

Recommendations by the Association of Environmental Professionals (AEP) on How to Analyze Greenhouse Gas Emissions and Global Climate Change in CEQA Documents

Comment Draft

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Introduction

The American public and government have recently become concerned about greenhouse gas (GHG) emissions and their effects on global climate change. In 2006, the State Legislature signed AB 32 which charged the California Air Resources Board (CARB) to develop regulations on how the state would address global climate change (also known as “global warming”). However, the State Attorney General's Office and some environmental groups are already asking individual projects to analyze the impacts on global warming as part of the California Environmental Quality Act (CEQA) process. CARB, the State EPA, the U.S. EPA, or other appropriate governmental organizations have not yet developed guidelines on how to prepare an impact assessment for global climate change.

The Association of Environmental Professionals (AEP) is a state-wide professional group of environmental planners. A primary focus of AEP members is the preparation of CEQA compliance documents such as Negative Declarations and Environmental Impact Reports (EIRs). The AEP has prepared this “White Paper” for consideration by the Governors Office of Planning and Research (OPR) and the California Air Resources Board (CARB). This paper recommends a reasonable interim approach to analyze the impact of individual development and planning projects on GHG emissions and global climate change in CEQA documents until official guidance or regulations are issued by the appropriate agencies. There is an immediate need for this type of guidance because Lead agencies are now being asked to assess a project’s significance with regards to global climate change in CEQA documents.

This paper focuses on the evaluation of climate change impacts in CEQA documents that result from typical development-related projects such as private development (residential, commercial, and industrial) and planning programs (Specific Plans, General Plan Updates, etc.). There are many other kinds of actions and projects undertaken or approved by lead agencies that are not addressed in this proposed approach, such as timber harvest plans, water quality management plans, highway improvement projects and others that do not directly contribute to GHG emissions or have complicated interrelationships to GHG balance in the atmosphere.

Executive Summary

In California, global climate change is a growing concern that needs to be addressed in CEQA documents. There are currently no published thresholds for measuring the significance of a project's cumulative contribution to global climate change. An individual project does not generate enough greenhouse gas emissions to significantly influence global climate change. Global climate change is a cumulative impact; a project participates in this potential impact through its incremental contribution combined with the cumulative increase of all other sources of greenhouse gases. The following approach is used to assess the significance of the project's cumulative contribution to global climate change:

- 1) **Inventory:** An inventory of greenhouse gas emissions (i.e., carbon dioxide, methane, nitrous oxide) generated by the project will be presented for informational purposes. The inventory will also be compared to the inventory for California and/or the County, when those inventories become available.
- 2) **Compliance with Strategies:** Project compliance with the emission reduction strategies contained in the California Climate Action Team's (CCAT) Report to the Governor will be assessed. This report proposes a path to achieve the Governor's greenhouse gas reduction targets. Projects can ensure compliance with strategies by including the incorporating the following design features: vehicle trip reduction strategies; providing multi-modal transportation options; increasing energy efficiency beyond Title 24 requirements; increased recycling; and incorporating green building technology.

If a project complies with the State's strategies to reduce greenhouse gases to the levels proposed by the governor, it follows that the project would have a less than significant cumulative impact to global climate change. In addition, projects that cannot comply with CCAT strategies may also be able to reduce their cumulative contributions to GHG emissions to less than significant levels by contributing to available regional, state, national, or international mitigation programs such as reforestation, tree planting, or carbon trading.

Global Climate Change

General Overview

Global climate change alleged to be caused by greenhouse gases (GHG) is currently one of the most important and widely debated scientific, economic, and political issues in the United States. Global climate change is a change in the average weather of the earth, which can be measured by wind patterns, storms, precipitation, and temperature. Historical records have shown that temperature changes have occurred in the past, such as during previous ice ages. Some data indicates that the current temperature record differs from previous climate changes in rate and magnitude.

The United Nations Intergovernmental Panel on Climate Change constructed several emission trajectories of greenhouse gases needed to stabilize global temperatures and climate change impacts. It concluded that a stabilization of greenhouse gases at 400-450 ppm carbon dioxide-equivalent concentration is required to keep global mean warming below 2° Celsius, which is assumed to be necessary to avoid dangerous climate change (IPCC 2001).

Greenhouse Gases

Gases that trap heat in the atmosphere are often called greenhouse gases, analogous to a greenhouse. Greenhouse gases are emitted by natural processes and human activities. The accumulation of greenhouse gases in the atmosphere regulates the earth's temperature. Without these natural greenhouse gases, the Earth's surface would be about 61°F cooler (CA 2006). Emissions from human activities such as electricity production and vehicles have elevated the concentration of these gases in the atmosphere.

Greenhouse gases have varying global warming potential (GWP). The GWP is the potential of a gas or aerosol to trap heat in the atmosphere; it is the “cumulative radiative forcing effects of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas” (EPA 2006a). The reference gas for GWP is carbon dioxide; carbon dioxide has a GWP of one. For example, methane has a GWP of 21, which means that it has a greater global warming effect than carbon dioxide on a molecule per molecule basis. One teragram of carbon dioxide equivalent (Tg CO₂ Eq.) is the emissions of the gas multiplied by the GWP. One teragram is equal to one million metric tons. The carbon dioxide equivalent is a good way to assess emissions because it gives weight to the GWP of the gas. The atmospheric lifetime and GWP of selected greenhouse gases are summarized in Table 1. As shown in the table, GWP ranges from 1 (carbon dioxide) to 23,900 (sulfur hexafluoride).

