RECON

Greenhouse Gas Emissions Analysis for the Castlerock Project, City of San Diego, California

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Executive Summary

The proposed Castlerock project (project) is located in the eastern portion of the city of San Diego, on the north side of Mast Boulevard between Medina Drive and West Hills Parkway. The project would result in the construction of 283 detached single-family residences, 147 detached small lot units (referred to as “green court” units), approximately 3.4 acres of public parks, 1.25 acres of pocket parks, a pedestrian trail, and public streets and private driveways on an undeveloped 203.6-acre site, within the East Elliott Community Plan. The remainder of the property would remain undisturbed as open space, except for small areas needed for brush management.

The proposed project would ~~generate a total of 5,204 metric tons of carbon dioxide equivalent ($MTCO_2E$) greenhouse gas (GHG) emissions annually. The project therefore~~ exceed~~s~~ the City’s interim 900 metric tons of carbon dioxide equivalent ($MTCO_2E$) greenhouse gas (GHG) screening threshold that identifies when a project must perform further analysis to show a 28.3 percent reduction in business-as-usual (BAU), as defined in the BAU 2020 Forecast developed by the California Air Resources Board (CARB).

Due to the recent Low Carbon Fuel Standards (LCFS) litigation and recent update to the CARB scoping plan, several analysis scenarios were completed in this report. First, analysis of the project using the City’s current interim GHG guidelines and associated 28.3 percent BAU reduction goal was completed taking into account vehicle emission reductions that would result from the LCFS. Then an analysis of the project was completed using the City’s current interim GHG guidelines and associated 28.3 percent BAU reduction goal without the vehicle emission reductions provided by LCFS. Finally, a 2011 CARB Scoping Plan analysis was completed that incorporates existing regulations into the baseline and uses a 16 percent BAU reduction goal. The results of these analysis scenarios are provided below, but it is noted that currently the LCFS is being enforced and therefore it is appropriate to utilize the LCFS in the analysis.

The proposed project with GHG reducing design features and statewide measures including the LCFS would generate a total of 4,886 $MTCO_2E$. This analysis demonstrates that a similar project under BAU would generate 6,996 $MTCO_2E$ of GHGs annually. The project’s annual emissions would be~~of 5,204 $MTCO_2E$ of GHGs is25.6~~30.2 percent less than BAU. The project’s reduction in total emissions compared to BAU would result from full implementation of statewide regulations to decrease vehicle GHG emissions and from project-specific design features that substantially reduce GHG emissions associated with energy and water use. ~~However, b~~Because these reductions would ~~not~~ meet the City’s current 28.3 percent reduction relative to BAU goal, impacts would ~~remain~~ be less than significant~~ and unmitigated~~.

Emissions were also calculated for the proposed project with GHG reducing design features but without the vehicle emission reductions provided by the LCFS. This project would generate a total of 5,204 $MTCO_2E$ of GHGs annually. This is 25.6 percent less than the equivalent BAU project. If the LCFS litigation is successful and the LCFS was no longer enforced, then the project would fall short of the City's current 28.3 percent GHG reduction goal.

A parallel analysis was conducted in this report that addresses a 16 percent reduction relative to BAU goal, based on CARB updates to its 2020 BAU GHG projections (to account for Scoping Plan measures already adopted and for the downturn in economic projections) and its Scoping Plan. These updates, begun in 2010 and finalized/adopted in 2011, establish a revised 2020 BAU reduction target of 16 percent. This 16 percent reduction target already incorporates the vehicle GHG reductions that are projected to result from implementation of Pavley I, and the energy emissions reductions that are projected to result from implementing the Renewables Portfolio Standard (i.e., 20 percent renewable energy supply) as well as the current 2008 (versus former 2005) Title 24 energy code. Considering these parameters, this analysis demonstrates that the project with mitigation (i.e., design features) resulting in a 20 percent improvement in energy efficiency over the current 2008 Title 24 energy code would reduce unmitigated emissions by ~~16~~ 22 percent, thus achieving the 2011 Scoping Plan statewide reduction goal. If the LCFS was eliminated, the project would still meet the 16 percent reduction goal. ~~Should the City decide to update its interim GHG threshold in accordance with this threshold, project impacts would be less than significant.~~

1.0 Introduction

This report evaluates the significance of the proposed project's contribution of GHG emissions to statewide GHG emissions and GHG emissions reduction targets. To evaluate the incremental effect of project development on statewide and global climate change, it is important to have a basic understanding of the nature of the global climate change problem.

1.1 Understanding Global Climate Change

Global climate change is a change in the average weather of the earth, which can be measured by wind patterns, storms, precipitation, and temperature. The earth's climate is in a state of constant flux with periodic warming and cooling cycles. Extreme periods of cooling are termed "ice ages," which may then be followed by extended periods of warmth. For most of the earth's geologic history, these periods of warming and cooling have been the result of many complicated, interacting natural factors that include volcanic eruptions which spew gases and particles (dust) into the atmosphere, the amount of water, vegetation, and ice covering the earth's surface, subtle changes in the earth's orbit, and the amount of energy released by the sun (sun cycles). However, since the beginning of the Industrial Revolution around 1750, the average temperature of the earth has been increasing at a rate that is faster than can be explained by natural climate cycles alone.

With the Industrial Revolution came an increase in the combustion of carbon-based fuels such as wood, coal, oil, natural gas, and biomass. Industrial processes have also created emissions of substances that are not found in nature. This in turn has led to a marked increase in the emissions of gases that have been shown to influence the world's climate. These gases, termed "greenhouse" gases, influence the amount of heat that is trapped in the earth's atmosphere. Because recently observed increased concentrations of GHGs in the atmosphere are related to increased emissions resulting from human activity, the current cycle of "global warming" is generally believed to be largely due to human activity. Of late, the issue of global warming or global climate change has arguably become the most important and widely debated environmental issue in the United States and the world. Because climate change is caused by the collective of human actions taking place throughout the world, it is quintessentially a global or cumulative issue.

1.2 Greenhouse Gases of Primary Concern

There are numerous GHGs, both naturally occurring and manmade. Table 1 summarizes some of the most common. Each GHG has variable atmospheric lifetime and global warming potential.

The atmospheric lifetime of the GHG is the average time the molecule stays stable in the atmosphere. Most GHGs have long atmospheric lifetimes, staying in the atmosphere hundreds or thousands of years. The potential of a gas to trap heat and warm the atmosphere is measured by its global warming potential or GWP. Specifically, GWP is defined as the cumulative radiative forcing effects of a gas, both direct and indirect, integrated over a specified period of time resulting from the emission of a unit mass of gas relative to some reference gas (U.S. EPA 2002). The reference gas for GWP is carbon dioxide which, as shown in Table 1, thus has a GWP of 1. As an example, methane, while having a shorter atmospheric lifetime than carbon dioxide, has a GWP of 21, which means that is has a greater global warming effect than carbon dioxide on a molecule by molecule basis.

TABLE 1
GLOBAL WARMING POTENTIALS (GWPs) AND ATMOSPHERIC LIFETIMES (YEARS)

Gas	Atmospheric Lifetime	100-year GWP	20-year GWP	500-year GWP
Carbon Dioxide (CO_2)	50-200	1	1	1
Methane (CH_4)[a]	12±3	21	56	6.5
Nitrous oxide (N_2O)	120	310	280	170
HFC-23	264	11,700	9,100	9,800
HFC-125	32.6	2,800	4,600	920
HFC-134a	14.6	1,300	3,400	420
HFC-143a	48.3	3,800	5,000	1,400
HFC-152a	1.5	140	460	42
HFC-227ea	36.5	2,900	4,300	950
HFC-236fa	209	6,300	5,100	4,700
HFC-4310mee	17.1	1,300	3,000	400
CF_4	50,000	6,500	4,400	10,000
C_2F_6	10,000	9,200	6,200	14,000
C_4F_{10}	2,600	7,000	4,800	10,100
C_6F_{14}	3,200	7,400	5,000	10,700
SF_6	3,200	23,900	16,300	34,900

SOURCE: U.S. EPA 2002.
[a] The methane GWP includes the direct effects and those indirect effects due to the production of tropospheric ozone and stratospheric water vapor. The indirect effect due to the production of CO_2 is not included.

Of the gases listed in Table 1, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide(N_2O) are produced by both biogenic (natural) and anthropogenic (human) sources. The remaining gases occur solely as the result of human processes. Hydrofluorocarbons (HFCs) are synthetic, made-made chemicals used as substitutes for ozone-depleting chloroflourocarbons in automobile air conditioners and refrigerants. Perfluorocarbons (PFCs) such as CF_4 are used primarily in aluminum production and semiconductor manufacture. Sulfur hexafluoride (SF_6) is used for insulation in electric power transmission and distribution equipment. These remaining gases are not of primary concern to the proposed project.

CO_2, CH_4, and N_2O are the GHGs of primary concern in this analysis. Carbon dioxide would be emitted by the proposed project during the combustion of fossil fuels in vehicles, from electricity generation and natural gas consumption, and from solid waste disposal. Smaller amounts of methane and nitrous oxide would be emitted from the same project operations.

More information on the background of global warming and GHGs can be found in Attachment 1, Understanding Global Climate Change.

2.0 Project Description

2.1 Development Summary

The project is located in the eastern portion of the City of San Diego, on the north side of Mast Boulevard between Medina Drive and West Hills Parkway. Figure 1 shows the regional location within the City of San Diego. Figure 2 shows an aerial photograph of the project area. Figure 3 shows the proposed vesting tentative map for the project. The project would result in the construction of 283 detached single-family residences, 147 detached small lot units (referred to as “green court” units), approximately 3.4 acres of public parks, 1.25 acres of pocket parks, a pedestrian trail, and public streets and private driveways on an undeveloped 203.6-acre site, within the East Elliott Community Plan. The remainder of the property would remain undisturbed as open space, except for small areas needed for brush management.

2.2 Green Building Standards

The applicant would design and construct the project in accordance with the residential standards of the Building Industry Association’s California Green Builder (CGB) program. The CGB program was conceived and created by the Building Industry Institute (BII), the research arm of the California Building Industry Association (CBIA). The CGB program sets goals for significant improvements in energy efficiency, water conservation, wood conservation, on-site waste recycling, and indoor air quality. The CGB program is a program recognized by the California Energy Commission as one of several green building performance rating systems available to potentially lower GHG emissions from buildings (CARB 2008a). While projects are generally not required to enroll in the CGB program, the applicant has made it a requirement as a Castlerock project design feature.

2.2.1 Energy Efficiency

CGB homes are required to exceed the current 2008 California Energy Code’s residential energy efficiency standards by 15 percent at a minimum. The project would exceed the current 2008 California Energy Code’s residential energy efficiency standards by 20 percent as a mandatory project design feature. It would accomplish this through improved HVAC systems and duct seals; enhanced ceiling, attic and wall insulation; EnergyStar appliances; high-efficiency water heaters; energy-efficient three-coat stucco exteriors; energy-efficient lighting; and high-efficiency window glazing. These energy features would undergo independent third party inspection and diagnostics as part of the CGB verification and commissioning process. The energy features would also be demonstrated/verified in the project's Title 24 Compliance Report submitted during the building permit process.

2.2.2 Water Conservation

CGB homes are designed to use at least 20,000 gallons less water per unit than non-CGB homes by featuring advanced plumbing systems, such as parallel hot water piping or hot water recirculation systems, and fixtures such as ultra-low flow toilets, water-saving showerheads and kitchen faucets, and buyer-optional high-efficiency clothes washers. Specifically, CGB standards reduce the overall use of potable water within each home by 20 percent. In accordance with CGB criteria, the 20 percent reduction in potable water use shall be demonstrated by verifying each plumbing fixture and fitting meets the 20 percent reduced flow rate or by calculating a 20 percent reduction in the building water use baseline.

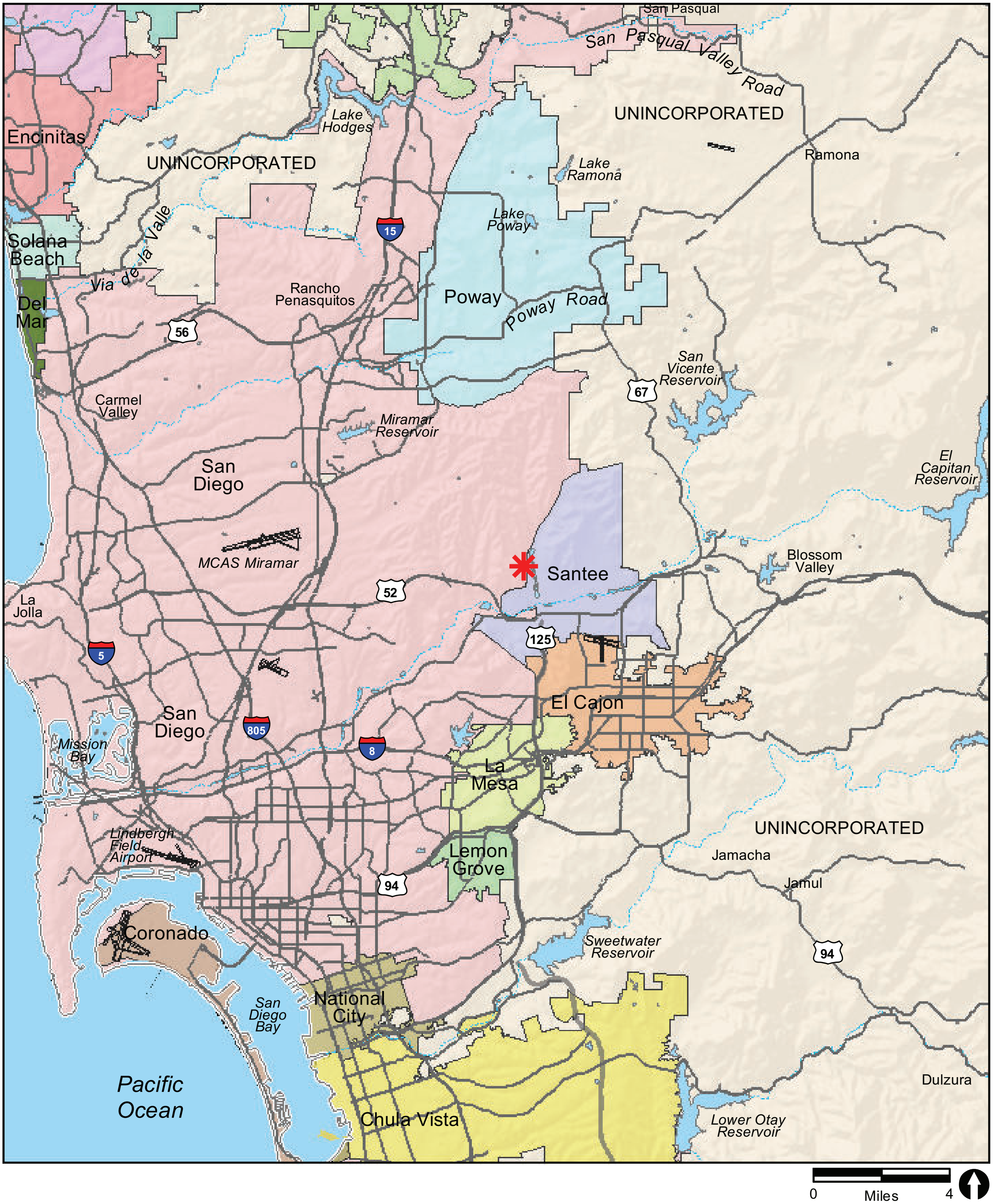
In addition to these indoor water use conservation features, the project's outdoor landscaping plan minimizes turf, maximizes drought-tolerant plants, and incorporates weather-based irrigation controllers, multi-programmable irrigation clocks, and a high-efficiency drip irrigation system. At the time of final inspection, a manual shall be placed in each building that includes, among other things, information about water conservation.

