres	3,089	2,567	6,772	12,496	2,617	(D)	4,442
220 to 259 acres ....farms	2	16	28	38	9	4	25
acres	(D)	3,752	6,782	9,017	2,168	964	5,973
260 to 499 acres ....farms	17	36	79	168	59	10	93
acres	6,400	13,159	27,817	60,958	20,783	3,201	33,297
500 to 999 acres ....farms	46	26	66	140	57	5	98
acres	31,433	16,208	44,561	98,085	38,388	3,398	71,864
1,000 to 1,999 acres ....farms	46	28	30	75	46	9	89
acres	63,279	37,206	37,910	106,416	59,160	13,305	128,938
2,000 acres or more ....farms	18	32	78	103	62	6	124
acres	59,581	199,571	601,802	615,667	389,331	33,390	991,350
2007 size of farm:							
1 to 9 acres ....farms	41	43	217	337	27	13	245
acres	(D)	224	891	1,611	131	47	967
10 to 49 acres ....farms	70	93	352	1,114	69	15	294
acres	1,575	2,336	8,687	27,430	1,790	356	7,169
50 to 69 acres ....farms	7	6	75	171	18	5	57
acres	370	350	4,340	9,866	1,011	(D)	3,338
70 to 99 acres ....farms	13	14	37	150	35	6	66
acres	1,069	1,154	3,090	12,253	2,694	546	5,518
100 to 139 acres ....farms	10	11	67	134	24	6	43
acres	1,216	1,356	7,758	15,711	2,823	655	5,098
140 to 179 acres ....farms	3	24	59	103	18	9	55
acres	(D)	3,911	9,372	16,165	2,895	1,421	8,827
180 to 219 acres ....farms	2	16	49	56	10	5	22
acres	(D)	3,172	9,665	11,023	1,947	957	4,508
220 to 259 acres ....farms	4	4	27	54	16	4	29
acres	982	945	6,426	12,902	3,825	989	6,933
260 to 499 acres ....farms	24	26	101	160	69	1	89
acres	8,185	10,274	35,085	57,748	24,303	(D)	32,085
500 to 999 acres ....farms	32	22	71	139	59	8	84
acres	21,925	13,784	47,861	97,073	41,546	4,848	60,548
1,000 to 1,999 acres ....farms	33	19	27	94	44	8	84
acres	47,011	25,593	37,180	130,717	59,842	10,096	119,841
2,000 acres or more ....farms	16	24	54	95	59	4	131
acres	49,937	149,425	438,319	648,616	454,933	23,956	1,073,140
LAND IN FARMS ACCORDING TO USE							
Total cropland ....farms, 2012	162	99	832	1,998	327	33	814
2007	116	80	826	2,178	327	41	911
acres, 2012	14,409	12,575	49,298	522,593	154,728	11,378	358,294
2007	11,973	4,377	53,838	537,716	145,784	10,479	311,052
Harvested cropland ....farms, 2012	135	66	758	1,903	257	30	694
2007	86	34	729	1,946	267	28	685
acres, 2012	7,868	835	31,411	480,103	123,008	10,591	282,694
2007	4,007	286	31,609	466,304	103,467	8,144	227,834
Other pasture and grazing land that could have been used for crops without additional improvements (see text) ....farms, 2012	26	24	83	64	49	3	72
2007	38	44	182	319	102	17	223
acres, 2012	5,536	10,962	14,366	13,309	18,249	(D)	22,428
2007	6,786	3,713	15,750	(D)	26,531	(D)	43,473

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Table 8. **Farms, Land in Farms, Value of Land and Buildings, and Land Use: 2012 and 2007** (continued)

[For meaning of abbreviations and symbols, see introductory text.]