Table 1: Global Warming Potentials and Atmospheric Lifetimes

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50 – 200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310
HFC-23	264	11700
HFC-134a	14.6	1300
HFC-152a	1.5	140
PFC: Tetrafluoromethane (CF ₄)	50000	6500
PFC: Hexafluoroethane (C ₂ F ₆)	10000	9200
Sulfur Hexafluoride (SF ₆)	3200	23900
Source: EPA 2006b		

Water vapor is the most abundant, important, and variable greenhouse gas in the atmosphere. It is not considered a pollutant; in the atmosphere it maintains a climate necessary for life. The main source of water vapor is evaporation from the oceans (approximately 85%). Other sources include evaporation from other water bodies, sublimation (change from solid to gas) from ice and snow, and transpiration from plant leaves.

Carbon dioxide (CO₂) is an odorless, colorless natural greenhouse gas. Natural sources include the following: decomposition of dead organic matter; respiration of bacteria, plants, animals, and fungus;

evaporation from oceans; and volcanic outgassing. Anthropogenic (human caused) sources of carbon dioxide are from burning coal, oil, natural gas, and wood. Concentrations are currently around 370 ppm; some say that concentrations may increase to 540 ppm by 2100 as a direct result of anthropogenic sources (IPCC 2001). Some predict that this will result in an average global temperature rise of at least 2° Celsius (IPCC 2001).

Methane is a flammable gas and is the main component of natural gas. When one molecule of methane is burned in the presence of oxygen, one molecule of carbon dioxide and two molecules of water are released. There are no health effects from methane. A natural source of methane is from the anaerobic decay of organic matter. Geological deposits known as natural gas fields contain methane, which is extracted for fuel. Other sources are from landfills, fermentation of manure, and cattle.

Nitrous oxide (N₂O), also known as laughing gas, is a colorless greenhouse gas. Higher concentrations can cause dizziness, euphoria, and sometimes slight hallucinations. Nitrous oxide is produced by microbial processes in soil and water, including those reactions which occur in fertilizer containing nitrogen. In addition to agricultural sources, some industrial processes (fossil fuel-fired power plants, nylon production, nitric acid production, and vehicle emissions) also contribute to its atmospheric load. It is used in rocket engines, as an aerosol spray propellant, and in race cars.

Chlorofluorocarbons (CFCs) are gases formed synthetically by replacing all hydrogen atoms in methane or ethane with chlorine and/or fluorine atoms. CFCs are nontoxic, nonflammable, insoluble, and chemically unreactive in the troposphere (the level of air at the earth's surface). CFCs were first synthesized in 1928 for use as refrigerants, aerosol propellants, and cleaning solvents. They destroy stratospheric ozone; therefore their production was stopped as required by the Montreal Protocol.

Hydrofluorocarbons (HFCs) are synthetic man-made chemicals that are used as a substitute for CFCs for automobile air conditioners and refrigerants.

Perfluorocarbons (PFCs) have stable molecular structures and do not break down through the chemical processes in the lower atmosphere. High-energy ultraviolet rays about 60 kilometers above Earth's surface are able to destroy the compounds. PFCs have very long lifetimes, between 10,000 and 50,000 years. Two common PFCs are tetrafluoromethane and hexafluoroethane. Concentrations of tetrafluoromethane in the atmosphere are over 70 ppt (EPA 2006d). The two main sources of PFCs are primary aluminum production and semiconductor manufacture.

Sulfur hexafluoride (SF₆) is an inorganic, odorless, colorless, nontoxic, nonflammable gas. It also has the highest GWP of any gas evaluated, 23,900. Concentrations in the 1990s were about 4 ppt (EPA 2006d). Sulfur hexafluoride is used for insulation in electric power transmission and distribution equipment, in the magnesium industry, in semiconductor manufacturing, and as a tracer gas for leak detection.

Ozone is a greenhouse gas; however, unlike the other greenhouse gases, ozone in the troposphere is relatively short-lived and therefore is not global in nature. According to CARB, it is difficult to make an accurate determination of the contribution of ozone precursors (NO_x and VOCs) to global warming (CARB 2004b). Therefore, project emissions of ozone precursors would not significantly contribute to global climate change.

Aerosols are particles emitted into the air through burning biomass (plant material) and fossil fuels. Aerosols can warm the atmosphere by absorbing and emitting heat and can cool the atmosphere by reflecting light. Cloud formation can also be affected by aerosols. Sulfate aerosols are emitted when fuel with sulfur in it is burned. Black carbon (or soot) is emitted during bio mass burning incomplete combustion of fossil fuels. Particulate matter regulation has been lowering aerosol concentrations in the United States; however, global concentrations are likely increasing.

International and Federal Legislation

In 1988, the United Nations and the World Meteorological Organization established the Intergovernmental Panel on Climate Change to assess “the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts, and options for adaptation and mitigation” (IPCC 2004).

The United States joined other countries around the world in signing the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC was entered on March 21, 1994. Under the Convention, governments: 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 (UNFCCC 2007).

The Kyoto Protocol is a treaty made under the UNFCCC. Countries can sign the treaty to demonstrate their commitment to reduce their emissions of greenhouse gases or engage in emissions trading. More than 160 countries, 55% of global emissions, are under the protocol. United States Vice President, Al Gore, symbolically signed the Protocol in 1998. However, in order for the Protocol to be formally adopted, or ratified, it must be adopted by the legislature, which was not done by the Clinton administration. The current President, George W. Bush, has indicated that he does not intend to submit the treaty for ratification.

The Montreal Protocol was originally signed in 1987 and substantially amended in 1990 and 1992. The Montreal Protocol stipulates that the production and consumption of compounds that deplete ozone in the stratosphere--chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform--were to be phased out by 2000 (2005 for methyl chloroform).

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.

California Legislation

Although not originally intended to reduce greenhouse gas emissions, California Code of Regulations Title 24 Part 6: California’s Energy Efficiency Standards for Residential and Nonresidential Buildings were 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 possible incorporation of new energy efficiency technologies and methods. The latest amendments were made in October 2005. Energy efficient buildings require less electricity. Electricity production by fossil

fuels results in greenhouse gas emissions. Therefore, increased energy efficiency results in decreased greenhouse gas emissions.