2.2.3 Materials Use and Waste Reduction

In accordance with CGB criteria and state and local laws, at least 50 percent of on-site construction waste and ongoing operational waste would be diverted from landfills through reuse and recycling. To further minimize waste, the project would incorporate recycled materials for flooring, and certified sustainable wood products and other recycled or rapidly renewable building materials where possible. Areas for storage and collection of recyclables and yard waste would be provided for each residence.

2.2.4 Pollutant Control and Heat Island Reduction

To maximize shade and reduce heat island effects, the landscape plan includes strategic location of deciduous trees and other vegetation. Impervious surfaces, including paved parking areas, would also be minimized and pervious pavers used instead where practical. No CFC-based refrigerants would be used, and interior finishes, adhesives, sealants, paints and coatings, and carpet systems would be low in VOCs (volatile organic compounds), and meet the testing and product requirements of one or more nationally recognized green product labeling programs. Compliance with these requirements of the CGB program shall be verified through documentation.



Project Location

FIGURE 1

Regional Location

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FIGURE 2

Aerial Photograph of the Project Site

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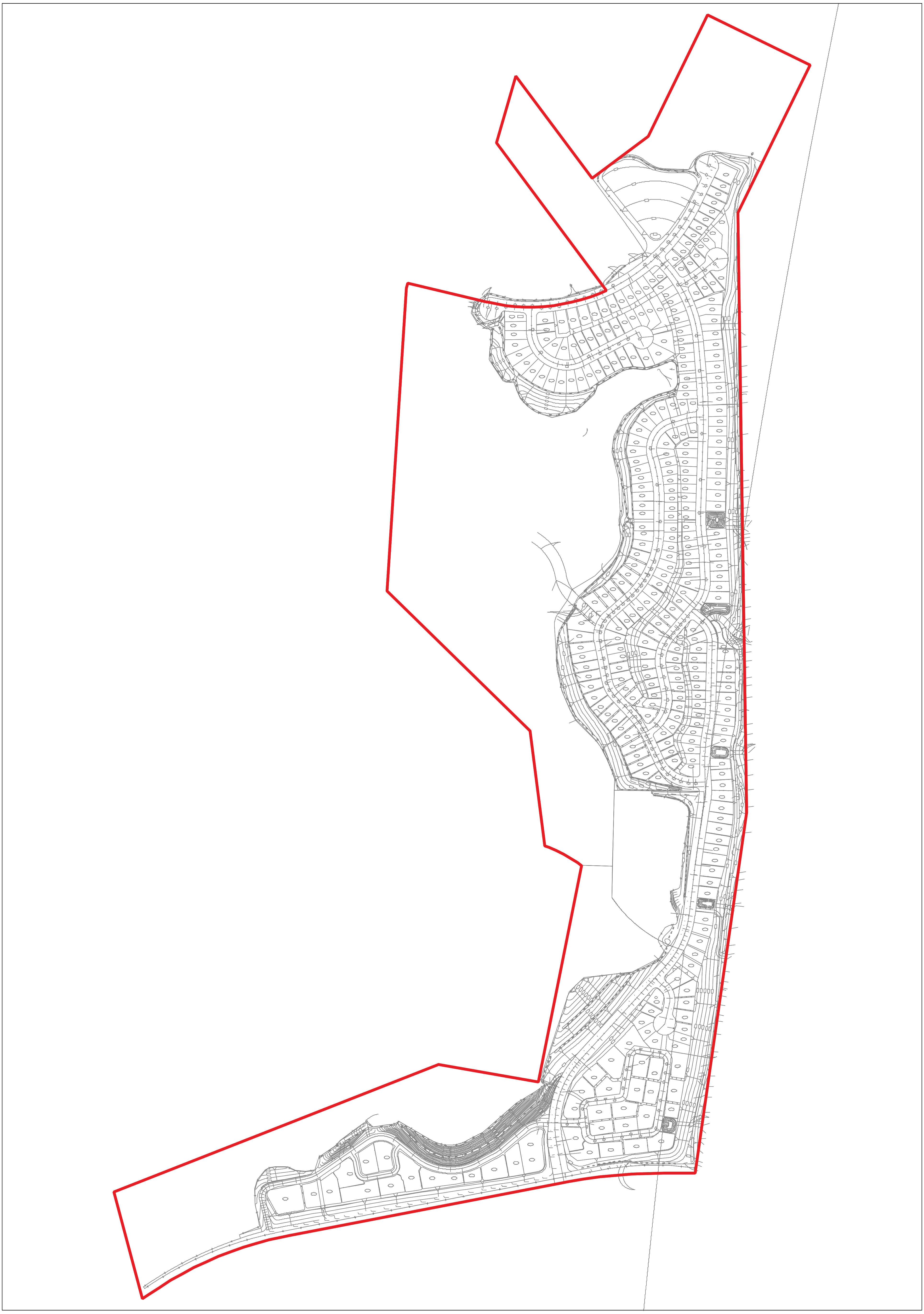

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Project Boundary

Project Plan Lines

FIGURE 3

Proposed Project Tentative Map

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3.0 Existing Conditions

3.1 Environmental Setting

3.1.1 State and Regional GHG Inventories

CARB performed statewide inventories for the years 1990 to 2008 (Table 2). The inventory is divided into nine broad sectors of economic activity, including agriculture, commercial, electricity generation, forestry, high GWP emitters, industrial, recycling and waste, residential, and transportation. Emissions are quantified in million metric tons of CO_2 equivalent ($MMTCO_2E$)

TABLE 2
CALIFORNIA GHG EMISSIONS BY SECTOR IN 1990, 2000, 2004, AND 2008

Sector	1990 Emissions in $MMTCO_2E$ (% total)[1]	2000 Emissions in $MMTCO_2E$ (% total)[1]	2004 Emissions in $MMTCO_2E$ (% total)[1]	2008 Emissions in $MMTCO_2E$ (% total)[1]
Sources				
Agriculture	23.4 (5%)	25.44 (6%)	28.82 (6%)	28.06 (6%)
Commercial	14.4 (3%)	12.80 (3%)	13.20 (3%)	14.68 (3%)
Electricity Generation	110.6 (26%)	103.92 (23%)	119.96 (25%)	116.35 (24%)
Forestry (excluding sinks)	0.2 (<1%)	0.19 (<1%)	0.19 (<1%)	0.19 (<1%)
High GWP	--	10.95 (2%)	13.57 (3%)	15.65 (3%)
Industrial	103.0 (24%)	97.27 (21%)	90.87 (19%)	92.66 (19%)
Recycling and Waste	--	6.20 (1%)	6.23 (1%)	6.71 (1%)
Residential	29.7 (7%)	30.13 (7%)	29.34 (6%)	28.45 (6%)
Transportation	150.7 (35%)	171.13 (37%)	181.71 (38%)	174.99 (37%)
Unspecified Remaining[2]	1.3 (<1%)	--	--	--
Subtotal	*433.3*	*458.03*	*483.89*	*477.74*
Sinks				
Forestry Sinks	-6.7 (--)	-4.72 (--)	-4.32 (--)	-3.98 (--)
Total	**426.6**	**453.31**	**479.57**	**473.76**

Source: CARB 2007, 2010a
[1] Percentages may not total 100 due to rounding.
[2] Unspecified fuel combustion and ozone depleting substance (ODS) substitute use, which could not be attributed to an individual sector.

As shown in Table 2, statewide GHG source emissions totaled 433 $MMTCO_2E$ in 1990, 458 $MMTCO_2E$ in 2000, 484 $MMTCO_2E$ in 2004, and 478 $MMTCO_2E$ in 2008. According to data from the CARB, it appears that statewide GHG emissions peaked in 2004, and are now beginning to decrease (CARB 2010a). Transportation-related emissions consistently contribute the most GHG emissions, followed by electricity generation and industrial emissions.

The forestry sector is unique because it not only includes emissions associated with harvest, fire, and land use conversion (sources), but also includes removals of atmospheric CO_2 (sinks) by photosynthesis, which is then bound (sequestered) in plant tissues. As seen in Table 2, the forestry sector consistently removes more CO_2 from the atmosphere statewide than it emits. As a result, although decreasing over time, this sector represents a net sink, removing a net 6.5 $MMTCO_2E$ from the atmosphere in 1990, a net 4.5 $MMTCO_2E$ in 2000, a net 4.1 $MMTCO_2E$ in 2004, and a net 3.8 $MMTCO_2E$ in 2008.

A San Diego regional emissions inventory was prepared by the University of San Diego School of Law, Energy Policy Initiative Center (EPIC) that took into account the unique characteristics of the region. Their 2006 emissions inventory for San Diego is duplicated below in Table 3. The sectors included in this inventory are somewhat different than those in the statewide inventory.

TABLE 3
SAN DIEGO COUNTY GHG EMISSIONS BY SECTOR IN 2006

Sector	2006 Emissions in $MMTCO_2E$ (% total) [1]
Agriculture/Forestry/Land Use	0.7 (2%)
Waste	0.7 (2%)
Electricity	9 (25%)
Natural Gas Consumption	3 (8%)
Industrial Processes & Products	1.6 (5%)
On-Road Transportation	16 (45%)
Off-Road Equipment & Vehicles	1.3 (4%)
Civil Aviation	1.7 (5%)
Rail	0.3 (<1%)
Water-Borne Navigation	0.127 (<0.5%)
Other Fuels/Other	1.1 (3%)
Total	**35.5**

SOURCE: San Diego County Greenhouse Gas Inventory: An Analysis of Regional Emissions and Strategies to Achieve AB 32 Targets. Prepared by the University of San Diego School of Law, Energy Policy Initiative Center (EPIC), and available online at http://www.sandiego.edu/ epic/ghginventory/.
[1] Percents may not total 100 due to rounding.

Similar to the statewide emissions, transportation-related GHG emissions contributed the most countywide, followed by emissions associated with energy use.

3.1.2 On-Site GHG Inventory

The existing project site is currently vacant. There are no current significant sources of on-site GHG emissions.

3.1.3 Consequences of Global Climate Change

CARB projects a future statewide GHG emissions increase of more than 23 percent (from 2004) by 2020 given current trends (CARB 2008b). The 2008 EPIC study predicts a countywide increase to 43 $MMTCO_2E$, or roughly 20 percent (from 2006) by 2020, given a BAU trajectory. Global GHG emissions forecasts also predict similar substantial increases, given a BAU trajectory.

The potential consequences of global climate change on the San Diego region are far reaching. The Climate Scenarios report, published in 2006 by the California Climate Change Center, uses a range of emissions scenarios to project a series of potential warming ranges (low, medium or high temperature increases) that may occur in California during the twenty-first century. Throughout the state and the region, global climate and local microclimate changes could cause an increase in extreme heat days; higher concentrations, frequency and duration of air pollutants; an increase in wildfires; more intense coastal storms; sea level rise; impacts to water supply and water quality through reduced snowpack and saltwater influx; public health impacts; impacts to near-shore marine ecosystems; reduced quantity and quality of agricultural products; pest population increases; and altered natural ecosystems and biodiversity.

3.2 Regulatory Background

In response to rising concern associated with increasing GHG emissions and global climate change impacts, several plans and regulations have been adopted at the international, national, and state levels with the aim of reducing GHG emissions.

3.2.1 International

3.2.1.1 Montreal Protocol on Substances that Deplete the Ozone Layer

Human caused effects on the global atmosphere first became widely known to the public at large in the mid-1970s when it was discovered that a number of substances, particularly chlorofluorocarbons (CFCs) used in refrigeration, when released into the atmosphere could cause the breakdown of significant quantities of the earth's protective ozone (O_3) in the stratosphere (i.e., the "ozone layer"). Somewhat concurrent with this was the discovery of the now well documented "ozone hole" over Antarctica. The ozone layer filters out most of the ultraviolet-B (UV-B) radiation reaching the earth. Therefore, destruction of the ozone layer would allow more UV-B radiation to reach the earth's surface potentially leading to increases in skin cancer and other effects such as crop damage and adverse effects on marine phytoplankton.

In response to these concerns, the Coordinating Committee on the Ozone Layer was established by the United Nations Environment Program (UNEP) in 1977, and UNEP's Governing Council adopted the World Plan of Action on the Ozone Layer. Continuing efforts led to the signing in 1985 of the Vienna Convention on the Protection of the Ozone Layer. This led to the creation of the Montreal Protocol on Substances That Deplete the Ozone Layer (Montreal Protocol), an international treaty designed to protect the stratospheric ozone layer by phasing out production of ozone depleting substances. The Montreal Protocol was adopted on September 16, 1987 and was enacted on January 1, 1989. The Protocol has been amended four times since 1989: the London Amendment in 1990, Copenhagen Amendment in 1992, Montreal Amendment in 1997, and most recently the Beijing Amendment in 1999 (U.S. EPA 2010).

This treaty is considered one of the most successful international treaties on environmental protection in the world, with ratification by 191 countries including the United States. By the end of 2006, the 191 parties to the treaty had phased out over 95 percent of ozone depleting substances (UNEP 2007). Because of this success, scientists are now predicting that the ozone hole will "heal" later this century.

The elimination of these ozone-depleting substances also has benefits relative to global climate change because most of these substances are also potent GHGs with very high GWPs, ranging from 4,680 to 10,720 (UNEP 2007, Australian Government 2007). However, the phasing out of ozone depleting substances has led to an increase in the use of non-ozone depleting substances such as hydrofluorocarbons (HFCs) which, although not detrimental to the ozone layer, are also potent GHGs. As shown in Table 1, these substances have GWPs ranging from 140 to 11,700.

3.2.1.2 Intergovernmental Panel on Climate Change

In response to growing concern about pollutants in the upper atmosphere and the potential problem of climate change, the World Meteorological Organization and the UNEP established the Intergovernmental Panel on Climate Change (IPCC) in 1988. The IPCC was tasked with assessing the scientific, technical, and socioeconomic information relevant to understanding the scientific basis for 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 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.

3.2.1.3 United Nations Framework Convention on Climate Change

In 1994, the Unites States joined a number of other nations in signing an international treaty known as the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC recognized that global climate is a shared resource that can be affected by industrial and other emissions of GHGs, and set an overall framework for intergovernmental efforts to tackle the challenges posed by global climate change.

As with the Montreal Protocol, this treaty was ratified by 191 countries including the United States. Under this treaty, governments were to (UNFCCC 2007a):

- Gather and share information on GHG emissions, national policies and best practices;
- Launch national strategies for addressing GHG emissions and adapting to expected impacts; and
- Cooperate with other nations in preparing for adaptation to the impacts of climate change.