Item	Napa	Nevada	Orange	Placer	Plumas	Riverside	Sacramento
FARMS AND LAND IN FARMS							
Farms ..... number, 2012	1,685	742	312	1,355	141	2,949	1,352
2007	1,638	690	325	1,488	142	3,463	1,393
Land in farms ..... acres, 2012	253,370	42,114	60,497	91,403	174,210	344,044	246,840
2007	223,246	70,167	87,435	132,221	120,253	354,753	328,593
Average size of farm ..... acres, 2012	150	57	194	67	1,236	117	183
2007	136	102	269	89	847	102	236
Estimated market value of land and buildings ..... farms, 2012	1,685	742	312	1,355	141	2,949	1,352
2007	1,638	690	325	1,488	142	3,463	1,393
$1,000, 2012	5,523,649	456,271	1,322,112	974,692	309,427	3,513,485	1,761,164
2007	6,054,884	514,399	1,057,529	1,347,133	220,222	5,592,639	2,208,429
Average per farm ..... dollars, 2012	3,278,130	614,921	4,237,538	719,330	2,194,519	1,191,416	1,302,636
2007	3,696,510	745,506	3,253,936	905,331	1,550,857	1,614,969	1,585,376
Average per acre ..... dollars, 2012	21,801	10,834	21,854	10,664	1,776	10,212	7,135
2007	27,122	7,331	12,095	10,188	1,831	15,765	6,721
2012 farms by value group:							
$1 to $49,999	67	24	39	62	6	183	150
$50,000 to $99,999	68	21	13	19	4	105	65
$100,000 to $199,999	162	66	35	75	6	276	86
$200,000 to $499,999	344	287	83	592	48	990	447
$500,000 to $999,999	249	230	73	406	26	835	309
$1,000,000 to $1,999,999	263	81	36	117	15	278	129
$2,000,000 to $4,999,999	295	31	17	66	20	167	93
$5,000,000 to $9,999,999	119	2	7	12	11	52	41
$10,000,000 or more	118	-	9	6	5	63	32
Approximate land area ..... acres, 2012	478,953	612,975	505,994	900,373	1,633,932	4,612,118	617,560
Proportion in farms ..... percent, 2012	52.9	6.9	12.0	10.2	10.7	7.5	40.0
2012 size of farm:							
1 to 9 acres ..... farms	670	255	210	540	17	1,581	561
acres	2,388	1,253	552	2,334	(D)	5,974	2,020
10 to 49 acres ..... farms	542	331	56	574	36	955	417
acres	12,799	6,325	1,134	11,299	945	18,831	8,384
50 to 69 acres ..... farms	107	41	9	39	5	57	52
acres	6,193	2,301	560	2,195	320	3,282	3,086
70 to 99 acres ..... farms	71	25	3	53	3	60	50
acres	5,882	2,054	266	4,453	253	4,897	4,239
100 to 139 acres ..... farms	56	24	8	37	-	57	31
acres	6,371	2,884	898	4,318	-	6,466	3,406
140 to 179 acres ..... farms	42	5	1	22	15	44	39
acres	6,758	807	(D)	3,458	2,235	6,931	6,028
180 to 219 acres ..... farms	23	12	1	15	1	28	19
acres	4,513	2,415	(D)	2,958	(D)	5,515	3,707
220 to 259 acres ..... farms	26	11	3	9	7	6	16
acres	6,103	(D)	722	2,160	1,732	1,415	3,822
260 to 499 acres ..... farms	58	23	6	33	9	59	64
acres	20,586	7,830	2,159	12,449	3,703	20,719	22,708
500 to 999 acres ..... farms	40	11	9	21	10	47	42
acres	29,012	8,059	6,229	13,953	6,091	34,241	29,475
1,000 to 1,999 acres ..... farms	28	3	2	7	15	15	31
acres	37,397	3,045	(D)	9,002	19,945	23,133	42,127
2,000 acres or more ..... farms	22	1	4	5	23	40	30
acres	115,368	(D)	45,340	22,824	138,736	212,640	117,838
2007 size of farm:							
1 to 9 acres ..... farms	624	209	203	624	26	1,899	534
acres	2,320	1,040	515	2,948	103	7,261	2,170
10 to 49 acres ..... farms	572	332	66	592	48	1,119	454
acres	13,685	6,460	1,407	11,518	1,142	22,343	8,629
50 to 69 acres ..... farms	96	22	10	56	6	71	42
acres	5,554	1,260	520	3,157	330	4,144	2,580
70 to 99 acres ..... farms	62	23	12	61	13	75	51
acres	5,213	1,881	1,016	4,973	1,068	6,157	4,357
100 to 139 acres ..... farms	47	27	5	19	6	57	28
acres	5,436	3,029	560	2,218	695	6,570	3,179
140 to 179 acres ..... farms	48	19	6	29	8	52	32
acres	7,588	3,179	923	4,683	1,237	8,270	4,980
180 to 219 acres ..... farms	22	11	2	15	2	24	42
acres	4,338	2,195	(D)	2,921	(D)	4,732	8,148
220 to 259 acres ..... farms	16	8	3	15	1	18	14
acres	3,869	1,883	716	3,567	(D)	4,264	3,317
260 to 499 acres ..... farms	65	13	9	38	10	46	71
acres	23,897	4,300	3,083	13,167	3,455	16,165	24,784
500 to 999 acres ..... farms	35	15	4	25	3	39	47
acres	24,620	10,231	(D)	17,522	1,864	26,937	33,231
1,000 to 1,999 acres ..... farms	34	5	3	5	7	25	44
acres	44,722	7,110	(D)	6,070	7,934	36,146	59,086
2,000 acres or more ..... farms	17	6	2	9	12	38	34
acres	82,004	27,599	(D)	59,477	101,749	211,764	174,132
LAND IN FARMS ACCORDING TO USE							
Total cropland ..... farms, 2012	1,561	354	226	600	68	2,127	750
2007	1,546	314	229	726	57	2,517	810
acres, 2012	63,049	3,349	15,183	33,607	25,970	227,246	105,721
2007	66,184	7,301	14,623	50,334	18,487	219,943	133,628
Harvested cropland ..... farms, 2012	1,521	312	217	508	62	1,962	660
2007	1,503	218	200	487	33	2,096	583
acres, 2012	52,180	1,555	10,058	19,535	11,767	156,469	92,090
2007	51,860	2,621	7,846	21,990	7,692	163,783	113,315
Other pasture and grazing land that could have been used for crops without additional improvements (see text) ..... farms, 2012	35	39	3	85	12	81	87
2007	195	112	16	290	30	550	279
acres, 2012	2,859	432	(D)	8,526	12,838	13,815	3,939
2007	9,475	3,659	(D)	20,436	9,854	6,704	10,858