California Assembly Bill 1493 (Pavley) enacted on July 22, 2002, required CARB to develop and adopt regulations that reduce greenhouse gases emitted by passenger vehicles and light duty trucks. Regulations adopted by CARB will apply to 2009 and later model year vehicles. CARB estimates that the regulation will reduce climate change emissions from light duty passenger vehicle fleet by an estimated 18% in 2020 and by 27% in 2030 (CARB 2004).

California Governor Arnold Schwarzenegger announced on June 1, 2005 through Executive Order S-3-05, GHG emission reduction targets as follows: 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 (CA 2005). Some literature equates these reductions to 11 percent by 2010 and 25 percent by 2020.

The U.S. EPA does not regulate greenhouse gases from motor vehicles. Notwithstanding the lack of U.S. EPA regulation of greenhouse gas emissions, in 2006, the California State Legislature adopted AB 32, the California Global Warming Solutions Act of 2006. AB 32 requires CARB, the State agency charged with regulating statewide air quality, to adopt rules and regulations that would achieve greenhouse gas emissions equivalent to statewide levels in 1990 by 2020. On or before June 30, 2007, CARB is required to publish a list of discrete greenhouse gas emission reduction measures that can be implemented. Emission reductions shall include carbon sequestration projects and best management practices that are technologically feasible and cost-effective. Greenhouse gases as defined under AB 32 include: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

AB 32 requires that by January 1, 2008, the state board shall determine what the statewide greenhouse gas emissions level 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, other publications indicate that levels varied from 425 to 468 Tg CO₂ Eq. (CEC 2006). In 2004, the emissions were estimated at 492 Tg CO₂ Eq. (CEC 2006). Using the range of 1990 emissions, a reduction of between 5 and 13 percent would be needed to reduce 2004 levels to 1990 levels.

Executive Order S-01-07 was enacted by the Governor on January 18, 2007. Essentially, the order mandates the following: 1) that a statewide goal be established to reduce the carbon intensity of California's transportation fuels by at least 10 percent by 2020; and 2) that a Low Carbon Fuel Standard ("LCFS") for transportation fuels be established for California.

Inventory

In 2004, total GHG emissions were 20,135 Tg CO₂ Eq., excluding emissions/removals from land use, land use change, and forestry (UNFCCC 2006). In 2004, the U.S. contributed the most GHG emissions (35% of global emissions). In 2004, GHG emissions in the U.S. were 7074.4 Tg CO₂ Eq., which is an increase of 15.8 percent from 1990 emissions (EPA 2006a).

California is a substantial contributor of global greenhouse gases as it is the second largest contributor in the U.S. and the sixteenth largest in the world (CEC 2006). In 2004, California produced 492 Tg

CO₂ Eq. (CEC 2006), which is approximately seven percent of U.S. emissions. The major source of GHG in California is transportation, contributing 41 percent of the state's total GHG emissions (CEC 2006). Electricity generation is the second largest source, contributing 22 percent of the state's GHG emissions.

Health and Other Effects

The potential health effects from global climate change may arise from temperature increases, climate-sensitive diseases, extreme events, and air quality. There may be direct temperature effects through increases in average temperature leading to more extreme heat waves and less extreme cold spells. Those living in warmer climates are likely to experience more stress and heat-related problems (i.e., heat rash and heat stroke). In addition, climate sensitive diseases may increase, such as those spread by mosquitoes and other disease carrying insects. Those diseases include malaria, dengue fever, yellow fever, and encephalitis. Extreme events such as flooding and hurricanes can displace people and agriculture, which would have negative consequences. Drought in some areas may increase, which would decrease water and food availability. Global warming may also contribute to air quality problems from increased frequency of smog and particulate air pollution (EPA 2006c).

California Environmental Quality Act Analysis

CEQA Challenges

The California Environmental Quality Act (CEQA), unlike other single-topic environmental laws, encourages the protection of all aspects of the environment by requiring state and local agencies to prepare multidisciplinary environmental impact analysis and to make decisions based on the analysis regarding the environmental effects of the proposed project (CEQA Guidelines § 15002(a)). To this end, the public and many groups of individuals concerned with the environment have used CEQA to block development projects they see as detrimental to the environment or insist upon additional mitigation to address environmental impacts of a project. CEQA challenges have been used to require analysis of impacts never contemplated by the lead agency or mandated in CEQA. As an example, the Center for Biological Diversity filed a CEQA challenge to the Black Bench Specific Plan project (*Center for Biological Diversity vs. City of Banning*) for failure to mitigate GHG emissions. In another case, the Natural Resource Defense Council filed a CEQA challenge to the development of land in the San Joaquin River delta (*Natural Resource Defense Council vs. Reclamation Board*) for failure of the EIR to analyze climate change impacts associated with the development. In addition, the State Attorney General is demanding that development projects assess climate change impacts in comments sent by the State Attorney General during the CEQA comment period for large development projects.

Until the passage of AB 32, CEQA documents did not generally evaluate GHG emissions or impacts on global climate change. The primary focus of air pollutant analysis in CEQA documents was the emission of criteria pollutants, or those identified in the state and federal Clean Air Acts as those that were of most concern to the public and government agencies. If any comments were made on a Draft EIR regarding GHG emissions or global warming, the Response to Comments would generally follow along the lines that the project was too small or did not produce GHG emissions, or that the procedures to estimate such emissions were too speculative and beyond the scope of the EIR. With the passage of AB 32, a more detailed analysis of GHG emissions is recommended in CEQA documents.