The UNFCCC divided countries into three main groups according to differing commitments based on economic strength, vulnerability to adverse climate change impacts, and capacity to respond or adapt to climate change effects. The stronger economic nations, including the United States, were to provide financial and technological support to developing countries to enable them to undertake emissions reduction activities and to help them adapt to adverse effects of climate change.

The UNFCCC was enacted in March 1994; however, it generally lacked powerful, legally binding measures. This led to the development of the Kyoto Protocol.

3.2.1.4 Kyoto Protocol to the UNFCCC

Knowing that the UNFCCC did not contain the legally binding measures that would be required to meaningfully address global climate change, a conference of the UNFCCC signatory nations was held in Berlin in 1995 that launched a new round of discussions to determine more detailed and stronger commitments for industrialized countries (the Berlin Mandate). After two and a half years of negotiations, the Kyoto Protocol was adopted in December 1997 (UNFCCC 2007b). While the 1997 Kyoto Protocol shared the UNFCCC’s objectives, it committed signatories to individual, legally binding targets to limit or reduce their GHG emissions. By March 1999, 84 countries, including the United States, had signed the Kyoto Protocol (UNFCCC 2009).

Only Parties to the UNFCCC that have also become Parties to the Kyoto Protocol are bound by the Kyoto Protocol's commitments. Governments become Parties to the Protocol by ratifying, accepting, approving, or acceding to it. Because of the complexity of the negotiations and uncertainty associated with the rules or how they would operate, several of the signing countries, including the United States, were reluctant to actually ratify the Protocol. Therefore a new round of negotiations was undertaken to flesh out the Kyoto Protocol's rulebook. These negotiations concluded with the adoption of the Marrakesh Accords in 2001. With the adoption of the Marrakesh Accords, the Protocol was enacted in February 2005, and by July 2009, 184 governments had become Parties to the Protocol (UNFCCC 2007b, 2009). In December 2009, a Copenhagen Accord was held to address global climate change issues in the future; however no further measures were adopted. The most recent UN Climate Change Conference occurred in Cancun, Mexico from November 29 to December 10, 2010, and resulted in 26 agreements related to GHG emission reductions (Cancun Accords).

Although a signer to the Kyoto Protocol, to date the U.S. has not ratified the Kyoto Protocol because it does not mandate emissions reductions from all countries, including several developing countries whose GHG emissions are expected to exceed emissions from developed countries within the next 25 years (U.S. EPA 2007a).

3.2.2 National

3.2.2.1 Clean Air Act, Title VI - Stratospheric Ozone Protection

Similar to the Montreal Protocol discussed above, Title VI of the Clean Air Act was established to protect stratospheric ozone by phasing out the manufacture of ozone-depleting substances, and by restricting their use and distribution (U.S. EPA 2007b). Also similar to the Montreal Protocol, while successful in phasing out ozone depleting substances, Title VI has inadvertently led to an increase in the production and use of non-ozone depleting substitutes such as HFCs that are global warming gases with high GWPs and relatively long atmospheric lifetimes.

3.2.2.2 Climate Change Action Plan

Adopted in 1993, the U.S. Climate Change Action Plan (CCAP) consists of voluntary actions to reduce all significant GHGs from all economic sectors. Backed by federal funding, the CCAP supports cooperative partnerships between the government and the private sector in establishing flexible and cost-effective ways to reduce GHG emissions. The CCAP encourages investments in new technologies, but also relies on previous actions and programs focused on saving energy, reducing transportation emissions, improving forestry management, and reducing waste. With respect to energy and transportation-related GHG emissions reductions, the CCAP includes the following (U.S. Global Change Research Information Office 1993).

- Energy Demand Actions to accelerate the use of existing energy saving technologies and encourage the development of more advanced technologies. Commercial actions focus on installing efficient heating and cooling systems in commercial buildings and upgrading to energy-efficient lighting systems (the *Green Lights* program). The *State Buildings Energy Incentive Fund* provides funding to states for the development of public building energy management programs. Residential actions focus on developing new residential energy standards and building codes and providing money-saving energy efficient options to homeowners.

- Energy Supply Actions to reduce emissions from energy supply. These actions focus on increasing the use of natural gas, which emits less CO_2 than coal or oil, and investing in renewable energy sources, such as solar and wind power, which result in zero net CO_2 emissions. Energy supply strategies also focus on reducing the amount of energy lost during distribution from power plants to consumers.

- Transportation Actions to reduce transportation related emissions are focused on investing in cleaner fuels and more efficient technologies and reducing vehicle miles traveled (VMT). Also, the U.S. EPA and Department of Transportation (DOT) are to draft guidance documents for reducing VMTs for us in developing local clean air programs.

3.2.2.3 GHG Emissions Intensity Reduction Programs

The GHG Emissions Intensity is the ratio of GHG emissions to economic output. In 2002, the U.S. GHG Emissions Intensity was 183 metric tons per million dollars of Gross Domestic Product (U.S. EPA 2007c). In February 2002, the U.S. set a goal to reduce this GHG Emissions Intensity by 18 percent by 2012 through various reduction programs. A number of ongoing voluntary programs have thus been instituted to reduce nationwide GHG emissions. These include (U.S. EPA 2007c):

- **Climate VISION Partnership:** In 2003, this program established a partnership between 12 major industries and the U.S. Department of Energy (U.S. DOE), the U.S. EPA, the DOT and the U.S. Department of Agriculture. The involved industries include electric utilities; petroleum refiners and natural gas producers; automobile, iron and steel, chemical and magnesium manufacturers; forest and paper producers; railroads; and cement, mining, aluminum, and semiconductor industries. These industries are working with the four agencies to reduce their GHG emissions by developing cost-effective solutions, measuring and reporting emissions, developing strategies for the adoption of advanced technologies, and implementing voluntary mitigation actions.

- **Cleaner Energy-Environment State Partnership:** This program established a partnership between federal and state agencies to support states in implementing strategies and policies to promote renewable energy, energy efficiency, and other cost-effective clean energies. States receive technical assistance from the U.S. EPA.

- **Climate Leaders:** Climate Leaders is a U.S. EPA voluntary program that establishes partnerships with individual companies. Together they establish individual corporate goals for GHG emissions reduction and monitor their emissions to measure progress. More than 100 corporations that represent 8 percent of U.S. GHG emissions are involved in Climate Leaders. More than half have reached their emissions goals so far.

- **Energy Star:** Energy Star was established in 1992 by the U.S. EPA and became a joint program with the U.S. DOE in 1996. Energy Star is a program that labels energy efficient products with the Energy Star label. Energy Star enables consumers to choose energy efficient and cost saving products. More than 1,400 manufacturers use Energy Star labels on their energy efficient products.

- **Green Power Partnership:** This program establishes partnerships between the U.S. EPA and companies and organizations that have bought or are considering buying green power, which is power generated from renewable energy sources. The U.S. EPA offers recognition and promotion to organizations that replace electricity consumption with green power.

3.2.2.4 Corporate Average Fuel Economy Standards

The federal Corporate Average Fuel Economy (CAFE) standards determine the fuel efficiency of certain vehicle classes in the U.S. While the standards had not changed since 1990, in 2007, as part of the Energy and Security Act of 2007, the CAFE standards were increased for new light-duty vehicles to 35 miles per gallon (mpg) by 2020. In May 2009, President Obama announced further plans to increase CAFE standards to require light duty vehicles to meet an average fuel economy of 35.5 mpg by 2016. With improved gas mileage, fewer gallons of transportation fuel would be combusted to travel the same distance, thereby reducing nationwide GHG emissions associated with vehicle travel.

3.2.2.5 Mandatory Reporting of GHGs Rule

Starting January 1, 2010, large emitters of heat-trapping gases began collecting GHG data and reporting their annual GHG emissions to the U.S. EPA. The first reports were generally due March 31, 2011, with extensions available under certain circumstances to September 30, 2011. Under this reporting Rule, approximately 10,000 facilities would be covered, accounting for nearly 85 percent of the nation's GHG emissions. This mandatory reporting applies to fossil fuel and industrial GHG suppliers, motor vehicle and engine manufacturers, and facilities that emit 25,000 $MTCO_2E$ or more per year.

Vehicle and engine manufacturers outside of the light-duty sector are required to begin phasing in their GHG reporting starting with engine/vehicle model year 2011.

3.2.3 State

The State of California has adopted a number of plans and regulations aimed at identifying statewide and regional GHG emissions caps, GHG emissions reduction targets, and actions and timelines to achieve the target GHG reductions.

3.2.3.1 EO S-3-05 – Statewide GHG Emission Targets

This executive order (EO) signed by Governor Schwarzenegger on June 1, 2005, established the following GHG emission reduction targets for the state of California:

- 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.

This executive order also directs the secretary of the California EPA (CalEPA) to oversee the efforts made to reach these targets, and to prepare biannual reports on the progress made toward meeting the targets and on the impacts to California related to global warming, including impacts to water supply, public health, agriculture, the coastline, and forestry. With regard to impacts, the report shall also prepare and report on mitigation and adaptation plans to combat the impacts. The first Climate Action Team Assessment Report was produced in March 2006 and has been updated every two years.

3.2.3.2 AB 32 – California Global Warming Solutions Act

In response to Executive Order S-3-05, the California legislature passed Assembly Bill (AB) 32 (Nuñez), the “California Global Warming Solutions Act of 2006”, which was signed by the governor on September 27, 2006. It requires the CARB to adopt rules and regulations that would reduce GHG emissions to 1990 levels by 2020. The CARB is also required to publish a list of discrete GHG emission reduction measures.

Specifically, AB 32, the California Global Warming Solutions Act of 2006, requires CARB to (State of California 2006):

- Establish a statewide GHG emissions cap for 2020, based on 1990 emissions by January 1, 2008.

- ü In December 2007, CARB approved a 2020 emission limit of 427 million metric tons of CO_2 equivalent.

- Adopt mandatory reporting rules for significant sources of GHGs by January 1, 2009.

  - ü In December 2007, CARB adopted regulations requiring the largest industrial sources to report and verify their GHG emissions. Facilities began tracking emissions in 2008 and reports were due June 1, 2009. Emissions reporting for 2008 was allowed to be based on best available data. Beginning in 2010, emissions reports became more rigorous and subject to third-party verification.

    This action builds on the earlier SB 177 (Sher) enacted in 2000 which established a nonprofit California Climate Action Registry for the purpose of administering a voluntary GHG emissions registry.

- Adopt a plan by January 1, 2009 indicating how emission reductions will be achieved from significant GHG sources via regulations, market mechanisms and other actions.

  - ü A Climate Change Scoping Plan (Scoping Plan) was approved on December 12, 2008. The Scoping Plan contains the main strategies California will implement to achieve a reduction of 174 million $MTCO_2E$ GHG emissions, or approximately 29 percent from the state's projected 2020 emission level of 596 million $MTCO_2E$ under a BAU scenario. The Scoping Plan is discussed in greater detail in Section 3.2.3.3 below.

- Adopt regulations by January 1, 2011 to achieve the maximum technologically feasible and cost-effective reductions in GHG, including provisions for using both market mechanisms and alternative compliance mechanisms.

- Convene an Environmental Justice Advisory Committee and an Economic and Technology Advancement Advisory Committee to advise CARB.

  - ü In January 2007, the CARB appointed a ten member Environmental Justice Advisory Committee and appointed members to the Economic and Technology Advancement Advisory Committee.

- Ensure public notice and opportunity for comment for all CARB actions.

  - ü A number of CARB documents, including the 2020 Emissions Forecast, the Scoping Plan, and the Draft Recommended Approaches for Setting Interim Significance Thresholds, have been circulated for public review and comment.

- Prior to imposing any mandates or authorizing market mechanisms, CARB must evaluate several factors, including but not limited to impacts on California's economy, the environment and public health; equity between regulated entities;

electricity reliability; conformance with other environmental laws; and ensure that the rules do not disproportionately impact low-income communities.

3.2.3.3 Climate Change Scoping Plan

As directed by AB 32, the Climate Change Scoping Plan prepared by CARB in December 2008 includes measures to reduce statewide GHG emissions to 1990 levels by 2020. These reductions are what CARB identified as necessary to reduce forecasted BAU 2020 emissions. CARB will update the Scoping Plan at least once every five years to allow evaluation of progress made and to correct the Plan's course where necessary.

In 2008, CARB estimated annual BAU 2020 emissions to reach 596 $MMTCO_2E$. To achieve 1990 emissions levels of 427 $MMTCO_2E$, a 169 $MMTCO_2E$ reduction was thus determined to be needed by 2020. As indicated in Table 4, the majority of reductions is directed at the sectors with the largest GHG emissions contributions–transportation and electricity generation–and involve statutory mandates affecting vehicle or fuel manufacture, public transit, and public utilities. CARB also lists several other recommended measures which will contribute toward achieving the 2020 statewide reduction goal, but whose reductions are not (for various reasons, including the potential for double counting) additive with the measures listed in Table 4. These include state and local government operations measures, green building, mandatory commercial recycling and other additional waste and recycling measures, water sector measures, and methane capture at large dairies.

The Scoping Plan reduction measures and complementary regulations are described further in the following sections, and are grouped under the two headings of Transportation-Related Measures and Non-Transportation-Related Measures as representative of the sectors to which they apply.

In 2010, CARB revised its 2020 BAU projections to account for the economic downturn and other factors. CARB's revised estimate calculated that BAU 2020 emissions would reach approximately 545 $MMTCO_2E$ in the absence of any Scoping Plan reduction measures (although two of the key measures - the Pavley I [Light-Duty Vehicle GHG Emissions Standards] and the Renewable Portfolios Strategy [RPS] - have begun to be enforced), and that the new 2020 baseline emissions (accounting for Pavley I and the RPS) would be approximately 507 $MMTCO_2E$ per year. Thus, in order to reach the 1990 emissions level of 427 $MMTCO_2E$, an 80 $MMTCO_2E$ reduction was determined to be needed by 2020 (CARB 2010e).

Transportation-Related Emissions Reductions

Transportation accounts for the largest share of the state's GHG emissions. Accordingly, a large share of the reduction of GHG emissions from the recommended

TABLE 4
CARB SCOPING PLAN RECOMMENDED GHG REDUCTION MEASURES

Recommended Reduction Measures	Reductions Counted Towards 2020 Target In $MMTCO_2E$ (% total) [2]
ESTIMATED REDUCTIONS RESULTING FROM THE COMBINATION OF CAPPED SECTORS AND COMPLEMENTARY MEASURES	**146.7**
California Light-Duty Vehicle Greenhouse Gas Standards · Implement Pavley I Standards · Develop Pavley II light-duty vehicle standards	31.7 (18%)
Energy Efficiency · Building/appliance efficiency, new programs, etc. · Increase CHP generation by 30,000 GWh · Solar Water Heating (AB 1470 goal)	26.3 (15%)
Renewables Portfolio Standard (33% by 2020)	21.3 (12%)
Low Carbon Fuel Standard	15 (9%)
Regional Transportation-Related GHG Targets[1]	5 (3%)
Vehicle Efficiency Measures	4.5 (3%)
Goods Movement · Ship Electrification at Ports · System-Wide Efficiency Improvements	3.7 (2%)
Million Solar Roofs	2.1 (1%)
Medium/Heavy Duty Trucks · Heavy-Duty Vehicle Greenhouse Gas Emissions Reduction (Aerodynamic Efficiency) · Medium- and Heavy-Duty Vehicle Hybridization	1.4 (<1%)
High Speed Rail	1.0 (<1%)
Industrial Measures (for sources covered under cap&trade program) · Refinery Measures · Energy Efficiency and Co-Benefits Audits	0.3 (<.5%)
Additional Reductions Necessary to Achieve the Cap	34.4 (20%)
ESTIMATED REDUCTIONS RESULTING FROM UNCAPPED SECTORS	**27.3**
Industrial Measures (for sources not covered under cap&trade program) · Oil and Gas Extraction and Transmission	1.1 (<1%)
High Global Warming Potential Gas Measures	20.2 (12%)
Sustainable Forests	5.0 (3%)
Recycling and Waste (landfill methane capture)	1.0 (0.6%)
TOTAL REDUCTIONS COUNTED TOWARDS 2020 TARGET	**174**[3]

SOURCE: Table 2 of the Climate Change Scoping Plan: A Framework for Change. Prepared by the California Air Resources Board, pursuant to AB 32 the California Global Warming Solution Act of 2006. December 2008.