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Exhibit Y

Exhibit Y

nature climate change

LETTERS

PUBLISHED ONLINE: 16 MARCH 2015 | DOI: 10.1038/NCLIMATE2556

Efficient use of land to meet sustainable energy needs

Rebecca R. Hernandez[1,2]*, Madison K. Hoffacker[1,2] and Christopher B. Field[1,2]

The deployment of renewable energy systems, such as solar energy, to achieve universal access to electricity, heat and transportation, and to mitigate climate change is arguably the most exigent challenge facing humans today[1–4]. However, the goal of rapidly developing solar energy systems is complicated by land and environmental constraints, increasing uncertainty about the future of the global energy landscape[5–7]. Here, we test the hypothesis that land, energy and environmental compatibility can be achieved with small- and utility-scale solar energy within existing developed areas in the state of California (USA), a global solar energy hotspot. We found that the quantity of accessible energy potentially produced from photovoltaic (PV) and concentrating solar power (CSP) within the built environment ('compatible') exceeds current statewide demand. We identify additional sites beyond the built environment ('potentially compatible') that further augment this potential. Areas for small- and utility-scale solar energy development within the built environment comprise 11,000–15,000 and 6,000 TWh yr^{-1} of PV and CSP generation-based potential, respectively, and could meet the state of California's energy consumptive demand three to five times over. Solar energy within the built environment may be an overlooked opportunity for meeting sustainable energy needs in places with land and environmental constraints.

Technology, economics and environmental values are decisive factors in identifying areas most compatible for renewable energy development, including solar energy systems. Environmental values are underlying determinants of attitudes, behaviours and beliefs about the environment[8,9]. These attitudes, behaviours and beliefs can, in turn, guide decisions concerning which ecosystems and human assets to protect. They can also inform the way that the emphasis on different kinds of impact changes with the scale of the solar energy deployment[10,11]. Solar energy systems integrated within the built environment have several advantages if protecting ecosystems and their services are priority values. They confer the lowest environmental and land-use and land-cover change impacts[6,12], reduce energetic losses from and load on transmission, and are co-located with the energy needs of a growing population expected to be concentrated entirely in urban areas (that is, 62% by 2035; refs 13,14). Such installations are modular in their capacity, ranging from small-scale (<1 MW) to utility-scale (≥1 MW), and can use existing infrastructure within the built environment (for example, residential rooftops, commercial rooftops).

Utility-scale solar energy (USSE) systems are uniquely advantageous with their large economy of scale, compatibility with a wide range of sites, and numerous environmental co-benefit opportunities[6]. With a land-use efficiency of 35 W m^{-2} at a capacity factor of 0.20, a single terawatt of USSE capacity scales to 142,857 km^2 (roughly the area of the state of New York)[12], providing challenges for the integration of potentially massive projects into complex and fragmented landscapes. Criteria for siting USSE can be diverse, emphasizing, for example, warehouse rooftops, degraded lands, deserts, or sites remote from human populations. However, resource constraint and opportunity modelling can be used to assess value-based trade-offs and technical potential at large spatial scales where energy development is needed[7,15–17].

The state of California (USA) has been a long-standing model system for understanding the land–energy–environment nexus owing to its early and aggressive adoption of renewable energy systems (predominately wind and geothermal), vast land area (larger than 189 countries, for example, Germany, the Philippines and Zimbabwe), large population (that is, 38 million) and economy (that is, the eighth largest in the world), vulnerability to climate change, and sensitive ecosystems[12,18,19]. Abundant solar resources and diverse storage technology options suggest that small- and USSE technologies within the built environment and in places that minimize environmental impacts may be underutilized within California's current resource mix. Here, we test the hypothesis that land, energy and environmental compatibility can be achieved with small-scale solar energy and USSE within landscapes that are already managed for human uses in the state of California (USA), a global solar energy hotspot[6,20–22].

To determine whether land, energy and environmental compatibility can be achieved within existing developed areas in the state of California, we developed the Carnegie Energy and Environmental Compatibility (CEEC) model (Supplementary Methods) to achieve four objectives. First, we seek to quantify the capacity-based technical potential (that is, satellite-based estimates of PV and CSP technologies operating at their full, nominal capacity over 0.1° surface cells). Second, we seek to quantify the (accessible) generation-based technical potential (that is, realized potential incorporating a satellite-based capacity factor model with 0.1 × 0.1° surface resolution) for PV and CSP. Owing to California's limited water resources, we model dry-cooled CSP parabolic trough technology. Photovoltaic technologies included three subtypes: fixed tilt (TILT25), single-axis (AX1FLAT), dual-axis (AX2). Third, we seek to create a compatibility index (that is, 'compatible', 'potentially compatible' and 'incompatible' areas) to categorize and quantify land resources meeting land, energy and environmental compatibility for solar energy infrastructure. Last, we seek to determine to what extent energy and climate change goals can be met therein.