Analysis of Criteria Pollutants vs. GHG Emissions

Current procedures for estimating emissions of “criteria” pollutants identified in the Clean Air Act have been well established by state and federal agencies for many years (e.g., URBEMIS program developed by the South Coast Air Quality Management District). To the extent practical, the analysis of GHG emissions should be based on current emission inventory models such as the California Air Resource Board’s EMFAC 2007 emissions model and U.S. EPA emission factors. Proposed mitigation to reduce greenhouse gas emissions should first emphasize on those measures that also reduce criteria pollutant emissions such as reducing vehicle trips, improving the efficiency of buildings in the project, and restricting idling time when feasible. The project should be evaluated based on GHG emission reduction measures in recent state legislation to determine if the project is consistent with those reduction measures.

CEQA Mandates for Analysis of Impacts

CEQA requires that Lead Agencies inform decision makers and the public about potential significant environmental effects of proposed projects, identify ways that environmental damage can be avoided or reduced, prevent significant, avoidable environmental damage through the use of feasible mitigation measures and/or project alternatives, and disclose to the public the reasons why the Lead Agency approved a project in the manner the agency chose if significant environmental effects are involved (CEQA Guidelines §15002). CEQA also requires Lead Agencies to evaluate potential environmental effects based to the fullest extent possible on scientific and factual data (CEQA Guidelines §15064b). Considering a review of scientific and factual data, the recent adoption of AB 32, and the requirements of CEQA, it is apparent that an analysis of a development project’s incremental contribution to global warming impacts is needed in CEQA documents if they are to be legally defensible.

Cumulative vs. Project Specific

Even a very large individual project cannot generate enough greenhouse gas emissions to influence global climate change. A project participates in this potential impact by its incremental contribution combined with the cumulative increase of all other sources of greenhouse gases, which when taken together form global climate change impacts.

Thresholds of Significance

There are currently no published thresholds of significance for measuring the impact of global climate change on or from a project. However, that does not relieve the lead agency of establishing a threshold.

Alternative Approaches to Analysis of Climate Change Impacts

In the absence of regulatory guidance, and prior to the resolution on various legal challenges for global climate change analysis, CEQA documents must address GHG emissions on a base-by-case basis using ad-hoc methods and individual judgment of existing CEQA guidance. The following section explores the various methodologies that could be used in CEQA documents to address global climate change impacts analysis. Options are presented in order of difficulty to implement.

Approach 1: Do not address GHG emissions at all in a CEQA document

This approach is effectively the continuation of the status quo where GHG emissions and global climate change impacts are not mentioned in CEQA documents. Because it is difficult to determine how a proposed project would contribute to climate change and what the overall impacts would be based on that contribution, some lead agencies have determined it to be speculative to attempt to

analyze a project's contribution to climate change. Obviously, this is the easiest approach, but it is likely that the omission of a climate change discussion on a project will result in critical remarks during the comment period and provides a foothold for legal challenge of the project's CEQA review process.

Approach 2: Discuss climate change only qualitatively without a significance determination

This approach would involve a discussion of what global climate is and potential ways the project will participate in the generation of GHG emissions, but does not provide any significance conclusions. Explanations may be added to the discussion about the fact that there is no regulatory guidance or established threshold of significance to compare with project impacts. This approach at least addresses the CEQA requirement for disclosure of potential impacts, but lacks a significance finding.

Approach 3: Discuss climate change qualitatively and determine impacts significant

This approach indicates that all projects are significant with regard to global climate change though it is an improvement upon approaches 1 and 2 in that it describes the impacts and makes a significance conclusion. Also, without offering reasonable mitigation measures and comparing impacts to a threshold, this approach is vulnerable to challenge.

Approach 4: Analyze GHG emissions quantitatively without a significance determination

In this approach, GHG emissions from the project are quantified but are not compared to a quantitative threshold. The level of sophistication has increased and the analysis has the "look and feel" of a standard CEQA air quality analysis used to determine air quality impacts, but lacks an actual significance conclusion. A paragraph may be added describing the lack of an established threshold. While the analysis shows effort toward quantifying emissions, this approach actually has the same vulnerabilities as approach 2 (i.e. lacking a significance determination).

Approach 5: Analyze GHG emissions quantitatively and use "no net carbon increase" as a threshold of significance

This approach would quantify GHG emissions and has a very conservative threshold that must be met requiring significant mitigation. However, this approach would make almost any project's impacts significant with regard to global climate change impacts. This approach favors emissions banking systems such as the Climate Change Registry as mitigation to address impacts as the only way to achieve the "no net carbon increase" is to buy emissions that are produced by the project. There are several problems with this approach. First, it sets the precedent that all projects without mitigation would be significant, which is implied within the threshold. This approach would deemphasize onsite mitigation that would lower GHG emissions through innovative energy conservation design, trip reduction measures, etc. Collectively, it does not make sense to rely on emissions banking systems to provide the bulk of mitigation and not change the way projects are designed. Also, the heavy reliance on emissions banking systems to mitigate project impacts may be problematic. While emissions banking systems may work in theory, it is unlikely that the CEQA document would have enough details about the emission banking system (i.e., the physical improvements and the schedule of when those physical improvements would be implemented). Legally defensible mitigation requires an adequate description of what physically would occur to reduce emissions and when those changes would take place.