[1] This number represents an estimate of what may be achieved from local land use changes. It is not the SB 375 regional target. CARB will establish regional targets for each Metropolitan Planning Organization following input of the Regional Targets Advisory Committee and a public stakeholders consultation process per SB 375.

[2] Percentages are relative to the total of 174 $MMTCO_2E$, and may not total 100 due to rounding.

[3] The total reduction for the recommended measures slightly exceeds the 169 $MMTCO_2E$ of reductions estimated in CARB's BAU 2020 Emissions Forecast made in 2008. This is the net effect of adding several measures and adjusting the emissions reduction estimates for some other measures.

[4] CARB's 2010 revised BAU 2020 projections of 507 $MMTCO_2E$, based on the economic downturn and incorporation of Pavley I and 20% RPS, indicate the total reduction for the recommended measures is now 80 $MMTCO_2E$.

measures comes from this sector. To address emissions from vehicles, CARB is proposing a comprehensive three-prong strategy: reducing GHG emissions from vehicles, reducing the carbon content of the fuel these vehicles burn, and reducing the miles these vehicles travel.

3.2.3.4 AB 1493 – Pavley Greenhouse Gas Vehicle Standards

AB 1493 (Pavley) enacted July 2002, directed CARB to adopt vehicle standards that lowered GHG emissions from passenger vehicles and light duty trucks to the maximum extent technologically feasible, beginning with the 2009 model year. CARB adopted regulations in 2004 and applied to the U.S. EPA for a waiver under the federal Clean Air Act to implement them.

Under federal law, California is the only state allowed to adopt its own vehicle standards, but it cannot implement them until the U.S. EPA grants an administrative waiver. In December 2004, the Alliance of Automobile Manufacturers sued to block implementation of the new regulations and ultimately, in December 2007, a federal judge decided the case in favor of the CARB (Sacramento Bee 2007). Despite this ruling, on December 19, 2007 the U.S. EPA announced that it would deny CARB's waiver request. In January 2008, the State of California sued the U.S. EPA in an attempt to overturn the U.S. EPA's denial (Marten Law Group 2008).

On June 30, 2009, the U.S. EPA rejected its earlier waiver denial reasoning and granted California the authority to implement these GHG emissions reduction standards for new passenger cars, pickup trucks, and sport utility vehicles. CARB adopted amendments to its new regulations in September 2009 that would enforce AB 1493 but provide vehicle manufacturers with new compliance flexibility.

With these actions, it is expected that the new regulations (Pavley I) will reduce GHG emissions from California passenger vehicles by about 31.7 $MMTCO_2E$ (or 18 percent) counted toward the total statewide reduction target (CARB 2008c) (see Table 4). However, the revised 2010 projections estimate that Pavley I will reduce GHG emissions from passenger vehicles by about 29.9 $MMTCO_2E$, for 37 percent of the total 80 $MMTCO_2E$ reduction target.

CARB has adopted a second, more stringent, phase of the Pavley regulations, termed "Pavley II" [now known as "Low Emission Vehicle (LEV) III"], that covers model years 2017 to 2025. Pavley II was estimated in 2008 to add an additional 4.0 $MMTCO_2E$ for 2 percent of the then-estimated 174 $MMTCO_2E$ reduction total. The revised 2010 projections estimate that Pavley II will reduce GHG emissions from passenger vehicles by 3.8 $MMTCO_2E$, for 5 percent of the total 80 $MMTCO_2E$ reduction target (per CARB's 2010 revised projections). These reductions are to come from improved vehicle technologies such as small engines with superchargers, continuously variable transmissions, and hybrid electric drives.

3.2.3.5 EO S-01-07 – Low Carbon Fuel Standard

This executive order signed by Governor Schwarzenegger in January 2007, directed that a statewide goal be established to reduce the carbon intensity of California's transportation fuels by at least 10 percent by 2020 through a LCFS. CARB adopted the LCFS as a discrete early action measure pursuant to AB 32 in April 2009 and includes it as a reduction measure in its Scoping Plan (see Table 4).

The LCFS is a performance standard with flexible compliance mechanisms intended to incentivize the development of a diverse set of clean, low-carbon transportation fuel options. Its aim is to accelerate the availability and diversity of low-carbon fuels such as biofuels, electricity and hydrogen, by taking into consideration the full life-cycle of GHG emissions. A 10 percent reduction in the intensity of transportation fuels is expected to equate to a reduction of 16.5 $MMTCO_2E$ in 2020 (based on the original 2008 Scoping Plan estimates). However, in order to account for possible overlap of benefits between LCFS and the Pavley GHG standards, CARB has discounted the contribution of LCFS to 15 $MMTCO_2E$ (CARB 2008c).

The LCFS is currently being challenged in court. Plaintiffs argue that the LCFS is unconstitutional because it violates the interstate commerce clause, which was intended to stop states from introducing laws that would discriminate against businesses located in other states. Litigation is ongoing, and no final decision has been made whether the program is unconstitutional. While litigation is ongoing, the LCFS is currently being enforced.

3.2.3.6 Regional Transportation-Related GHG Targets

The Regional Transportation-Related GHG Targets measure included in the Scoping Plan identifies policies to reduce transportation emissions through changes in future land use patterns and community design, as well as through improvements in public transportation, that reduce VMT. By reducing the miles vehicles travel, vehicle emissions will be reduced. Improved planning and the resulting development are seen as essential for meeting the 2050 emissions target (CARB 2008c p. 20). CARB expects that this measure will reduce transportation-related GHG emissions by about 5 $MMTCO_2E$ or 4 percent of the total statewide reductions attributed to the capped sectors (see Table 4). Specific regional reduction targets established through SB-375 (see discussion below) will determine more accurately what reductions can be achieved through this measure.

3.2.3.7 SB 375 – Regional Emissions Targets

SB 375 was signed in September 2008 and requires CARB to set regional targets for reducing passenger vehicle GHG emissions in accordance with the Scoping Plan measure described above. Its purpose is to align regional transportation planning efforts, regional GHG reduction targets, and land use and housing allocation to reduce GHG emissions by promoting high-density, mixed-use developments around mass transit hubs.

CARB, in consultation with the metropolitan planning organizations (MPOs), was required to provide each affected region with passenger vehicle GHG emissions reduction targets for 2020 and 2035 by September 30, 2010. The San Diego Association of Governments (SANDAG) is the San Diego region's MPO. On August 9, 2010 CARB released the staff report on the proposed reduction target, which was subsequently approved by CARB on September 23, 2010. The San Diego region will be required to reduce greenhouse gas emissions from cars and light trucks 7 percent per capita by 2020 and 13 percent by 2035 (SANDAG 2010a).

The reduction targets are to be updated every eight years, but can be updated every four years if advancements in emissions technologies affect the reduction strategies to achieve the targets.

Once reduction targets are established, each of California's MPOs must prepare and adopt a Sustainable Communities Strategy (SCS) that demonstrates how the region will meet its greenhouse gas reduction targets through integrated land use, housing and transportation planning. 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 the SCS. After the SCS is adopted by the MPO, the SCS will be incorporated into that region's federally enforceable regional transportation plan (RTP).

CARB is also required to review each final SCS to determine whether it would, if implemented, achieve the greenhouse gas emission reduction target for its region. If the combination of measures in the SCS will not meet the region's target, the MPO must prepare a separate "alternative planning strategy (APS)" to meet the target. The APS is not a part of the RTP. As an incentive to encourage implementation of the SCS and APS, developers can obtain relief from certain requirements under the California Environmental Quality Act (CEQA) for those projects that are consistent with either the SCS or APS (CARB 2010d).

San Diego's MPO, SANDAG, completed and adopted its 2050 RTP in October 2011, the first such plan in the state that included a SCS.

3.2.3.8 EO S-7-04/SB 1505 – California Hydrogen Highway Network

This executive order signed in 2004 designated California's 21 interstate freeways as the "California Hydrogen Highway Network", and directed the CalEPA and all other relevant state agencies to plan and build a network of hydrogen fueling stations along these roadways and in the urban centers. This EO also called for the CalEPA and others to develop by January 1, 2005 a California Hydrogen Economy Blueprint Plan (Blueprint Plan) for the rapid transition to a hydrogen economy in California. The Blueprint Plan was delivered to the Governor in May 2005.

In response to this EO, SB 1505 (Lowenthal), chaptered on September 30, 2006, required the CARB to adopt regulations to ensure that the production and use of hydrogen for transportation purposes contributes to the reduction of GHGs and other air contaminants (Union of Concerned Scientists 2007). The regulation, referenced as the Environmental and Energy Standards for Hydrogen Production, is currently in the development process and was expected to be approved by the Board before the end of 2010. The approval remains pending.

Non-Transportation-Related Emissions Reductions

In the energy sector, Scoping Plan measures aim to provide better information and overcome institutional barriers that slow the adoption of cost-effective energy efficiency technologies. They include enhanced energy efficiency programs to provide incentives for customers to purchase and install more efficient products and processes; and building and appliance standards to ensure that manufacturers and builders bring improved products to market. Over the long term, the recommended measures will increase the amount of electricity from renewable energy sources and improve the energy efficiency of industries, homes, and buildings. While energy efficiency gains the largest emissions reductions from this sector, other land development applicable measures such as water conservation, materials use and waste reduction, and green building design and development practices, achieve additional emissions reduction.

3.2.3.9 Renewables Portfolio Standard

The RPS promotes diversification of the state's electricity supply. Originally adopted in 2002 with a goal to achieve a 20 percent renewable energy mix by 2020, the goal has been accelerated and increased; most recently by EOs S-14-08 and S-21-09 to a goal of 33 percent by 2020. Its purpose is thus to achieve 33 percent renewable energy mix statewide; providing 33 percent of the state's electricity needs met by renewable resources by 2020 (CARB 2008c). The RPS is included in CARB's Scoping Plan list of reduction measures (see Table 4). Increasing the RPS to 33 percent is designed to accelerate the transformation of the electricity sector, including investment in the transmission infrastructure and systems changes to allow integration of large quantities of intermittent wind and solar generation. Renewable energy includes (but is not limited to) wind, solar, geothermal, small hydroelectric, biomass, anaerobic digestion, and landfill gas. Increased use of renewables would decrease California's reliance on fossil fuels, thus reducing emissions of GHGs from the electricity sector. In 2008, as part of the Scoping Plan original estimates, CARB estimates that full achievement of the RPS would decrease statewide GHG emissions by 21.3 $MMTCO_2E$ (CARB 2008c). In 2010, CARB revised this number upwards to 24.0 $MMTCO_2E$ (CARB 2010e).

3.2.3.10 Million Solar Roofs Program

The Million Solar Roofs Program was created by SB 1 in 2006 and includes the CPUC's California Solar Initiative and CEC's New Solar Homes Partnership. It requires publicly owned utilities to adopt, implement and finance solar incentive programs to lower the cost of solar systems and help achieve the goal of installing 3,000 MW of new solar capacity by 2020. The Million Solar Roofs Program is one of CARB's GHG reduction measures identified in the 2008 Scoping Plan (see Table 4). Achievement of the program's goal is expected to equate to a reduction of 2.1 $MMTCO_2E$ in 2020 statewide BAU emissions, as counted toward the total 2008 estimated statewide reduction of 174 $MMTCO_2E$ (CARB 2008c); or 1.1 $MMTCO_2E$ of the 2010 estimated statewide reduction of 80 $MMTCO_2E$ (CARB 2010e).

3.2.3.11 SB 1368 – Public Utility Emission Standards

SB 1368 (Parata), passed in 2006, requires the California Energy Commission (CEC) to set GHG emission standards for entities providing electricity in the state. The bill further requires that the California Public Utilities Commission (CPUC) prohibit electricity providers and corporations from entering into long-term contracts if those providers and corporations do not meet the CEC's standards (Union of Concerned Scientists 2007).

3.2.3.12 Title 24, Part 6 - California Energy Code

The California Code of Regulations, Title 24, Part 6 is the California Energy Code. This code, originally enacted in 1978 in response to legislative mandates, establishes energy efficiency standards for residential and non-residential buildings in order to reduce California's energy consumption. The Code is updated periodically to incorporate and consider new energy efficiency technologies and methodologies as they become available. The most recent amendments to the Code, known as Title 24 2008, or the 2008 Energy Code, became effective January 1, 2010. Title 24 2008 requires energy savings of 15-35 percent above the former Title 24 2005 energy code. At a minimum, residential buildings must achieve a 15 percent reduction in their combined space heating, cooling and water heating energy compared to the Title 24 2005 standards. Incentives in the form of rebates and tax breaks are provided on a sliding scale for buildings achieving energy efficiency above the minimum 15 percent reduction over Title 24 2005. The reference to Title 24 2005 is relevant in that many of the State's long-term energy and GHG reduction goals identify energy saving targets relative to Title 24 2005. By reducing California's energy consumption, emissions of statewide GHGs may also be reduced.

3.2.3.13 Title 24, Part 11 – California Green Building Standards

In 2007, Governor Schwarzenegger directed the California Building Standards Commission to work with state agencies on the adoption of green building standards for residential, commercial, and public building construction for the 2010 code adoption process. A voluntary version of this California Green Building Standards Code, referred to as CALGreen, was added to Title 24 as Part 11 in 2009. The 2010 version of CALGreen took effect January 2011 and will institute mandatory minimum environmental performance standards for all ground-up new construction of commercial and low-rise residential buildings, state-owned buildings, schools, and hospitals. It also includes voluntary tiers (I and II) with stricter environmental performance standards for these same categories of residential and non-residential buildings. Local jurisdictions must enforce the minimum mandatory requirements and may also adopt the Green Building Standards with amendments for stricter requirements.

The mandatory standards require:

- 20 percent mandatory reduction in indoor water use relative to specified baseline levels;
- 50 percent construction/demolition waste diverted from landfills;
- Mandatory inspections of energy systems to ensure optimal working efficiency; and
- Requirements for low-pollutant emitting exterior and interior finish materials such as paints, carpets, vinyl flooring, and particleboards.