California has a total area of over 400,000 km^2 with a solar resource of 881,604 TWh yr^{-1} and 1,000,948 TWh yr^{-1} for PV

[1]Department of Global Ecology, Carnegie Institution for Science, Stanford, California 94035, USA. [2]Department of Environmental Earth System Science, Stanford University, Stanford, California 94305, USA. *e-mail: rebecca.hernandez@stanford.edu

NATURE CLIMATE CHANGE DOI: 10.1038/NCLIMATE2556

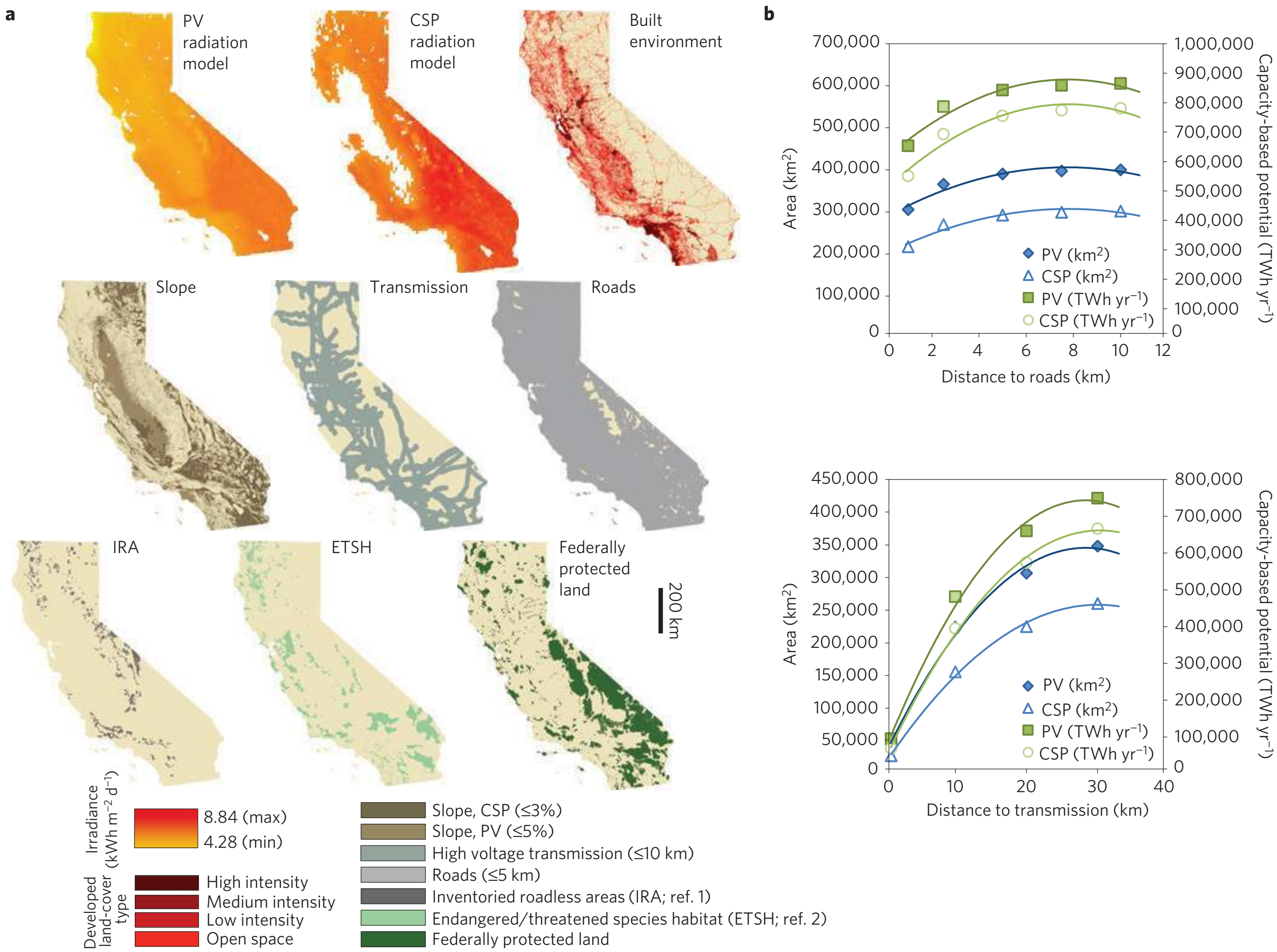

Figure 1 | Selected model inputs and sensitivity analyses. a, Maps showing resource opportunities (that is, PV and CSP radiation models, built environment land-cover types (high, medium, low intensity, and open space)) and resource constraints including slope, proximity to transmission, proximity to roads, inventoried roadless areas, endangered and threatened species habitat, and federally protected land (for greater detail, see Supplementary Section 2). **b**, Solar resource area (km^2) and technical potential (TWh yr^{-1}) as a function of distance to existing high-voltage transmission ($\geq$69 kV; 38,835 km total) and roads (700,914 km total). Trendlines are the best fit (polynomial), where the saturation point (slope = 0) is the mean distance between transmission corridors ($\mu \approx 30$ km) and between roads ($\mu \approx 8$ km). Technical potential increases with increasing distance from existing transmission corridors and road infrastructure up to approximately 30 km and 8 km, respectively ($r^2_{PV} = 0.99714$; $r^2_{CSP} = 0.99901$; $r^2_{PV} = 0.98499$; $r^2_{CSP} = 0.98768$). Last, incremental increases in capacity are greatest in the kilometre closest to existing transmission or roads and decrease as distance increases from these elements.