Approach 6: Discuss climate change qualitatively and to the fullest extent possible determine GHG emissions quantitatively with significance criteria and mitigation methods

Both qualitative and quantitative approaches in determining significance criteria would be employed in this approach. This approach lends itself to a variety of project types and sizes. For most projects of small to moderate size, GHG emissions could be to some extent quantified, but the analysis would focus on qualitative compliance with the emission reduction strategies contained in the California Climate Action Team's Report to the Governor. This report proposes a path to achieve the GHG reduction targets found in AB 32 and Executive Order S-3-05. While the report and Executive Order S-3-05 does not specifically mention CEQA, they do include a list of various measures that can be employed to achieve the GHG reduction targets. It can be easily argued that proposed projects that implement all appropriate actions listed in the emissions reduction strategies relevant to the proposed project would have a less than significant impact to global climate change. This same type of approach can be used for projects within counties that have an adopted GHG Reduction Plan (currently Marin County is the only one). In cases where quantifying emissions is not reasonable or possible, such as Specific Plans where the development is at a very programmatic approach, this approach could still be used and is defensible.

For projects that have an established emissions inventory (such as cities, counties, or specific plans) the analysis can rely more heavily upon the quantitative analysis by estimating the existing GHG emissions inventory, the past GHG emissions inventory for year 2000, year 1990, and the future year emissions inventory with the project. This approach can then quantitatively show how the project will (or will not) meet the GHG emissions targets (i.e. achieve the year 2000 GHG emissions inventory by year 2010, and the 1990 GHG emissions inventory by year 2020) found in Executive Order S-3-05. The types of projects that can rely upon the quantities of GHG emissions in determining significance is fairly limited, but lend themselves to General Plan updates.

By combining both a qualitative and quantitative approach, the analysis can be tailored to the particular type and size of the project and still provide, to the fullest extent feasible, a comprehensive analysis of global climate change impacts that includes a comparison of significance criteria and mitigation methods. This is the most legally defensible method currently available.

Recommended Climate Change Impact Analysis Process

As discussed earlier, the most defensible method to assess the significance of a project's cumulative contribution to global climate change involves: 1) project compliance with emission reduction strategies, or when available and feasible comparison of emissions inventories; and 2) an inventory of project GHG emissions.

Onsite Mitigation - Compliance with Strategies

Project compliance with the greenhouse gas emission reduction strategies contained in the California Climate Action Team's Report to the Governor will be assessed. If new projects are consistent with those strategies, it follows that the project would not be significantly contributing to a cumulative global climate change impact. To reduce California's greenhouse gas emissions to the levels proposed in Executive Order S-3-05, the California EPA Climate Action Team developed a report that outlines strategies for meeting the Governor's targets. Use of the strategies in the report to determine project consistency are the most appropriate to use at this time because the report "proposes a path to achieve the Governor's targets that will build on voluntary actions of California businesses, local government and community actions, and State incentive and regulatory programs" (CA 2006). AB 32 requires that a list of emission reduction strategies be published to achieve the

goals set out in AB 32. However, until those reduction strategies are published, emission reduction strategies to meet Executive Order S-3-05 will be relied upon.

The strategies are assigned to a responsible agency. The strategies that CARB is to implement over the next two years are summarized in Table 2. Strategies to be implemented by other agencies are summarized in Table 3.

Table 2: California Air Resources Board Greenhouse Gas Emission Reduction Strategies

Strategy	Description of Strategy
Vehicle Climate Change Standards	AB 1493 (Pavley) required the state to develop and adopt regulations that achieve the maximum feasible and cost-effective reduction of climate change emissions emitted by passenger vehicles and light duty trucks. Regulations were adopted by the ARB in September 2004.
Diesel Anti-Idling	In July 2004, the CARB adopted a measure to limit diesel-fueled commercial motor vehicle idling.
Other Light Duty Vehicle Technology	New standards would be adopted to phase in beginning in the 2017 model year
Hydrofluorocarbon Reduction	1) Ban retail sale of HFC in small cans; 2) Require that only low GWP refrigerants be used in new vehicular systems; 3) Adopt specifications for new commercial refrigeration; 4) Add refrigerant leak-tightness to the pass criteria for vehicular Inspection and Maintenance programs; 5) Enforce federal ban on releasing HFCs.
Transportation Refrigeration Units, Off-Road Electrification, Port Electrification	Strategies to reduce emissions from TRUs, increase off-road electrification, and increase use of shore-side/port electrification.
Manure Management	The proposed San Joaquin Valley Rule 4570 will reduce volatile organic compounds from confined animal facilities through implementation of control options.
Alternative Fuels: Biodiesel Blends	CARB would develop regulations to require the use of 1 to 4 percent biodiesel displacement of California diesel fuel.
Alternative Fuels: Ethanol	Increased use of ethanol fuel.
Heavy-Duty Vehicle Emission Reduction Measures	Increased efficiency in the design of heavy duty vehicles and an education program for the heavy duty vehicle sector.
Reduced Venting and Leaks in Oil and Gas Systems	Rule considered for adoption by the Air Pollution Control Districts for improved management practices.
Hydrogen Highway	The California Hydrogen Highway Network (CA H2 Net) is a State initiative to promote the use of hydrogen as a means of diversifying the sources of transportation energy.
Achieve 50% Statewide Recycling Goal	Achieving the State’s 50 percent waste diversion mandate as established by the Integrated Waste Management Act of 1989, (AB 939, Sher, Chapter 1095, Statutes of 1989), will reduce climate change emissions associated with energy intensive material extraction and production as well as methane emission from landfills. A diversion rate of 48% has been achieved on a statewide basis.

	Therefore, a 2% additional reduction is needed.
Landfill Methane Capture	Install direct gas use or electricity projects at landfills to capture and use emitted methane.
Zero Waste - High Recycling	Additional recycling beyond the State's 50% recycling goal.
Source: Summarized from CA 2006.	