The voluntary standards require:

- Tier I — 15 percent improvement in energy requirements, stricter water conservation requirements for specific fixtures, 65 percent reduction in construction waste, 10 percent recycled content, 20 percent permeable paving, 20 percent cement reduction, cool/solar reflective roof; and
- Tier II — 30 percent improvement in energy requirements, stricter water conservation requirements for specific fixtures, 75 percent reduction in construction waste, 15 percent recycled content, 30 percent permeable paving, 30 percent cement reduction, cool/solar reflective roof.

Similar to the compliance reporting procedure described above for demonstrating energy code compliance in new buildings and major renovations, compliance with the CalGreen water reduction requirements must be demonstrated through completion of water use reporting forms for new low-rise residential and non-residential buildings. The water use compliance form must demonstrate a 20 percent reduction in indoor water use by either showing a 20 percent reduction in the overall baseline water use as identified in CalGreen or a reduced per-plumbing-fixture water use rate.

Related to CALGreen are the earlier Sustainable Building Goal (EO D-16-00) and Green Building Initiative (EO S-20-04). The 2000 Sustainable Building Goal instructed that all state buildings be constructed or renovated and maintained as models of energy, water and materials efficiency. The 2004 Green Building Initiative recognized further that significant reductions in GHG 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.

The CARB Scoping Plan includes a Green Building Strategy with the goal of expanding the use of green building practices to reduce the carbon footprint of new and existing buildings. Consistent with CALGreen, the Scoping Plan recognized that GHG reductions would be achieved through buildings that exceed minimum energy efficiency standards, decrease consumption of potable water, reduce solid waste during construction and operation, and incorporate sustainable materials. Green building is thus a vehicle to achieve the Scoping Plan's statewide electricity and natural gas efficiency targets and lower GHG emissions from waste and water transport sectors.

In the Scoping Plan, CARB projects that an additional 26 $MMTCO_2E$ could be reduced through expanded green building (CARB 2008c, p.17). However, this reduction is not counted toward the BAU 2020 reduction goal to avoid any double counting, as most of these reductions are accounted for in the electricity, waste, and water sectors. Because of this, CARB has assigned all emissions reductions that occur as a result of green building strategies to other sectors for the purpose of meeting AB 32 requirements, but will continue to evaluate and refine the emissions from this sector.

3.2.3.14 SB 97 – CEQA GHG Amendments

SB 97 (Dutton) passed by the legislature and signed by the governor on August 24, 2007 required the office of Planning and Research (OPR) on or before July 1, 2009, to prepare, develop, and transmit to the Resources Agency amendments to the CEQA guidelines to assist public agencies in the mitigation of GHGs or the effects of GHGs as required under CEQA, including the effects associated with transportation and energy consumption, and required the Resources Agency to certify and adopt those guidelines by January 1, 2010. Proposed amendments to the state CEQA Guidelines for GHG emissions were submitted on April 13, 2009, adopted on December 30, 2009, and became effective March 18, 2010.

Section 15064.4 of the amended Guidelines includes the following requirements for determining the significance of impacts from GHG emissions. While the amendments require either a qualitative or quantitative analysis of a project's contribution, they clearly do not establish a standard by which to judge a significant effect or a means to establish such a standard.

> (a) The determination of the significance of greenhouse gas emissions calls for a careful judgment by the lead agency consistent with the provisions in section 15064. A lead agency should make a good-faith effort, based to the extent possible on scientific and factual data, to describe, calculate or estimate the amount of GHG emissions resulting from a project. A lead agency shall have discretion to determine, in the context of a particular project, whether to:
>
> > (1) Use a model or methodology to quantify greenhouse gas emissions resulting from a project, and which model or methodology to use. The lead agency has discretion to select the model or methodology it considers most appropriate provided it supports its decision with substantial evidence. The lead agency should explain the limitations of the particular model or methodology selected for use; and/or
> >
> > (2) Rely on a qualitative analysis or performance based standards.

3.2.4 Local

3.2.4.1 San Diego Sustainable Community Program

In 2002, the San Diego City Council unanimously approved the San Diego Sustainable Community Program (SCP) and requested that an Ad Hoc Advisory Committee be established to provide recommendations that would decrease GHG emissions from City operations. Actions identified in the SCP include:

1. Participation in the International Council for Local Environmental Initiatives (ICLEI) Cities for Climate Protection (CCP) Campaign to reduce GHG emissions, and in the California Climate Action Registry;
2. Establishment of a reduction target of 15 percent by 2010, using 1990 as a baseline; and
3. Direction to use the recommendations of the *Ad Hoc* Advisory Committee as a means to expand the GHG Emission Reduction Action Plan for the City organization and broaden its scope to include community actions.

3.2.4.2 Cities for Climate Protection

As a participant in the ICLEI Cities for Climate Protection Program, the City made a commitment to voluntarily decrease its GHG emissions by 2030. The Program includes five milestones: (1) establish a CCP campaign, (2) engage the community to participate, (3) sign the U.S. Mayors Climate Protection Agreement, (4) take initial solution steps, and (5) perform a GHG audit. The City has advanced past milestone 3 by signing the Mayor's agreement and establishing actions to decrease City operations' emissions.

3.2.4.3 Climate Protection Action Plan

In July 2005 the City of San Diego developed a Climate Protection Action Plan (CPAP) that identifies policies and actions to decrease GHG emissions from City operations. Recommendations included in CPAP for transportation included measures such as increasing carpooling and transit ridership, improving bicycle lanes, and converting the City vehicle fleet to low-emission or non-fossil-fueled vehicles. Recommendations in the CPA for energy and other non-transportation emissions reductions included increasing building energy efficiency (i.e., requiring that all City projects achieve the U.S. Green Building Council's LEED Silver standard); reducing waste from City operations; continuing use of landfill methane as an energy source; reducing the urban heat island by avoiding dark roofs and roads which absorb and retain heat; and increasing shade tree and other vegetative cover plantings.

Because of City actions implemented earlier between 1990 and 2002, moderate GHG emissions reductions were reported in the CPAP. City actions taken to capture methane gas from solid waste landfills and sewage treatment plants resulted in the largest decrease in GHG emissions. Actions taken thus far to incorporate energy efficiency and alternative renewable energy reached only 5 percent of the City's 2010 goal. The transportation sector remains a significant source of GHG emissions in 2010 and has had the lowest GHG reductions, reaching only 2.2 percent of the goal for 2010. The recently amended City General Plan includes a Policy CE-A.13 to regularly monitor and update the CPAP.

3.2.4.4 Sustainable Building Policies

In several of its policies, the City aims to reduce GHG emissions by requiring sustainable development practices. In Council Policy 900-14 "Green Building Policy" adopted in 1997, Council Policy 900-16 "Community Energy Partnership," and the updated Council Policy 900-14 "Sustainable Buildings Expedite Program" last revised in 2006, the City establishes a mandate for all City projects to achieve the U.S. Green Building Council's LEED silver standard for all new buildings and major renovations over 5,000 square feet. Incentives are also provided to private developers through the Expedite Program, where green building projects get expedited project review and discounted project review fees.

The City has also enacted codes and policies aimed at helping the City achieve the State's 50 percent waste diversion mandate, including the Refuse and Recyclable Materials Storage Regulations (Municipal Code Chapter 14, Article 2 Division 8), Recycling Ordinance (O-19678 Municipal Code Chapter 6, Article 6, Division 7), and the Construction and Demolition (C & D) Debris Deposit Ordinance (0-19420 & 0-19694 Municipal Code Chapter 6, Article 6, Division 6).

3.2.4.5 General Plan

The City of San Diego 2008 General Plan includes several climate change-related policies to ensure that GHG emissions reductions are imposed on future development and City operations. For example, Conservation Element policy CE-A.2 aims to "reduce the City's carbon footprint" and to "develop and adopt new or amended regulations, programs, and incentives as appropriate to implement the goals and policies set forth" related to climate change. The Land Use and Community Planning, Mobility, Urban Design, and Public Facilities and Safety Element also support GHG reduction and climate change adaptation goals. These elements contain policy language related to sustainable land use patterns, alternative modes of transportation, energy efficiency, water conservation, waste reduction, and greater landfill efficiency. The overall intent of these policies is to support climate protection actions, while retaining flexibility in the design of implementation measures which could be influenced by new scientific research, technological advances, environmental conditions, or state and federal legislation.

Cumulative impacts of GHG emissions were qualitatively analyzed and determined to be significant and unavoidable in the 2008 Program Environmental Impact Report (PEIR) for the General Plan. A PEIR Mitigation Framework was included that indicated "for each future project requiring mitigation (measures that go beyond what is required by then-existing programs, plans and regulations), project-specific measures will [need to] be identified with the goal of reducing incremental project-level impacts to less than significant; or the incremental contributions of a project may remain significant and unavoidable where no feasible mitigation exists."

3.2.4.6 Climate Mitigation and Adaptation Plan

A citywide Climate Mitigation and Adaptation Plan (CMAP) is currently under development to provide a mechanism for the City to achieve the goals of AB 32 and the CARB Scoping Plan at a program level. The CMAP elements are being prepared pursuant to guidance from the amended CEQA Guidelines and CARB recommendations for what constitutes an effective GHG reduction plan, as follows.

Section 15183.5 of the amended Guidelines includes the following requirements for plans that serve to tier and streamline the analysis of GHG emissions.

(a) Lead agencies may analyze and mitigate the significant effects of GHG emissions at a programmatic level, such as in a general plan, a long-range development plan, or a separate plan to reduce GHG emissions. Later project-specific environmental documents may tier from and/or incorporate by reference that existing programmatic review.

(b) Plans for the Reduction of GHG Emissions. Public agencies may choose to analyze and mitigate significant GHG emissions in a plan for the reduction of GHG emissions or similar document. A plan to reduce GHG emissions may be used in a cumulative impact analysis as set forth below. Pursuant to sections 15064 (h)(3) and 15130(d), a lead agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable, if the project complies with the requirements in a previously adopted plan or mitigation program under specified circumstances.

(1) Plan Elements. A plan for the reduction of GHG emissions should:

(A) Quantify GHG emissions, both existing and projected over a specified time period, resulting from activities within a defined geographic area.

(B) 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.

(C) Identify and analyze the GHG emissions resulting from specific actions or categories of actions anticipated within the geographic area.

(D) 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 specific emissions level.

(E) Establish a mechanism to monitor the plan's progress toward achieving the level and to require amendment if the plan is not achieving specified levels.

(F) Be adopted in a public process following environmental review.

(2) Use with Later Activities. A plan for the reduction of GHG emissions, once adopted following certification of an EIR or adoption of an environmental document, may be used in the cumulative impacts analysis of later projects. An environmental document that relies on a GHG reduction plan for a cumulative impacts analysis must identify those requirements specified in the plan that apply to the project, and, if those requirements are not

otherwise binding and enforceable, incorporates those requirements as mitigation measures applicable to the project. If there is substantial evidence that the effects of a particular project may be cumulatively considerable notwithstanding the project's compliance with the specified requirements in the plan for the reduction of GHG emissions, an EIR must be prepared for the project.

(c) Special Situations. As provided in the Public Resource Code sections 21155.2 and 21159.28, environmental documents for certain residential and mixed-use projects and transit priority projects, as defined in section 21155, that are consistent with the general use designation, density, building intensity, and applicable policies specified for the project area in an applicable sustainable communities strategy or alternative planning strategy [refer to Section 3.2.3.4.d] need not analyze global warming impacts resulting from cars and light duty trucks. A lead agency should consider whether such projects may result in GHG emissions from other sources, however, consistent with these Guidelines.

It is anticipated that the City's CMAP will contain measures that address both the causes of climate change (i.e., through mitigation) and the effects of climate change (i.e., through adaptation). It is anticipated that the City's CMAP would thus offer both proactive options (mitigation) and also a plan to live with the consequences (adaptation) of global warming. The City's CMAP is anticipated to be completed in late 2012. Once adopted, discretionary and ministerial projects within the City's jurisdiction would be evaluated through an Initial Study or similar review to determine conformance with the measures identified in the CMAP. However, the plan is not final, and CEQA does not require a lead agency to analyze a projects consistency with draft plans.

3.2.4.7 Regional Climate Action Plan

The SANDAG Regional Climate Action Plan (RCAP) is a long-range policy (year 2030) that focuses on transportation, electricity and natural gas sectors. It is a complement to the Regional Energy Strategy 2030 Update and feeds into the SANDAG Regional Transportation Plan (RTP) and Regional Comprehensive Plan (RCP). It is currently in process of being prepared.

As indicated above, per the requirements of SB 375 the San Diego region will be required to reduce greenhouse gas emissions from cars and light trucks 7 percent per capita by 2020 and 13 percent by 2035 (SANDAG 2010a). These reduction targets have been incorporated into the 2050 RTP.

4.0 Significance Criteria and Analysis Methodologies

4.1 Determining Significance

The CEQA Guidelines require Lead Agencies to adopt GHG thresholds of significance. When adopting these thresholds, the amended Guidelines allow Lead Agencies to consider thresholds of significance adopted or recommended by other public agencies, or recommended by experts, provided that the thresholds are supported by substantial evidence, and/or to develop their own significance threshold.

The City of San Diego is currently using a 900-metric-ton screening criterion for determining when a GHG emissions analysis is required, based on the California Air Pollution Control Officers Association (CAPCOA) report “CEQA & Climate Change”, dated January 2008. . The CAPCOA report references the 900 metric ton guideline as a conservative threshold for requiring further analysis and mitigation. This emissions level is based on the amount of vehicle trips, the typical energy and water use, and other factors associated with projects. CAPCOA identifies the following project types that are estimated to emit approximately 900 metric tons of GHGs annually (Table 5).

TABLE 5
PROJECT TYPES THAT REQUIRE A GHG ANALYSIS AND MITIGATION

Project Type	Project Size that Generates Approximately 900 Metric Tons of GHGs per Year
Single Family Residential	50 units
Apartments/Condominiums	70 units
General Commercial Office Space	35,000 square feet
Retail Space	11,000 square feet
Supermarket/Grocery Space	6,300 square feet

For projects that exceed 900 metric tons of annual GHG emissions, the City has determined that a project would be consistent with the state's goal to reduce GHG emissions to 1990 levels by 2020 (established in AB 32) if the project demonstrates it can reduce its GHG emissions by 28.3 percent compared to a 2020 BAU scenario. This is based on CARB’s 2020 BAU forecast model developed in 2008, which represents the GHG emissions that would be expected to occur without any GHG project reducing features or mitigation. .

4.1.1 Business-as-Usual 2020 Emissions

As described above in Section 3.2, AB 32 directed CARB to develop a Scoping Plan that identified the reduction measures needed to achieve the targets established in AB 32/S-3-05. In order to assess the scope of the reductions California needed to make to return to 1990 emissions levels by 2020, CARB staff first needed to estimate 2020 BAU GHG emissions to represent the emissions that would be expected to occur in the absence of any Scoping Plan GHG reductions. In 2008, CARB staff estimated that statewide 2020 BAU GHG emissions would be 596 MMTCO_2E, requiring a reduction of 169 MMTCO_2E to attain the 2020 emissions limit of 427 MMTCO_2E. This equates to a 28.3 percent reduction relative to BAU (Table 6).