and CSP, respectively (Table 1 and Fig. 1a). However, CSP is economically maximized where direct normal irradiance (DNI) is 6 kWh m^{-2} d^{-1} or greater. California comprises approximately 310,000 km^2 of land where solar resources meet this criterion, conferring a theoretical capacity-based CSP potential of 795,973 TWh yr^{-1}. Although PV systems can be deployed on water, conferring reduced evaporation as a co-benefit (for example, floatovoltaics, Supplementary Table 1), we excluded open bodies of water and perennial ice and snow (Supplementary Section 1).

Collectively, 8.1% of all terrestrial surfaces in California, particularly along the west coast, have been modified by humans ('developed'; 32,675 km^2) and are classified as: high intensity, medium intensity, low intensity, and open space[23]. On the basis of our hypothesis about the adequacy of the areas modified by humans, we defined these developed areas as the 'compatible' opportunity space for solar energy generation (Fig. 1a and Supplementary Table 1). We excluded CSP potential from the built environment classified as high and medium density, because CSP schemes are, at this time, not deployed in such locations. More than a third of these developed areas (12,372 km^2) are urban open space, which is a matrix of vegetation with some constructed infrastructure (<20% impervious surfaces) as is commonly found in large-lot single-family residential units, parks, golf courses and vegetated landscape elements. Within the urban open space land-cover type, the total capacity-based PV (for example, ground or rooftop mounted) and CSP generation is 25,902 and 16,680 TWh yr^{-1}, respectively (Supplementary Table 1). Low- and medium-intensity environments are mostly single-family housing units and together encompass about as much land (13,336 km^2) as urban open space. The area of land potentially available for PV development is approximately equal in low- and medium-intensity built environments, and PV capacity-based generation (for example, ground or rooftop mounted) in these areas is comparable at 13,749 TWh yr^{-1} and 14,204 TWh yr^{-1}, respectively. PVs in high intensity developed land (for example, mostly rooftop modules) have a capacity-based generation potential of 3,244 TWh yr^{-1}. CSP in low-intensity developed land has a capacity-based generation potential of 7,268 TWh yr^{-1}, encompassing 2,942 km^2.

To identify 'potentially compatible' development opportunities beyond these 'compatible', developed areas, we identified

Table 1 | Technical potential of solar energy within environmentally compatible and potentially compatible land in California.

Land area, capacity-based potential and generation-based potential for PV and CSP development after integrating each parameter constraint (for example, slope).

CEEC model resource constraint or opportunity	PV					CSP		
	Total area (km^2)	Capacity-based potential ($TWh\,yr^{-1}$)	Generation-based potential ($TWh\,yr^{-1}$)			Total area (km^2)	Capacity-based potential ($TWh\,yr^{-1}$)	Generation-based potential ($TWh\,yr^{-1}$)
			TILT25§	AX1FLAT	AX2			
California	409,443	881,604	169,461	209,790	240,520	409,443	1,000,948	386,395
DNI $\geq 6\,kWh\,m^{-2}\,d^{-1}$	–	–	–	–	–	309,209	795,973	321,827
Open water and perennial ice/snow	404,062	870,242	167,288	207,088	237,420	305,454	786,715	318,223
Developed, high intensity*	–	–	–	–	–	305,257	786,248	318,052
Developed, medium intensity*	–	–	–	–	–	303,348	781,696	316,357
Developed, low intensity*	–	–	–	–	–	–	–	–
Developed, open space*	–	–	–	–	–	–	–	–
Slope*,†	142,056	310,423	59,735	73,790	84,454	70,102	183,912	75,451
Transmission line (10 km)*	101,765	220,202	41,873	51,575	58,869	46,469	120,364	48,594
Roads (5 km)*	101,527	219,640	41,757	51,431	58,702	46,333	119,988	48,432
Inventoried roadless areas*	101,044	218,648	41,572	51,201	58,436	45,974	119,147	48,110
ET species habitat*,‡	86,738	186,410	35,195	43,289	49,370	39,136	99,734	39,650
Federally protected areas*	81,334	174,148	32,756	40,260	45,889	35,917	91,048	35,999

Moving down columns, area and potential decrease as each constraint is integrated. Cells marked (–) indicate no change in area or potential from previous (above) constraint.

Land area, capacity-based potential and generation-based potential for all schemes (that is, small- and utility-scale) and for solely USSE (≥1 MW), according to the CEEC compatibility matrix.