Table 3: Other California Agency Greenhouse Gas Emission Reduction Strategies

Strategy	Description of Strategy
Department of Forestry	
Urban Forestry	A new statewide goal of planting 5 million trees in urban areas by 2020 would be achieved through the expansion of local urban forestry programs.
Afforestation/Reforestation Projects	Reforestation projects focus on restoring native tree cover on lands that were previously forested and are now covered with other vegetative types.
Department of Water Resources	
Water Use Efficiency	Approximately 19 percent of all electricity, 30 percent of all natural gas, and 88 million gallons of diesel are used to convey, treat, distribute and use water and wastewater. Increasing the efficiency of water transport and reducing water use would reduce greenhouse gas emissions.
Energy Commission (CEC)	
Building Energy Efficiency Standards in Place and in Progress	Public Resources Code 25402 authorizes the CEC to adopt and periodically update its building energy efficiency standards (that apply to newly constructed buildings and additions to and alterations to existing buildings).
Appliance Energy Efficiency Standards in Place and in Progress	Public Resources Code 25402 authorizes the Energy Commission to adopt and periodically update its appliance energy efficiency standards (that apply to devices and equipment using energy that are sold or offered for sale in California).
Cement Manufacturing	Cost-effective reductions to reduce energy consumption and to lower carbon dioxide emissions in the cement industry.
Municipal Utility Strategies	Includes energy efficiency programs, renewable portfolio standard, combined heat and power, and transitioning away from carbon-intensive generation.
Alternative Fuels: non-Petroleum Fuels	Increasing the use of non-petroleum fuels in California's transportation sector, as recommended in the CEC's 2003 and 2005 Integrated Energy Policy Reports.
Business Transportation and Housing	
Measures to Improve Transportation Energy Efficiency	Builds on current efforts to provide a framework for expanded and new initiatives including incentives, tools and information that advance cleaner transportation and reduce climate change emissions.

Strategy	Description of Strategy
Smart Land Use and Intelligent Transportation Systems (ITS)	<p>Smart land use strategies encourage jobs/housing proximity, promote transit-oriented development, and encourage high-density residential/commercial development along transit corridors.</p> <p>ITS is the application of advanced technology systems and management strategies to improve operational efficiency of transportation systems and movement of people, goods and services.</p> <p>Governor Schwarzenegger is finalizing a comprehensive 10-year strategic growth plan with the intent of developing ways to promote, through state investments, incentives and technical assistance, land use, and technology strategies that provide for a prosperous economy, social equity, and a quality environment.</p> <p>Smart land use, demand management, ITS, and value pricing are critical elements in this plan for improving mobility and transportation efficiency. Specific strategies include: promoting jobs/housing proximity and transit-oriented development; encouraging high density residential/commercial development along transit/rail corridor; valuing and congestion pricing; implementing intelligent transportation systems, traveler information/traffic control, incident management; accelerating the development of broadband infrastructure; and comprehensive, integrated, multimodal/intermodal transportation planning.</p>
Department of Food and Agriculture	
Enteric Fermentation	Cattle emit methane from digestion processes. Changes in diet could result in a reduction in emissions.
State and Consumer Services Agency	
Green Buildings Initiative	Green Building Executive Order, S-20-04 (CA 2004), sets a goal of reducing energy use in public and private buildings by 20 percent by the year 2015, as compared with 2003 levels. The Executive Order and related action plan spell out specific actions state agencies are to take with state-owned and -leased buildings. The order and plan also discuss various strategies and incentives to encourage private building owners and operators to achieve the 20 percent target.
Public Utilities Commission (PUC)	
Accelerated Renewable Portfolio Standard (33 percent by 2020)	The Governor has set a goal of achieving 33 percent renewables in the State's resource mix by 2020. The joint PUC/Energy Commission September 2005 Energy Action Plan II (EAP II) adopts the 33 percent goal.
California Solar Initiative	The solar initiative includes installation of 1 million solar roofs or an equivalent 3,000 MW by 2017 on homes and businesses, increased use of solar thermal systems to offset the increasing demand for natural gas, use of advanced metering in solar applications, and creation of a funding source that can provide rebates over 10 years through a declining incentive schedule.

Strategy	Description of Strategy
Investor-Owned Utility	This strategy includes energy efficiency programs, combined heat and power initiative, and electricity sector carbon policy for investor owned utility.
Source: Summarized from CA 2006.	

The preferred approach to reducing a project’s impact on global climate change is to incorporate design features into the project that comply with the state’s strategies to reduce greenhouse gas emissions. Features that could apply to residential projects are presented in Table 4. Features that could apply to commercial and/or industrial projects are presented in Table 5. Features that could apply to agricultural and select industrial projects are contained in Table 6.

Table 4: Residential Design Features

State Strategy to Reduce Greenhouse Gas Emissions ¹	Project Design/Mitigation to Comply with Strategy
Vehicle Climate Change Standards and Other Light Duty Vehicle Technology	These are CARB enforced standards; vehicles that access the project that are required to comply with the standards will comply with the strategy.
Hydrofluorocarbon Reduction	This measure applies to consumer products. When CARB adopts regulations for these reduction measures, any products that the regulations apply to will comply with the measures.
Achieve 50% Statewide Recycling Goal	In multi-family housing, separate recycling and waste receptacles should be planned.
Zero Waste - High Recycling	
Urban Forestry	Trees planted near dwelling units act as insulators from weather thereby decreasing energy requirements. Onsite trees also provide carbon storage.
Afforestation/Reforestation	Clustering residential development to preserve forest/woodland resources, increasing density, and preserving and restoring open space would comply with this strategy.
Water Use Efficiency	Features to increase water use efficiency include use of both potable and non-potable water to the maximum extent practicable and use of low flow appliances (i.e., toilets, shower heads, washing machines, etc).
Building Energy Efficiency	Pursuant to the description of Building Energy Efficiency in Table 3, it is recommended that a project achieve 20 percent reduction in the residential building’s combined space heating, cooling and water heating energy compared to the current Title 24 Standards.
Appliance Energy Efficiency	Use of energy efficient appliances (i.e., washer/dryers, refrigerators, stoves, etc.)
Smart Land Use and Intelligent Transportation Systems	Encourage high-density residential and commercial mixed use.
Green Buildings Initiative	Increase energy efficiency 20 percent beyond Title 24 requirements. Use of other green building design (i.e., natural daylighting and on-site renewable, electricity generation)