TABLE 6
CALIFORNIA BAU 2020 GHG EMISSIONS FORECAST

Sector	2008 Scoping Plan Projected 2020 Emissions in MMTCO_2E (% total)	2011 Scoping Plan Projected 2020 Emissions in MMTCO_2E (% total)
Transportation	225.4 (38%)	183.9 (36%)
Electricity	139.2 (23%)	110.4 (22%)
Commercial and Residential	46.7 (8%)	45.3 (9%)
Industry	100.5 (17%)	91.5 (18%)
Recycling and Waste	7.7 (1%)	8.5 (2%)
High GWP	46.9 (8%)	37.9 (7%)
Agriculture	29.8 (5%)	29.1 (6%)
Forest Net Emissions	0.0	0.0
TOTAL	**596.4**	**506.6**

SOURCE: CARB, California 1990 GHG Emissions Inventory and 2020 GHG Emissions Forecast. Prepared by the CARB, October 2008 and October 2010. Available at http://www.arb.ca.gov/cc/inventory/data/forecast.htm.

The 2020 BAU emissions forecast modeled in 2008 currently serves as the basis for establishing the City's significance guidelines for addressing GHGs from projects and is consistent with the amended CEQA Guidelines, which state that cumulative impacts may be measured relative to a cumulative baseline that includes a

> summary of projections contained in an adopted local, regional or statewide plan, or related planning document, that describes or evaluates conditions contributing to the cumulative effect. Such plans may include: a general plan, regional transportation plan, or plans for the reduction of GHG emissions.

Also, this general BAU approach to determining the significance of a project's GHG contribution was upheld in *Citizens for Responsible Equitable Environmental Development v. Chula Vista* (2011) 197 Cal. App. 4th 327 ("*CREED v. Chula Vista*").

However, since 2008, CARB has updated its projected BAU emissions based on current economic forecasts (i.e., as influenced by the economic downturn) and reduction measures already in place. There have also been subsequent court cases affecting what regulatory programs designed to reduce GHG emissions statewide can be implemented and/or attributed toward a project's analysis of whether it is meeting the applicable BAU threshold. Specifically, in October 2010 CARB updated its 2020 BAU forecast, reducing the originally estimated statewide 2020 BAU emission estimate of 596 $MMTCO_2E$ to 507 $MMTCO_2E$ (see third column in Table 6 above). This value accounts not only for reduced energy demand and growth due to the economic downturn, but also incorporates two adopted Scoping Plan GHG reduction measures. The two measures the revised 2020 forecast accounts for include the Pavley I and RPS 20 percent (refer to Sections 3.2.3.4 and 3.2.3.9 above). 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 (CARB 2011).

Also, CARB's implementation of a GHG reduction program called the Low Carbon Fuel Standard (LCFS; refer to Section 3.2.3.5) ~~has been~~was temporarily impeded by recent litigation. In December 2011, a preliminary injunction blocking CARB's implementation of the LCFS was granted. On April 23, 2012, the Ninth Circuit Court of Appeals overturned the injunction pending a ruling on the merits of the case. As the LCFS is currently being enforced, the City is allowing projects to take credit for the CARB's implementation of the LCFS when analyzing whether or not the project meets the City's 28.3 BAU reduction goal. Nonetheless, this report includes analysis per the City's guidelines and interim GHG memorandum methodology with and without the reductions provided by the LCFS for informational purposes. ~~While there is no injunction currently in place, the City has determined there is sufficient legal uncertainty with this program that the projects cannot take credit for CARB's implementation of the LCFS program when analyzing whether or not the project meets the BAU threshold.~~

Although these are interim thresholds they represent a good faith effort to evaluate whether GHG impacts from the project are significant, taking into account the type and location of the proposed development, the best available scientific data regarding GHG emissions, and the current statewide goals and strategies for reduction of GHG emissions. It is also important to note that the San Diego Air Pollution Control District (SDAPCD) has not provided any guidance on the quantification of GHG emissions or emissions thresholds for the San Diego Region.

~~Accordingly, the City has approved a new protocol requiring GHG technical studies to analyze project impacts without reliance on the LCFS. T~~it is noted that the City is also currently evaluating whether or not to update its GHG guidelines and interim threshold to a 16 percent reduction relative to BAU in accordance with the updated 2011 CARB projection, or some other threshold. However, the City has not yet made a decision on whether or not to update their GHG guidelines and interim threshold. To determine the project's compliance with the 2011 CARB Scoping Plan, a separate analysis was completed. The 2011 CARB Scoping Plan includes a 16 percent BAU reduction goal.

Based on the screening criteria, the proposed construction of 283 detached single-family residences and 147 detached small lot units is required to complete a GHG emission analysis in order to determine if the project with GHG reducing features, not including the LCFS, would achieve a 28.3 percent reduction relative to the 2008 BAU scenario. Also, in the event the City's threshold is updated prior to project approval, this report analyzes the project's GHG impacts according to a potential 16 percent reduction relative to BAU threshold. As will be explained in greater detail below, the 16 percent BAU analysis evaluates the project's GHG reducing features (not accounting for the LCFS, Pavley I or RPS 20 percent) when compared to the project without GHG reduction features. Both the 28.3 percent BAU and 16 percent BAU analyses are included in this report in order to provide the public more opportunity to comment on the project under multiple threshold scenarios.

Although these are interim thresholds they represent a good faith effort to evaluate whether GHG impacts from the project are significant, taking into account the type and location of the proposed development, the best available scientific data regarding GHG emissions, and the current statewide goals and strategies for reduction of GHG emissions. It is also important to note that the San Diego Air Pollution Control District (SDAPCD) has not provided any guidance on the quantification of GHG emissions or emissions thresholds for the San Diego Region.

4.2 Methodology and Assumptions

Emission estimates were calculated for the three GHGs of primary concern (CO_2, CH_4, and N_2O) that would be emitted from project construction and from the project's five sources of operational emissions including on-road vehicular traffic, electricity generation, natural gas consumption, water usage, and solid waste disposal. The method of quantifying GHG emissions in this analysis was based on methodologies recommended and used by several California air quality management districts (AQMD), including the South Coast and Bay Area AQMDs; as well as by the CARB.

To evaluate the reductions in GHG emissions from project design features relative to the BAU 2020 Forecast, emissions from each source of GHGs were estimated for two scenarios: first, the project without GHG-reducing design features (i.e., the Project-Equivalent under BAU conditions) and; second, the project with GHG-reducing green building design. Emissions calculations for both scenarios started with following identical land use assumptions: the construction of 283 detached single-family residences and 147 detached small lot units.

4.2.1 Estimating Vehicle Emissions

Vehicle emissions were estimated through a series of calculations based on the following equation derived from the URBEMIS2007, EMFAC2007 and OFFROAD2007 computer models:

$$E = EF´\ Fuel´\ C´\ GWP$$

Where,

E = emission in metric tons per year
EF = an emission factor normalized for engine fuel consumption and expressed in units of pounds of GHG per gallon of transportation fuel
Fuel = the total quantity of fuel consumed per year
C = a constant reflecting the conversion of pounds to metric tons
GWP = the global warming potential of each GHG

The vehicle emission factors used in this analysis are identified in Table 7 below. Annual fuel consumption was obtained by multiplying the project's average daily traffic (ADT) by the regional average trip length to derive total VMT, which was then multiplied by average vehicle mileage. This fuel-based method of estimating GHG emissions from on-road vehicles is commonly used to estimate regional emissions from the transportation sector (UCTC 1996, 2000), and is similar to the method CARB used in its 2020 BAU Forecast.

TABLE 7
GHG EMISSION FACTORS

Gas	Vehicle Emission Factors (pounds/gallon gas)[1]	Construction Equipment Emission Factors (pounds/gallon of diesel fuel)	Electricity Generation Emission Factors (pounds/MWh)[4, 5]	Natural Gas Combustion Emission Factors (pound/million ft^3)[6]
Carbon Dioxide	19.564	22.37[2]	1,340	120,000
Methane	0.00055	0.00128[3]	0.0111	2.3
Nitrous Oxide	0.0002	0.00057[3]	0.0192	2.2

[1]SOURCE: BAAQMD 2006.
[2]SOURCE: Energy Information Administration, Documentation for Emissions of Greenhouse Gases in the U.S. 2005, DOE/EIA-0638 (2005), October 2007, Tables 6-1, 6-4, and 6-5.
[3]SOURCE: U.S. Environmental Protection Agency. Inventory of U.S. Greenhouse Gas Emission and Sinks: 1990-2005, EPA 430-R-07-002, Annex 3.2, (April 2007), http://www.epa.gov/climatechange/emission/usinventoryreport.html. Converted from grams per gallon of fuel to pounds per gallon of fuel: CH_4 at 0.58 grams/gallon, N_20 a t0.26 grams/gallon.
[4]SOURCE: U.S. DOE 2002.
[5]Emissions associated with water use are calculated from the embodied energy in a gallon of water multiplied by the same emissions factors for electricity generation. Waste emissions were similarly calculated using the U.S. EPA WasteReduction model ([WARM], U.S. EPA 2008) emission factors specific to each waste type (e.g., glass, metal, plastic).
[6]SOURCE: U.S. EPA 1998.

URBEMIS 2007 is a computer model developed by a CARB consultant with the input of several air quality management and pollution control districts to estimate criteria air pollutant emissions from various urban land uses (Rimpo and Associates 2007). URBEMIS 2007 has the ability to calculate both mobile (i.e., vehicular) and some area source or stationary sources of emissions. It incorporates the two CARB off-road and on-road emissions models in its mobile emissions component and regional trip length and vehicle trip generation data from the participating air districts. The SDAPCD did not contributed to the model's development; therefore the San Diego Air Basin is not available as a selection in the model's input parameters. San Diego's average trip length and typical trip generation rates are also not included in the model. The model can be adapted somewhat to incorporate region-specific and project-specific information, and to account for GHGs other than CO_2. Here the adaptation was made through manual calculations incorporating project-specific traffic data obtained from the traffic impact analysis and region-specific vehicular trip data obtained from SANDAG. ~~Given current LCFS litigation, the vehicle emissions estimates did not account for the LCFS GHG reductions identified in the Scoping Plan.~~ Also, for the 16 percent BAU Threshold Analysis, the mitigated vehicle emissions estimates only accounted for the Pavley II reductions, as the Pavley I reductions were already accounted for in the baseline estimates. Another way to say this is that both the unmitigated and the mitigated project calculations under the 16 percent BAU Threshold Analysis accounted for Pavley I effects on vehicle emissions, consistent with the revised CARB projection that determined the 16 percent reduction relative to BAU goal. Based on the updated 2011 Scoping Plan, Pavley II would account for approximately 4.75 percent of the total 80 $MMTCO_2E$ statewide reductions.

4.2.2 Estimating Building Use Emissions

For estimates of non-transportation related emissions, similar equations were used whereby total projected energy, water, and waste demands were multiplied by emission factors for each emission source and each GHG. These emission factors are shown in Table 7.

Because the BAU 2020 Forecast modeled in 2008 assumed commercial and residential building energy efficiencies in accordance with the Title 24 2005 Energy Efficiency Standards, estimates of energy emissions due to the project without GHG-reducing design features in the 28.3 percent BAU Threshold Analysis use energy consumption data applicable to Title 24 2005. At the time the BAU 2020 Forecast of 2008 was developed, energy consumption projections (and resulting GHG emissions estimates) were made based on the then-current Title 24 2005. The subsequent Scoping Plan noted the potential to reduce GHG emissions through iterative updates to the Title 24 Energy Efficiency Standards. The now-current Title 24 2008 includes standards to achieve a minimum 15 percent greater energy efficiency than Title 24 2005; thus, in the 28.3 percent BAU Threshold Analysis, estimates of energy emissions from the project with GHG-reducing design features incorporates a 15 percent improvement in BAU energy use rates in order to reflect current 2008 energy code standards. Similar adjustments to historic rates of energy use were also made for both the unmitigated and mitigated project scenarios in the 16 percent BAU Threshold Analysis in order to represent the current energy code building standards.

As described in Section 2.2.1, Project Description, the project incorporates green building design that would exceed the current 2008 California Energy Code's residential energy efficiency standards by 20 percent. It would accomplish this through improved HVAC systems and duct seals; enhanced ceiling, attic, and wall insulation; EnergyStar appliances; high-efficiency water heaters; energy-efficient three-coat stucco exteriors; energy-efficient lighting; and high-efficiency window glazing. The 16 percent BAU Threshold Analysis additionally incorporated a 13 percent reduction in energy-associated GHGs due to implementation of the RPS beyond the already mandated (and accounted for in the baseline estimates) 20 percent renewable energy mix requirement for electricity providers. This project-improved energy efficiency was incorporated into the project with GHG reducing features calculations where appropriate, and as described in the separate emission source analyses below in Sections 5.1 and 5.2.

4.2.3 Estimating Construction Emissions

Construction activities emit GHGs primarily though combustion of fuels (mostly diesel) in the engines of off-road construction equipment and through combustion of diesel and gasoline in the on-road construction vehicles and in the commute vehicles of the construction workers. Smaller amounts of GHGs are also emitted through the energy use embodied in any water use (for fugitive dust control) and lighting for the construction activity. Every phase of the construction process, including demolition, grading, paving, and building, emits GHG emissions, in volumes proportional to the quantity and type of construction equipment used. The heavier equipment typically emit more GHGs per hour of use than the lighter equipment because of their greater fuel consumption and engine design.

GHG emissions associated with each phase of project construction were calculated by multiplying the total fuel consumed by the construction equipment and worker trips estimated through URBEMIS and by emission factors contained in Table 7. It was assumed that construction would be completed within a one-year period. Construction GHG emissions are thus typically calculated in terms of total volume, not in annual emissions. However, the Association of Environmental Professionals (AEP) has recently recommended that total construction emissions be amortized over 30 years and added to operational emissions (AEP 2010). Thus, while construction emissions are not included in the BAU 2020 forecast, and reductions in construction emissions are not specifically identified in the CARB Scoping Plan, the project's estimated construction emissions are added to the project's building use emissions in Section 5.2 below.

4.2.4 General Assumptions

The emission factors used to calculate vehicle, construction, electricity and natural gas GHG emissions are shown below.

Emissions estimated for each of the emission sources are summed and expressed in terms of total $MTCO_2E$. CO_2-equivalent emissions are the preferred way to assess combined GHG emissions because they give weight to the GWP of a gas. The GWP, as described above in Section 1.1, is the potential of a gas to warm the global climate in the same amount as an equivalent amount of emissions of CO_2. CO_2 thus has a GWP factor of 1. CH_4 has a GWP factor of 21 and N_2O has a GWP of 310, which means they have a greater global warming effect than CO_2.

Assumptions particular to each scenario and/or to each emission source are identified below in the Impact Analysis Section 5.0. Complete emissions calculations are contained in Attachments 2 and 3.

5.0 Impact Analysis

5.1 28.3 Percent BAU Threshold Analysis (with LCFS)

5.1.1 Transportation-Related Emissions

Transportation-related GHG emissions comprise the largest sector contributing to both inventoried and projected statewide GHG emissions, accounting for 38 percent of the projected total statewide 2020 BAU emissions (CARB 2008b). On-road vehicles alone accounted for 35 percent of forecasted 2020 BAU emissions. GHG emissions from vehicles come from the combustion of fossil fuels (primarily gasoline and diesel) in vehicle engines. The quantity and type of transportation fuel consumed determines the amount of GHGs emitted from a vehicle. Therefore, not only are vehicle engine and fuel technology of importance, but so too are the amount of vehicle trips and trip distances that motorists travel.