CEEC model results								
All schemes (small-scale + USSE)								
California (all)	409,443	881,604	169,461	209,790	240,520	409,443	1,000,948	386,394
Compatible areas	27,286	57,098	10,617	12,866	14,612			
Potentially compatible areas	54,048	117,050	22,139	27,394	31,277			
USSE only								
Compatible areas	22,028	46,080	8,565	10,349	11,744	6,274	15,400	5,947
Potentially compatible areas	55,733	120,460	22,751	28,139	32,119	27,215	69,551	27,650

USSE installations necessitate parcels large enough for a 1 MW power plant after ref. 12. CSP schemes are all utility-scale. *Reported area and solar potential do not include areas of open water, perennial ice and snow, and for CSP areas where DNI is $<6\,kWh\,m^{-2}\,d^{-1}$. †Slope must be ≤5% and ≤3% for PV and CSP, respectively. ‡Endangered and threatened species habitat. §Fixed tilt (TILT25), single-axis (AX1FLAT), dual-axis (AX2).

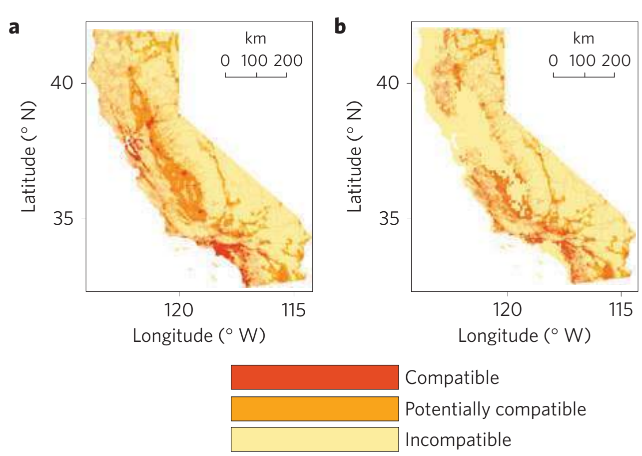

Figure 2 | Compatibility matrices for PV and CSP. a,**b**, Compatible (red polygons), potentially compatible (orange polygons), and incompatible (yellow polygons) areas for PV (**a**) and CSP (**b**) energy systems within the state of California. Compatible areas are restricted to areas within the built environment (that is, developed land-cover type).

topography most suitable for solar energy systems; where slopes are 3% and 5% or less, for CSP and PV installations, respectively. Next, we prioritized a 10 km development zone on each side of high-voltage (≥69 kV; 38,835 km total) transmission lines, and prioritized a 5 km development zone along each side of all roads of interest (700,914 km total). Last, we identified and excluded 20,193 km^2 of ecologically sensitive, federally protected habitat (Fig. 1a and Supplementary Table 1 and Supplementary Section 2). Such constraints, which are adjustable in the model, can be set to manage economic costs and environmental values associated with construction activities and materials (Methods and Supplementary Section 1.3). We qualify these areas as 'potentially compatible', recognizing that local-scale constraints and regulations beyond the scope of this study may render such areas 'incompatible'[20].

Slope and access to transmission had the greatest absolute effect on the compatibility of land and technical potential. For CSP, DNI was also an important constraint (Supplementary Table 2 and Supplementary Section 1.3). Owing to economic and environmental costs of high-voltage and long-distance transmission and road construction, we performed a sensitivity analysis to determine the effect of distance to transmission and roads on area and capacity-based technical potential for CSP and PV technologies, and to determine mean distance between transmission corridors and be-

Table 2 | Potential to meet 33% renewable energy for all retail electricity by 2020 (California RPS, by scenario type) and total energy demand from PV and CSP technologies according to the CEEC compatibility matrix in California.

	PV				CSP	
Potential to meet 33% 2020 RPS	**Capacity-based* (times over)**	**Generation-based (times over)***			**Capacity-based (times over)**	**Generation-based (times over)**
		TILT25‡	**AX1FLAT**	**AX2**		
High-demand scenario (47.0 TWh)						
Compatible areas	1,214.9	225.9	273.7	310.9	327.7	126.5
Potentially compatible areas	2,490.4	471.0	582.9	665.5	1,479.8	588.3
Medium-demand scenario (41.3 TWh)						
Compatible areas	1,382.5	257.1	311.5	353.8	372.9	144.0
Potentially compatible areas	2,834.2	536.0	663.3	757.3	1,684.0	669.5
Low-demand scenario (35.3 TWh)						
Compatible areas	1,617.5	300.8	364.5	413.9	436.3	168.5
Potentially compatible areas	3,315.9	627.1	776.0	886.1	1,970.2	783.3
Potential to meet total energy consumption†	**Capacity-based (times over)**	**Generation-based (times over)**			**Capacity-based (times over)**	**Generation-based (times over)**
		TILT25	**AX1FLAT**	**AX2**		
All schemes						
Compatible areas	25.6	4.8	5.8	6.5	–	–
Potentially compatible areas	52.5	9.9	12.2	14.1	–	–
USSE only						
Compatible areas	20.7	3.8	4.6	5.3	6.9	2.7
Potentially compatible areas	53.9	10.2	12.7	14.4	31.2	12.4