State Strategy to Reduce Greenhouse Gas Emissions ¹	Project Design/Mitigation to Comply with Strategy
California Solar Initiative	<p><u>Sample Mitigation</u></p> <p>The applicant shall join the California Energy Commission’s New Solar Homes Partnership for this project. The Partnership mandates that a minimum of 50 percent of the residences have solar panels installed. In addition, each appliance provided by the builder must be Energy Star if an Energy Star designation is applicable for that appliance. One of the requirements of the Partnership is selection of one of the following building efficiency options:</p> <p>a) 15 percent reduction in the residential building’s combined space heating, cooling and water heating energy compared to the current Title 24 Standards; or</p> <p>b) 35 percent reduction in the residential building’s combined space heating, cooling and water heating energy and 40 percent in the residential building’s air conditioning energy compared to the current Title 24 Standards.</p>
1) Source: Table 2 and Table 3	

Table 5: Commercial and Industrial Design Features

State Strategy to Reduce Greenhouse Gas Emissions ¹	Project Design/Mitigation to Comply with Strategy
Vehicle Climate Change Standards and other Light Duty Vehicle Technology	These are CARB enforced standards; vehicles that access the project that are required to comply with the standards will comply with the strategy.
Diesel Anti-Idling	Signs posted that restrict idling; onsite education for truck drivers regarding health impacts of diesel.
Hydrofluorocarbon Reduction	This measure applies to consumer products. When CARB adopts regulations for these reduction measures, any products that the regulations apply to will comply with the measures.
Transportation Refrigeration Units, Off-Road Electrification, Port Electrification	In projects where TRUs access the site, implement measures to reduce emissions; install electrification in applicable projects (i.e., truck stops, warehouses, etc.)
Heavy-Duty Vehicle Emission Reduction Measures	These are CARB enforced standards; vehicles that access the project that are required to comply with the standards will comply with the strategy.
Achieve 50% Statewide Recycling Goal and Zero Waste - High Recycling	1) Design locations for separate waste and recycling receptacles. 2) Utilize recycled components in the building design.
Urban Forestry	Trees act as insulators from weather thereby decreasing energy requirements. Onsite trees also provide carbon storage.
Afforestation/Reforestation	Increasing density; preserving and restoring open space.
Water Use Efficiency	Features to increase water use efficiency include: use of both potable and non-potable water to the maximum extent practicable; low flow appliances (i.e., toilets, dishwashers, washing machines, etc.); automatic shut off valves for sinks in restrooms; drought resistant landscaping; “Save Water” signs near water faucets.

State Strategy to Reduce Greenhouse Gas Emissions ¹	Project Design/Mitigation to Comply with Strategy
Building Energy Efficiency Standards	Increase energy efficiency by 20 percent beyond Title 24 requirements.
Appliance Energy Efficiency	Use of energy efficient appliances
Smart Land Use and Intelligent Transportation Systems	Encourage high-density residential and retail mixed use, infill development, transit oriented design, jobs/housing proximity, alternative forms of transportation, pedestrian friendly design features, etc.
Green Buildings Initiative	Increase energy efficiency 20 percent beyond Title 24 requirements. Use of other green building design (i.e., natural daylighting and on-site renewable, electricity generation)
California Solar Initiative	Encourage solar panels.
1) Source: Table 2 and Table 3	

Table 6: Design Features for Agriculture and Other Land Uses

State Strategy to Reduce Greenhouse Gas Emissions ¹	Project Design/Mitigation to Comply with Strategy
Manure Management	San Joaquin Valley: In projects that address confined animal facilities, project design as recommended in proposed Rule 4570 would reduce GHG emissions.
Alternative Fuels: Biodiesel Blends	The use of alternative fuels would be applicable to some industrial and agricultural projects.
Alternative Fuels: Ethanol	
Landfill Methane Capture	Methane capture would be applicable to projects involving landfills.
Cement Manufacturing	Features to reduce emissions would be applicable to projects involving cement manufacturing.
Enteric Fermentation	In agricultural/cattle related projects, design features that reduce emissions would be implemented.

Offsite Mitigation - Established Programs

It may be necessary for some projects to find other ways of reducing their GHG emission impacts other than compliance with onsite CCAT strategies. In those instances, projects could contribute to established regional, state, federal, or international GHG mitigation programs, such as reforestation, planting/replanting, or carbon trading program. Programs that introduce new plants or trees help reduce GHG emissions by absorbing carbon dioxide and producing oxygen. Once the overall carbon dioxide emissions of a project are calculated, a developer could offset their project GHG emissions by making a monetary contribution to a planting program that would provide for the absorption of that amount of GHG emissions over a reasonable period of time (i.e. three to five years).

In addition, the Kyoto Protocol established a number of ways of reducing project-level GHG emissions called Clean Development Mechanisms (CDMs) with approximately 20 different

categories, including: voluntary activities implemented jointly; registry systems; emission trading; and Joint Implementation Programs. The Kyoto Protocol implementation program considered CDMs and Joint Implementation Programs to be most applicable to specific development projects. According to the Union of Concerned Scientists website, the benefits of some CDMs such as carbon sequestration (storing carbon geologically or biologically) or a carbon tax are unknown or overly speculative at this time. However, carbon trading is an already established program that could be a very successful way of mitigating GHG emissions from typical development projects. Carbon trading may be especially beneficial for smaller projects for which it may be difficult to mitigate using design changes for larger projects such as onsite photovoltaic electric production, increased public transit, etc. Carbon trading also compliments market based “cap and trade” options which CARB is considering as one method of mitigating GHG emission impacts within California. With this program, a project could purchase offsets or credits to compensate for its proportion of GHG emissions.