5.1.1.1 Project without GHG-Reducing Design Features

The project without GHG-reducing design features would generate 4,450 ADT (Urban Systems Associates, Inc. 2010). Assuming a regional average trip length of 5.8 miles (SANDAG 2009), a total of 25,810 miles would be traveled each day by project residents for 6,728,036 miles traveled each year. Based on an average fuel economy of 18.80 miles per gallon for 2020 (Caltrans 2009), the project without GHG-reducing design features would consume 357,927 gallons of vehicle fuel annually. This would result in the emission of 3,188 $MTCO_2E$ each year assuming BAU.

5.1.1.2 Project with GHG-Reducing Design Features

The same trip generation rate, trip length, and fuel economy figures used above would be applicable to the project with GHG reduction features as well; resulting in the same quantities of projected daily VMT of 25,810 and resulting annual vehicle emissions of 3,188 $MTCO_2E$.

However, as identified in the Section 3.2 Regulatory Background, there are several plans, policies, and regulations aimed at reducing transportation-related GHG emissions statewide by 2020. These regulations would reduce statewide transportation-related GHG emissions by increasing average vehicle fuel economy, decreasing engine combustion emissions, and decreasing average VMT and trip length.

The key regulations affecting vehicle emissions include the national CAFE Standards that would increase average fuel economy to 35 mpg by 2020; the state Pavley GHG Vehicle Emissions Standards which require improved vehicle engine technologies to reduce GHG emissions from vehicles, and the LCFS which reduce the carbon content of the fuel vehicles burn. All of these actions have been approved by either the national or state legislatures and are coming into effect on a staggered timeline, with 2016 being the earliest vehicle model year affected. As shown in Table 4, CARB estimates that an approximate 46.7 $MMTCO_2E$ reduction, or 32 percent of the reduction target for capped sources and 27 percent of the total 174 $MMTCO_2E$ reduction target specified in the Scoping Plan, would be achieved through just these two transportation-related regulatory actions. A third action, the Vehicle Efficiency Measure, is estimated by CARB to add another 4.5 $MMTCO_2E$, or 2.5 percent, to the total statewide reductions. The national CAFE Standards, while not quantified in the CARB Scoping Plan, would likely contribute to further reductions in statewide vehicle GHG emissions.

It can be assumed that vehicles associated with the project would benefit from the new regulations, and associated vehicle emissions would accordingly decrease. However, because of the pending litigation over the LCFS, two analysis scenarios were completed; one that accounts for emission reductions due to the LCFS and one that does not ~~were not taken into account in this analysis~~. Since the LCFS are currently enforced, the appropriate project analysis to use when determining project impacts is the analysis that considers the LCFS. The analysis scenario that does not include the LCFS is included for informational purposes only. By accounting for the Scoping Plan measures already adopted (Pavley and LCFS), the estimated vehicle emissions associated with the Annexation Scenario could decrease by nearly 28 percent, resulting in vehicular GHG emissions of 2,296 $MTCO_2E$. ~~For this analysis, it was assumed that Pavley would decrease emissions by 18 percent, based on the original 2008 Scoping Plan estimates.,~~

resulting in vehicular GHG emissions of 2,614 $MTCO_2E$. These transportation-related emissions reductions would be achieved through mandatory regulations applicable to all vehicle emissions within the state and are not attributable to specific GHG reduction features of the project. Thus, in order to evaluate the significance of the project features on projected BAU 2020 vehicle emissions and the Scoping Plan's vehicle emissions reductions, it is necessary to look at the project in terms of its average trip length and effects on regional VMT.

5.1.1.3 Project Vehicle Emissions Relative to Regional VMT

GHG emissions from the transportation sector as a whole are expected to increase from current levels to 225.4 $MMTCO_2E$ by 2020 assuming BAU. This forecasted increase is dominated by increases in emissions from on-road passenger vehicles. CARB estimated BAU 2020 vehicle emissions based on growth in projected VMT due to growth in statewide population as projected by the Department of Finance. CARB's projected increase in statewide VMT did not assume an increase in average vehicle trip lengths or changes in vehicle fleet mix. The BAU trip length for the San Diego region would thus be 5.8 miles, as currently reported by SANDAG (SANDAG 2009).

If a project were to add motorists or to increase local trip lengths to such a degree that the regional average trip length was increased, regional and potentially statewide VMT could be increased. The project would thus be considered to generate vehicle GHG emissions in excess of those accounted for in the BAU 2020 Emissions Forecast. By extension, it would also be considered to generate vehicle emissions beyond those accounted for in the Scoping Plan reduction measures.

Patterns of development can increase, decrease, or have no effect at all on travel choices, depending on their location and design. For example, through provision of public transit, carpooling, and walking and biking amenities, and by bringing more people closer to more destinations, a project can increase low carbon travel and decrease on-road VMT. These are the types of strategies identified in the Scoping Plan's Regional Transportation-Related GHG Targets measure. CARB expects that this measure will reduce transportation-related GHG emissions by about 5 million $MTCO_2E$, or 3 percent of the total statewide GHG reductions (see Table 4).

The project comprises a residential development in compliance with an adopted land use plan that was accounted for in regional growth projections. It cannot therefore be considered growth-inducing and would not add more motorists to regional roadways that have not already been accounted for in regional projections. The proposed project is surrounded by residential, school, and park land uses. While these proximities might encourage walking and biking, in general, the proposed project's local trip lengths would not measurably decrease the average regional trip length of 5.8 miles.

Because of the relative size of the proposed project, its development would have no measurable effect on the average regional trip length in a region with 3,173,407 people and 1,145,156 housing units and more than 79,000,000 VMT (SANDAG 2010c).Accordingly, its projected vehicle-emissions would be consistent with forecast vehicle emissions. The project's cumulative contribution to statewide vehicle emissions would therefore be less than significant.

5.1.2 Non-Transportation-Related Emissions

To evaluate the significance of the project's contribution of non-transportation-related emissions relative to BAU, GHG emissions were estimated for both the project with and without GHG-reducing design features.

5.1.2.1 Electricity Emissions

Electric power generation accounted for the second largest sector contributing to both inventoried and projected statewide GHG emissions, comprising 24 percent of the projected total 2020 statewide BAU emissions (CARB 2008b). Buildings use electricity for lighting, heating and cooling. Electricity generation entails the combustion of fossil fuels, including natural gas and coal, which are then stored and transported to end users. A building's electricity use is thus associated with the off-site or indirect emission of GHGs at the source of electricity generation (power plant). Due to the nature of the electrical grid, it is not possible to say with certainty where energy consumed will be generated. Therefore, GHG emissions resulting from electricity generation were estimated using national average emission factors developed by the U.S. DOE (2002) as contained in Table 7.

The average electricity consumption rate for residential uses was obtained from consumption data published by the U.S. EIA. In California in 2007, the average electricity consumption for a residential consumer was 587 kilowatt hours (kWh) per month per consumer (U.S. EIA 2010). This average BAU consumption rate was multiplied by the proposed number of residential units and emission factors to obtain electricity emissions for the project without GHG reduction features.

For the calculations for the project with GHG-reducing design features, a 35 percent improvement in building energy efficiency over Title 24, 2005 (i.e. a 35 percent reduction in the BAU energy use projections) was factored into the equation. This reduction is due to the project's incorporation of design features that achieve energy efficiency at least 20 percent above the current Title 24 2008 Energy Efficiency Standards; on top of energy efficiency standards in the current Title 24 2008 being a minimum 15 percent greater energy efficient than the older Title 24 2005.

a. Project without GHG-Reducing Design Features

Based on buildout of 283 detached single-family residences and 147 detached small lot units the total annual electricity consumption associated with the project without GHG-reducing design features was calculated to be 3,028,920 kWh or 3,029 megawatt hours (MWh). This equates to the emission of 1,850 $MTCO_2E$ each year.

b. Project with GHG-Reducing Design Features

GHG emissions associated with electricity use would arise from the combustion of fossil fuels to provide energy for the proposed residences. Given energy efficient design features that achieve a total of 35 percent greater efficiency than BAU (i.e. the Title 24 2005 Energy Efficiency Standards), the total annual electricity consumption associated with the project would be approximately 1,969 MWh. This equates to 1,202 $MTCO_2E$ emissions each year.

As shown in Table 4, the CARB Scoping Plan includes a Renewables Portfolio Standard which requires public utilities to acquire an increasing proportion of their energy supply from renewable energies. By 2020, 33 percent of all statewide electricity generation is to come from renewable energies. This would result in a statewide emissions reduction of 26.3 $MMTCO_2E$ and is a reduction that is counted toward the total 2020 emissions reduction target. As a result of implementation of the Renewables Portfolio Standard, GHG emissions from electricity generation needed to supply the project would likely decline as energy supply shifts from fossil-fuel based energies to renewable energy. Renewable energies have zero to little carbon content and their use in electricity generation emits fewer GHGs.

5.1.2.2 Natural Gas Emissions

Buildings combust natural gas primarily for heating and cooking purposes, resulting in the emission of GHGs. GHG emissions associated with natural gas combustion are estimated by multiplying the total number of units by average residential natural gas consumption rates and then by their respective GHG emissions factors.

As discussed above under Electricity Emissions, for the calculations for the project without GHG-reducing design features, statewide monthly average natural gas consumption rates were used consistent with the BAU 2020 forecast model that assumed building energy efficiencies in accordance with the 2005 Title 24 Energy Efficiency Standards. The natural gas consumption rate for a residential single family consumer is 62,384.4 cubic feet per year (Rimpo and Associates 2007). For the calculations for the project with GHG-reducing design features, a 35 percent improvement in building energy efficiency was factored into the equation, as discussed above under Electricity Emissions.

a. Project without GHG-Reducing Design Features

Based on buildout of 283 detached single-family residences and 147 detached small lot units, the total quantity of natural gas estimated to be consumed by the project without GHG-reducing design features each year would be 26.83 million cubic feet. Using the emission factors in Table 7 for natural gas consumption, this equates to the emission of approximately 1,469 $MTCO_2E$ each year.

b. Project with GHG-Reducing Design Features

Given energy efficient design features that achieve a total of 35 percent greater efficiency than BAU (i.e., greater than the Title 24 2005 Energy Efficiency Standards), the total quantity of natural gas estimated to be consumed by the project each year would be 17.44 million cubic feet. Using the emission factors in Table 7 for natural gas consumption, this equates to the emission of approximately 955 $MTCO_2E$ emissions each year.

5.1.2.3 Water Use Emissions

The provision of potable water consumes large amounts of energy associated with source and conveyance, treatment, distribution, end use, and wastewater treatment. This type of energy use is known as embodied energy. The GHG emissions associated with water use are calculated by multiplying the embodied energy in a gallon of potable water by the total number of gallons projected to be consumed by the project and then by the electricity generation GHG emissions factors. For these estimates, it is assumed that water delivered to the project site would have an embodied energy of 2,779 kWh/acre foot, or 0.0085 kWh/gallon (Torcellini 2003).

BAU water consumption was calculated using the average consumption rate for San Diego County of 10,472 gallons per household per month (San Diego County Water Authority 2010).

a. Project without GHG-Reducing Design Features

Multiplying the proposed 430 units for the project by the water demand rate of 10,472 gallons per household per month yields a total annual water demand of 54,035,520 gallons per year. The embodied energy demand associated with this water use of 459 MWh per year was converted to GHG emissions with the same electrical grid coefficients as the other purchased electricity. The resulting emissions amount to 280 $MTCO_2E$ per year.

b. Project with GHG-Reducing Design Features

As discussed in Section 2.2 above, the project with GHG-reducing design features would reduce the overall use of potable water within each home by 20 percent. The project would therefore consume 43,228,416 gallons of water per year. The embodied energy demand associated with this water use equates to roughly 367 MWh per year. Multiplying this value by the electricity emission factors for the three primary GHGs of concern in Table 7 yields an estimated annual emission of 224 $MTCO_2E$.

While not shown in Table 4, the CARB Scoping Plan includes other reduction strategies not counted toward the 2020 target reduction of 174 $MMTCO_2E$ statewide. CARB estimates that their recommended water sector measures would reduce an additional 4.8 $MMTCO_2E$ by 2020. These are measures required of water suppliers that would improve energy and other efficiencies associated with water supply. Thus, it is possible that the embodied energy and resulting GHG emissions associated with supplying potable water to the proposed project would be even less than 224 $MTCO_2E$ by 2020.

5.1.2.4 Solid Waste Emissions

The disposal of solid waste produces GHG emissions from anaerobic decomposition in landfills, incineration, and transportation of waste. For the project calculations with and without GHG-reducing design features, a countywide average waste disposal rate was used and was obtained from the California Department of Resources Recycling and Recovery (CalRecycle). While the proposed project would implement lumber and other materials conservation (see Section 2.2) and likely generate less landfill waste than average, these savings cannot be estimated at this time.

CalRecycle maintains a list of different waste generation rates for residential, commercial, and industrial uses from a variety of sources. The single family residential waste generation rates range from 7.8 to 11.4 pounds per unit per day (CalRecycle 2009). To be conservative, the higher generation rates of 11.4 pounds per unit per day was used to determine the total volume of waste by weight. This value was then multiplied by emissions factors obtained from the U.S. EPA report *Solid Waste Management and Greenhouse Gases* (U.S. EPA 2006) for the different material classes (glass, metal, plastic, etc.) and two different waste streams (to landfill or to recycling). For the landfill estimates, landfill gas recovery for energy was assumed, and for both the landfill and recycling estimates, a truck haul distance of 20 miles and frequency of once per week. Local recycling and disposal (to landfill) percentages (of total waste generated) were also obtained from CalRecycle and reflect current waste disposal practice in accordance with the statutory 50 percent diversion mandate.

a. Project without GHG-Reducing Design Features

The project without GHG-reducing design features would generate 895 tons of solid waste each year. GHG emissions associated with the disposal or diversion of this waste would equal approximately 126 $MTCO_2E$ per year.

b. Project with GHG-Reducing Design Features

For calculating GHG emissions, it was assumed that the project with GHG-reducing design features would generate up to the same amount of waste and associated GHG emissions as the project without GHG-reducing design features: 895 tons of solid waste each year, resulting in 126 $MTCO_2E$ emissions each year. While the project would provide areas for storage and collection of recyclables and yard waste and divert 50 percent of its construction waste (including lumber) from the landfill the GHG emissions reductions from these measures cannot be accurately determined at this time. However, the importance of this project action is revealed in CalRecycle's annual Statewide Waste Characterization Study (2008), which noted that inerts and other materials accounted for nearly one-third (29 percent) of the statewide waste stream, with lumber representing nearly 15 percent. The largest change in the overall waste stream was an increase, from 22 percent to 29 percent, in this materials class, largely due to an increase in lumber.