*2020 RPS data for PVs represent potential for areas compatible for all schemes: small- and utility-scale. †Fixed tilt (TILT25), single-axis (AX1FLAT), dual-axis (AX2). ‡Total California state energy usage in 2011 was 2,291 TWh from, in order of increasing consumption: coal, other petroleum, nuclear electric power, distillate fuel oil, jet fuel, net interstate flow of electricity, motor gasoline, hydroelectric power, other renewables, biomass, natural gas, residual fuel, and liquefied petroleum gas. Source: Supplementary Table 4.

tween roads. Relationships between distance to infrastructure and area (or capacity-based potential) are nonlinear and best-fit equations are polynomial; that is, incremental increases in capacity are greatest in the kilometre closest to existing transmission or roads and decrease as distance increases from these elements. Technical potential increases with increasing distance from existing transmission corridors and road infrastructure up to approximately 30 km and 8 km, respectively ($r^2_{PV} = 0.99714$; $r^2_{CSP} = 0.99901$; $R^2_{PV} = 0.98499$; $R^2_{CSP} = 0.98768$; Fig. 1b).

In total, California has more than 27,286 km^2 and 6,274 km^2 of 'compatible' land for PV and CSP solar energy development, respectively (Table 1 and Fig. 2). Areas within California that are considered 'potentially compatible' amount to a total of 55,733 km^2 for PV systems and 27,215 km^2 for CSP technology. These areas constitute 174,148 TWh yr^{-1} of PV and 84,951 TWh yr^{-1} of CSP capacity-based potential. Utility-scale PV systems can be developed in 96% of these areas, that is, 77,761 km^2 in area and 166,540 TWh yr^{-1} of capacity-based potential. Next, we calculated realized generation-based solar energy potential for fixed tilt (TILT25), one-axis tracking (AX1FLAT), and two-axis tracking (AX2) PV installations and for parabolic trough CSP installations for all resource opportunities and constraints (Table 1). After integrating each resource opportunity and constraint (Supplementary Table 3), total realized generation-based potential in 'compatible' areas for development ranges from 10,617 to 14,612 TWh yr^{-1} for PV technologies and is 5,947 TWh yr^{-1} for CSP (Table 1). The generation-based potential for PV installations constructed at the utility-scale in 'compatible' areas ranges from 8,565 to 11,744 TWh yr^{-1}. 'Potentially compatible' areas have approximately three times the generation-based potential for PV and CSP technologies as 'compatible' areas.

California's dynamic renewable energy landscape is driven, in part, by legislation and renewable portfolio standards (RPS) that, for example, require renewables to serve 33% of retail electricity load by 2020—enacted as a 'floor' rather than 'ceiling'[22]—and greenhouse-gas emissions 80% below 1990 levels by 2050. In 2012, 22% of retail electricity sales were derived from renewable sources[24] and total energy consumption was 2,231 TWh where non-biomass, non-hydro renewable energy consumption comprises 6.7% (153.3 TWh; Supplementary Table 4). On the basis of the RPS and related legislation (for example, California Global Warming Solutions Act), California state and governmental agencies are directed by law to take all appropriate actions to facilitate the timely realization of RPS requirements including siting, permitting, procurement and transmission infrastructure needs[22].

Framing the realized, generation-based potential of solar energy technologies within the context of policy goals is a useful exercise for weighing its potential contribution to California's current renewable energy mix. We calculated the number of times over that PV (small- and utility-scale schemes) and CSP energy systems could meet the 2020 renewable net short (difference between current renewable energy production and target levels) for three different demand scenarios: low, medium and high. Total projected statewide retail sales demand is 292.6, 297.9 and 305.3 TWh. Net short demand is 35.3, 41.3 and 47.0 TWh for these respective scenarios[22,25]. Within 'compatible' areas, PV generation could meet the state of California's 33% renewable energy goal 301 (low demand), 257 (medium demand) and 226 (high demand) times over with fixed tilt (TILT25) modules. CSP generation in 'compatible' areas could meet the state's goal 436 (low demand), 373 (medium demand) and 328 (high demand) times over (Table 2).

Comparing the realized, generation-based potential of solar energy technologies to the state of California's total energy consumption further underscores the value of solar. The quantity of energy that could be produced solely within the built environment (that is, 'compatible'; conferring the least land-use or land-cover change) exceeds the energy needed to meet the state's total energy consumption (Table 2). Potential realized PV generation (small- and utility-scale) within 'compatible' areas is 4.8, 5.8 and 6.5 times greater than current demand using fixed tilt, single-axis and dual-axis modules. CSP generation within 'compatible' areas is 2.7 times greater than current total energy demand.

The built environment is conducive to high levels of solar energy development. The authors of ref. 26 estimate that 20–27% of all United States residential rooftop space and 60–65% of commercial rooftops are favourable for PV systems, depending on climate and accounting for roof material and structure, shading and orientation. For example, the 121 km^2 city of San Francisco has 23 MW of PV capacity producing an estimated 31,113 MW h yr^{-1} on residential and commercial rooftops and other features within the built environment[27]. At present, 11% and 44% of CSP installations are sited in 'compatible' and 'potentially compatible' areas, respectively, corroborating their feasibility within these land-cover types (R.R.H., unpublished data). Our model assumes that deployed CSP will use dry-cooling technology and therefore water resource constraints may pose unanticipated trade-offs for wet-cooled systems. Last, issues of cost, intermittency and storage, and local siting opposition can impact the scale of deployment in California and elsewhere.