Carbon trading involves paying into established third party programs such as alternative energy projects with proven track records that construct or invest in biomass, wind energy, alternative vehicular fuels, or increased energy efficiency programs. For example, a company called “TerraPass” provides carbon trading schedules for various types of development impacts, mainly housing occupancy and personal vehicle use. It should be noted that most of the following data and examples mainly address carbon dioxide emissions, since those are the most likely GHGs to be generated by development compared to other GHGs (ie., methane, nitrous oxide, hydroflourocarbons, perflourocarbons, and sulphur hexaflouride). For example, the TerraPass website indicates that the installation of compact fluorescent light bulbs instead of incandescent bulbs in a typical residential unit would save 362 pounds per year (ppy) of carbon dioxide, while cleaning the heating and air conditioning ducts and changing the heater filter every six months would save approximately 37.3 ppy of carbon dioxide.

Using the TerraPass website figures as a guide, a typical residential unit generates 7500 ppy of carbon dioxide from utility usage, while vehicular emissions from a personal vehicle driven under “normal” conditions (current average fleet vehicle driven 10,000 miles per year) generates 9,000 ppy of carbon dioxide. Typical TerraPass offsets would be \$40 for 7,500 ppy and \$45 for 9,000 ppy. If a project were to “pay” a third party to offset these emissions, it would cost approximately \$85 per year or \$850 per house if averaged over 10 years. The values presented in Table 7 are based on typical estimates from the TerraPass website.

Table 7: Offsite Mitigation Cost

Home Occupancy		Vehicle Use	
Emissions (pounds)	Cost (\$)	Emissions (pounds)	Cost (\$)
7000	35	6000	30
12000	60	8000	40
20000	100	12000	50
28000	140	20000	80
Source: TerraPass 2007 (www.terrapass.com)			

Project Inventory of Greenhouse Gases

An inventory of greenhouse gas emissions (carbon dioxide, ethane, nitrous oxide) generated by the project will be presented for informational purposes and for full disclosure. The inventory will be compared to the California inventory and/or the County, when they become available.

The emissions are typically estimated in tons per year, which are converted to teragrams of carbon dioxide equivalents (Tg CO₂ Eq.) using the formula: $Tg\ CO_2\ Eq. = (tons\ of\ gas) \times (GWP) \times (Tg / 1,000,000)$. One Tg is equal to one million metric tons. The global warming potential (GWP) for selected gases assessed are located in Table 1. The emissions are also compared with the current inventory for California, the air district, the county, and/or the city, as available.

Most commercial, residential, and industrial projects attract or use motor vehicles. Motor vehicles emit carbon dioxide, methane, and nitrous oxide. URBEMIS2002 currently does not estimate emissions of carbon dioxide. However, URBEMIS2007, which should be released later this year, will estimate emissions of carbon dioxide. In the interim, carbon dioxide from motor vehicles can be manually calculated using emission factors from EMFAC2002 or EMFAC2007, whichever version of EMFAC the air district with jurisdiction over the basin in which the project is located has accepted. Emissions of methane from motor vehicles can also be calculated with EMFAC. There are a couple of different U.S. EPA emission factors available to calculate nitrous oxide and methane emissions from vehicles (EPA 2004, EPA 2004b).

Stationary sources of greenhouse gases should also be estimated. One stationary source is natural gas combustion. URBEMIS2002 includes default natural gas usage rates for residential, industrial, hotel/motel, retail/shopping, and office. Emission factors for natural gas are from the U.S. EPA (EPA 1998).

Air conditioning equipment installation, leakage, and disposal emit a small amount of HFC emissions (EPA 2004c). As mentioned previously, there is a ban for chlorofluorocarbons; therefore, projects will not generate emissions of chlorofluorocarbons. Perfluorocarbons and sulfur hexafluoride are typically used in industrial applications. If the project will involve emissions of perfluorocarbons and/or sulfur hexafluoride, that would need to be identified.

Level of Significance after Mitigation

With the proposed onsite and/or offsite mitigation, the project's cumulative incremental contribution to greenhouse is anticipated to be less than significant.

CEQA Projects Affected by Climate Change Impacts

The impacts of climate change will also affect projects in various ways. Effects of climate change specifically mentioned in AB 32 such as rising sea levels and changes in snow pack should be addressed in CEQA documents as well. However, the extent of climate change impacts at specific locations remains unclear. In the near term, these effects can be described in generally using the language found in AB 32 to describe impacts imposed upon a project. However, it is expected that California agencies will more precisely quantify impacts in various regions of the State. As an example, it is expected that the Department of Water Resources will formalize a list of foreseeable water quality issues associated with various degrees of climate change. Once state government agencies make these lists available, they could be used to more precisely determine to what extent a project is affected by global climate change impacts.

Conclusions

We are currently in a period of transition within the regulatory community with regards to global climate change impact. With the passage of AB 32, the issue of climate change has moved from the scientific speculation into reality. It is anticipated that other states, and eventually the federal government, will pass legislation similar to AB 32.

AB 32 is essentially a roadmap and timeline of how climate change will be addressed in California. Consequently, it does not issue any new explicit regulations or guidelines for environmental review of new projects. However, AB 32 and supporting documents (i.e. Executive Order S-3-05, and the California Climate Action Team's Report to the Governor) give great credence to the argument that climate change should be addressed during the CEQA review process.

Prior to the explicit issuance of new CEQA guidance, it is anticipated that the courts will issue rulings on the need for global climate change impact analysis in determining specific cases. The recommended framework and methodology discussed in this paper can form the basis by which lead agencies can address and evaluate climate change impacts in CEQA.

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