Our study identified a diverse suite of sites in California that could be candidates for small- and USSE development, focusing on the generation potential of well-suited areas within the built environment and additional land that combines high-quality solar resources with proximity to existing roads and transmission lines. These areas provide options for minimizing environmental impacts associated with a large-scale transition to a renewable energy mix where solar energy technologies serve as a growing source alongside increasingly flexible, and optimized transmission integration[10,11,28,29]. California's energy stakeholders, developers and policymakers can use our results to inform development decisions, and the multiple-criteria model, CEEC, can be implemented in other regions.

Methods

Full details are in Supplementary Methods. The CEEC model is an adaptable multiple-criteria model that calculates technical solar energy potential for areas of interest, incorporating user-specified development opportunities and resource constraints. For this study, we applied the CEEC model for California (USA), integrating satellite-based solar radiation estimates with hydrologic, socioeconomic, topographic, energy infrastructure, and ecological opportunities and constraints (for data sources, see Supplementary Table 5). Model outputs include intermediate products of interest (for example, land area and technical potential) as well as a spatially explicit compatibility index ('compatible', 'potentially compatible', 'incompatible'). With a spatial resolution of $0.1 \times 0.1°$, CEEC calculated capacity-based technical potential for PV and CSP (that is, energy output for systems operating at their full, nominal capacity), and generation-based technical potential (that is, realized potential incorporating a capacity factor model) for CSP (dry-cooled, parabolic trough) and for PV technology subtypes (that is, fixed tilt, single-axis, dual-axis).

Radiation estimates were from the National Renewable Energy Lab (NREL) Diffuse/Direct Normal Irradiation Model and the NREL Direct Normal Irradiation Model. These estimates incorporate geostationary weather satellite imagery, daily snow cover data, and monthly atmospheric water vapour, trace gas and aerosol data as well as ground measurement validation (1998–2005) to output annual average daily total solar energy at a spatial resolution of $0.1 \times 0.1°$ ($\sim 10 \times 10$ km).

Capacity factors were from the NRELPV Watts model[30] for three PV system types: fixed tilt, south-facing with a 25° tilt (TILT25); one-axis tracking, rotating east–west with a ±45° maximum tracking angle (AX1FLAT); and two-axis tracking, rotating east–west and north–south of the sun across the horizon (AX2). We used five direct normal irradiance classes of capacity factors for a parabolic trough CSP system (Supplementary Table 6).

Features assessed with spatially explicit mapping included bodies of open water and perennial ice and snow; space within the built environment; topography suitable for solar energy systems, that is, where slopes are 3% and 5% or less for CSP and PV installations, respectively; 10-km-wide corridors on each side of high-voltage (≥69 kV) transmission lines; 5-km-wide corridors along each side of all roads; and ecologically sensitive and protected habitat (Supplementary Methods).

To better understand the amount of energy potential available within California and the CEEC Model Compatibility Matrix areas, we calculated the ratio of PV and CSP capacity and generation-based technical potential to the net short needed for meeting the state's RPS, defined as requiring renewables to serve 33% of retail electricity load by 2020 using the following equation:

potential to meet RPS goal (times over) = solar energy technical potential / (net short = difference between current renewable energy production and target levels)

Renewable net short is calculated for upper, mid-, and lower bound cases as:

net renewable net short (TWh) = ([projected retail electricity sales − energy efficiency programs − combined Heat & power customer services − self-generation additions − other demand reduction programs] × policy goal percentage) − generation from existing eligible renewable facilities likely to be generating in 2020.

Estimates of renewable net short depend on assumptions of future energy supply and demand and are, therefore, subject to change over time (for example, reductions in electricity retail sales will reduce renewable net short)[22].

Received 3 September 2014; accepted 30 January 2015; published online 16 March 2015

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Acknowledgements

The McGee Research Grant of Stanford's School of Earth Sciences, the TomKat Center for Sustainable Energy, the Jean Langenheim Research Fellowship of Graduate Women in Science Society, the Hispanic Scholarship Fund's William Randolph Hearst Fund Scholarship, and the Vice Provost Office of Graduate Education's Diversifying Academia, Recruiting Excellence Program provided financial support for this study. We thank M. Tavassoli who contributed to the data collection and N. Alvarez who assisted with several spatial analyses. We thank L. White who contributed to graphic design.

Author contributions

R.R.H. conceived the project, R.R.H. developed the model, R.R.H. and M.K.H. conducted analyses and model runs, and R.R.H., M.K.H. and C.B.F. wrote the paper.

Additional information

Supplementary information is available in the online version of the paper. Reprints and permissions information is available online at www.nature.com/reprints. Correspondence and requests for materials should be addressed to R.R.H.

Competing financial interests

The authors declare no competing financial interests.