As shown in Table 4, the CARB Scoping Plan includes Recycling and Waste measures that would reduce statewide emissions by roughly 1.0 $MMTCO_2E$ by 2020. This is to be achieved through improved landfill methane capture. Also, while not shown in Table 4, the CARB Scoping Plan includes other waste sector reduction strategies not counted toward the statewide 2020 emissions reduction target. CARB estimates that these additional waste and recycling sector measures would provide up to an additional 10 $MMTCO_2E$ reduction by 2020. Thus, it is possible that the embodied energy and emissions resulting from disposing of the proposed project's solid waste would be less than 126 $MTCO_2E$ by 2020 due to these measures.

5.1.2.5 Construction Emissions

a. Project without GHG-Reducing Design Features

Based on all phases of construction, the total estimated GHG emissions associated with constructing the project would be 2,463 $MTCO_2E$. This results in an annual BAU construction emission of approximately 82 $MTCO_2E$ per year.

b. Project with GHG-Reducing Design Features

For calculating GHG emissions, it was assumed that the project with GHG-reducing design features would generate the same approximate amount of construction emissions as the project without GHG-reducing design features: 82 $MTCO_2E$ per year. The majority (88 percent) of these emissions would come from the off-road construction equipment, with on-road diesel vehicles contributing another 10 percent and worker trips contributing two percent. Over half of the total construction emissions would occur during the building phase, with the remainder occurring over the grading, trenching and paving phases.

The Scoping Plan does not identify any measures specific to reducing GHG emissions from construction activities. However, the reduction measure affecting heavy-duty truck emissions would potentially encompass construction on-road diesel vehicles and off-road equipment and reduce emissions through improved engine technology and conversion to non-diesel, low carbon fuels. Thus, as with the majority of the Scoping Plan's transportation-related reduction measures, reductions in construction emissions would have to come from emissions limits on construction equipment, redesign of construction equipment technology, and/or conversion to low carbon fuels. These measures are outside the control of the City or project-specific design.

5.1.3 Significance of Impacts

5.1.3.1 Project GHG Reductions Relative to BAU 2020

Based on the calculations described above, the combined total BAU GHG emissions without GHG reductions would be approximately 6,996 $MTCO_2E$, and the total project emissions would be approximately 4,886~~5,204~~ $MTCO_2E$. These emissions are summarized in Table 8. As shown, the project would result in a 30.2~~25.6~~ percent reduction and would, therefore, ~~not~~ would meet the City's reduction goal of 28.3 percent. Impacts would be less than significant. The project does not require any additional GHG mitigation or GHG-reducing measures beyond those already included in the project. ~~It may be possible to increase the project's GHG reductions further, through more enhanced green building design such as installation of on-site renewable energy, water-reuse/grey water systems for irrigation, operational waste recycling programs, advanced glazing and insulation materials use, use of alternate HVAC systems, and such. However, given the increased cost per square foot that would be incurred to build according to these higher green building standards, these measures may be infeasible to implement.~~

TABLE 8
SUMMARY OF ESTIMATED GHG EMISSIONS AND PROJECT REDUCTIONS (WITH LCFS) ($MTCO_2E$)

Emission Source	BAU Project-Equivalent	Project	Percent Reduction
Transportation/Vehicles	3,188	2,296~~614~~	2~~1~~8.0%*
Electricity Use	1,850	1,202	35.0%**
Natural Gas Use	1,469	955	35.0%**
Water Consumption	280	224	20.0%**
Solid Waste Disposal	126	126	0.0%
Construction	82	82	0.0%
TOTAL*	**6,996**	**~~5,204~~4,886**	**~~25.6%~~30.2%**

NOTE: Totals may vary due to independent rounding.
* Denotes GHG reductions achieved through Pavley and LCFS.
** Denotes GHG reductions achieved through project-specific design features.

5.1.3.2 Project Design Features that Reduce GHG Emissions

As described in Section 2.2, the project has been designed in accordance with the Building Industry Association's CGB program, a professionally recognized green building program that identifies building performance standards to achieve improved energy efficiency, water conservation, sustainable materials use, waste reduction, lumber conservation, indoor air quality, and heat island avoidance. The key project CGB design features accounted for in the project GHG reduction estimates include: 20 percent greater energy efficiency than the current Title 24 2008 energy code (i.e., 35 percent greater energy efficiency than Title 24 2005 or BAU); and 20 percent greater water savings than the current plumbing code. Incorporation of the following measures will ensure that the proposed project meets the reductions discussed above. ~~However, because these reductions would fall short of the City's 28.3 percent reduction relative to BAU goal, impacts would remain significant and unmitigated.~~

a. Increased Energy Efficiency

As a condition of building permit approval, the project's construction plans and specifications shall indicate in the general notes or individual detail drawings the design features, product specifications and methods of construction and installation that are required to surpass the 2008 Title 24 Energy Efficiency Standards by a minimum of 20 percent. Verification of increased energy efficiencies shall be demonstrated based on a performance approach, using a CEC-approved energy compliance software program, in the Title 24 Compliance Reports provided by the project applicant to the City prior to issuance of the building permit.

Prior to issuance of a final certificate of occupancy, the energy features shall undergo independent third party inspection and diagnostics as part of the CGB verification and commissioning process; with compliance verified by the City's Building Official. Additional inspections may be conducted as needed to ensure compliance, and during the course of construction and following completion of the project, the City may require the applicant to provide information and documents showing use of products, equipment and materials specified on the permitted plans and documents.

b. Increased Water Conservation

As a condition of approval, the project's construction plans and specifications shall indicate in the general notes or individual detail drawings the advanced water conservation features, product specifications and methods of construction and installation that are required to surpass the state plumbing code by a minimum of 20 percent, to achieve a minimum 20 percent reduction in water usage. In accordance with CGB criteria, verification of the 20 percent reduction in potable water use shall be demonstrated by verifying each plumbing fixture and fitting meets the 20 percent reduced flow rate or by calculating a 20 percent reduction in the building water use baseline. This documentation shall be provided by the project applicant to the City prior to issuance of the first building permit. The performance of the water conservation design shall be verified through final inspection prior to issuance of a final certificate of occupancy.

5.2 28.3 Percent BAU Threshold Analysis (without LCFS)

5.2.1 Transportation-Related Emissions

~~Refer to the discussion in Section 5.1.1 above.~~

5.2.1.1 Project without GHG-Reducing Design Features

Refer to the discussion in Section 5.1.1.1 above.

5.2.1.2 Project with GHG-Reducing Design Features

Refer to the discussion in Section 5.1.1.2 above with the following exceptions.

The above analysis incorporated the LCFS. Due to the recent LCFS litigation, this analysis scenario does not include vehicle emission reductions provided by the LCFS. This analysis scenario without the LCFS is included for informational purposes only. Assuming that Pavley would decrease emissions by 18 percent, based on the original 2008 Scoping Plan estimates, and not assuming the implementation of the LCFS, the project would result in vehicular GHG emissions of 2,614 $MTCO_2E$. These transportation-related emissions reductions would be achieved through mandatory regulations applicable to all vehicle emissions within the state and are not attributable to specific GHG reduction features of the project.

5.2.1.3 Project Vehicle Emissions Relative to Regional VMT

Refer to the discussion in Section 5.1.1.3 above.

5.2.2 Non-Transportation-Related Emissions

To evaluate the significance of the project's contribution of non-transportation-related emissions relative to BAU, GHG emissions were estimated for both the project with and without GHG-reducing design features. As the GHG-reducing design features would be the same as those described above under Section 5.1.2, refer to Section 5.1.2 for this information.

5.2.3 Significance of Impacts

5.2.3.1 Project GHG Reductions Relative to BAU 2020

Based on the calculations described above, the combined total BAU GHG emissions without GHG reductions would be approximately 6,996 $MTCO_2E$, and the total project emissions would be approximately 5,204 $MTCO_2E$. These emissions are summarized in Table 9. As shown, the project would result in a 25.6 percent reduction and would, therefore, not meet the City's reduction goal of 28.3 percent if the LCFS are not enforced. However, the LCFS are currently enforced and this analysis is provided for informational purposes only.

TABLE 9
SUMMARY OF ESTIMATED GHG EMISSIONS AND PROJECT REDUCTIONS
($MTCO_2E$)

Emission Source	BAU Project-Equivalent	Project	Percent Reduction
Transportation/Vehicles	3,188	2,614	18.0%*
Electricity Use	1,850	1,202	35.0%**
Natural Gas Use	1,469	955	35.0%**
Water Consumption	280	224	20.0%**
Solid Waste Disposal	126	126	0.0%
Construction	82	82	0.0%
TOTAL*	**6,996**	**5,204**	**25.6%**

NOTE: Totals may vary due to independent rounding.
*Denotes GHG reductions achieved through Pavley.
**Denotes GHG reductions achieved through project-specific design features.

5.2.3.2 Project Design Features that Reduce GHG Emissions

Refer to the discussion in Section 5.1.3.2 above.

5.3~~2~~ 16 Percent BAU Threshold Analysis

The CARB recently adopted a 2011 Scoping Plan. The County has recently adopted new thresholds and GHG analysis methodology in response to this update, as indicated in ~~The City of San Diego is currently considering updating its GHG thresholds of significance. It is anticipated that the City may adopt a revised percentage reduction threshold in accordance with the updated CARB 2020 BAU projections and similar to the Performance Threshold provided in~~ the County of San Diego *Guidelines for Determining Significance* (County of San Diego 2012). The County's Performance Threshold states that:

> A proposed project would have a cumulatively considerable contribution to climate change impacts if it would result in a net increase of construction and operational greenhouse gas emissions, either directly or indirectly, and if the project would incorporate mitigation that achieves less than a 16 percent total reduction compared to unmitigated emissions.

As described above in Section 4.1.1, the 16 percent threshold is based on current adjustments to the 2008 Scoping Plan forecasts for 2020 that adjusted both the estimates of future BAU emissions, and the quantities of reductions coming from the Scoping Plan GHG reduction measures. Per the County's new draft GHG guidelines, unmitigated project GHG emissions attributable to the project at full buildout in 2020 are compared to project GHG emissions with mitigation. Unmitigated GHG emissions represent the proposed project in compliance with any applicable standards and regulations. This would include effects on vehicle emissions due to Pavley I, and effects on energy emissions due to current energy code enforcements and the RPS (to 20 percent). This means that electricity and natural gas emissions reductions (on the order of 15 percent) due to stricter energy efficiency standards in the current 2008 Title 24 energy code compared to the older 2005 Title 24 energy code are to be accounted for in the baseline emissions estimate and not to be counted as project mitigation. Project mitigation identified toward the 16 percent requirement thus cannot also include the effects of the Pavley I or the 20 percent RPS because these programs are already included in the calculations that support the 16 percent reduction requirement. Other statewide measures, however, can be included without risk of double counting. This includes the RPS beyond 20 percent (up to 33 percent) ~~and~~ Pavley II, and LCFS, which can ~~both~~ all be included toward the minimum 16 percent mitigation requirement for the project with mitigation.

Using this threshold and the calculation methodology discussed in Section 4.2 above, unmitigated and mitigated project emissions were calculated and are provided here to evaluate the project against CARB's 2011 Scoping Plan for informational purposes. ~~Calculations are contained in Attachment 3.~~

5.3~~2~~.1 Unmitigated Project Emissions

5.3~~2~~.1.1 Vehicle Emissions

As discussed above, the project would generate 4,450 ADT, and the regional average trip length is 5.8 miles. Because the unmitigated GHG emissions represent the proposed project in compliance with any applicable standards and regulations, the vehicle GHG emissions calculated above in the 28.3 percent BAU Threshold Analysis were adjusted to account for Pavley I. This adjusted baseline would result in the emission of 2,149 $MTCO_2E$ annually.

5.32.1.2 Electricity Emissions

An unmitigated project would be constructed in accordance with the current 2008 Title 24. As discussed above, the now-current Title 24 2008 includes standards to achieve a minimum 15 percent greater energy efficiency than Title 24 2005. Because the model estimates of energy emissions due to the unmitigated project use energy consumption data applicable to approximately year 2005, these emission rates were reduced by 15 percent to account for the increased energy efficiency standards now present in the 2008 Title 24. Additionally, electricity emissions were reduced by 20 percent to account for the adopted RPS and adjusted baseline consistent with the CARB 2010 BAU projections. This would result in the emission of 1,258 $MTCO_2E$ annually.

5.32.1.3 Natural Gas Emissions

As with the electricity emissions, natural gas emission calculations are based on 2005 energy consumption data adjusted to 2008/current Title 24 standards. This would result in the emission of 1,249 $MTCO_2E$ annually from the unmitigated project.

5.32.1.4 Water Emissions

Since the unmitigated project would be constructed in accordance with the current Title 24, the unmitigated project water emissions were adjusted to account for the recent CalGreen mandate to reduce water consumption by 20 percent. This would result in the emission of 224 $MTCO_2E$ annually from the unmitigated project.

5.32.1.5 Solid Waste Emissions

The unmitigated project solid waste emissions would be the same as the emissions calculated in Section 5.1.2.4(a) and (b) above. This would result in the emission of 126 $MTCO_2E$ annually.

5.32.1.6 Construction Emissions

The unmitigated project construction emissions would be the same as the emissions calculated in Section 5.1.2.5(a) and (b) above. This would result in the emission of 82 $MTCO_2E$ annually.

5.32.2 Mitigated Project Emissions

5.2.2.1 Vehicle Emissions

As discussed above, Pavley II and the LCFS can be included toward the minimum 16 percent mitigation requirement. The vehicle GHG emissions calculated above for the unmitigated project were thus reduced to account for Pavley II as well. This would result in the emission of ~~1,997~~1,679 $MTCO_2E$ annually from the mitigated project.

5.3~~2~~.2.2 Electricity Emissions

As discussed above, the RPS beyond 20 percent (up to 33 percent) can be included toward the minimum 16 percent mitigation requirement. Therefore, the electricity emissions calculated for the unmitigated project were reduced by an additional 13 percent to account for further implementation of the RPS. Additionally, the project would exceed the current 2008 California Energy Code's residential energy efficiency standards by 20 percent. Implementation of these measures would result in the emission of 843 $MTCO_2E$ annually for the mitigated project. (Please note that no mitigation credit was taken for the 15 percent stricter efficiency standards reflected in the current 2008 Title 24 energy code compared to the older 2005 Title 24 energy code, because this energy efficiency improvement was already accounted for in the CARB revised baseline projections and then accordingly in the unmitigated project estimates. Thus, both the unmitigated and mitigated project estimates assume the current 2008 energy efficiency standards and associated energy demand rates.)

5.3~~2~~.2.3 Natural Gas Emissions

By exceeding the current 2008 California Energy Code's residential energy efficiency standards by 20 percent, the mitigated project would reduce natural gas emissions by 20 percent. This would result in the emission of 999 $MTCO_2E$ annually from the mitigated project. (Similar to the electricity emissions estimates, no mitigation credit was taken for the 15 percent stricter energy efficiency standards reflected in the current 2008 Title 24 energy code compared to the older 2005 Title 24 energy code, and both the unmitigated and mitigated project estimates assume the current 2008 energy efficiency standards and associated natural gas demand rates.)

5.3~~2~~.2.4 Water Emissions

The mitigated project water emissions would be the same as the emissions calculated for the unmitigated project: 224 $MTCO_2E$ annually.

5.3~~2~~.2.5 Solid Waste Emissions

The mitigated project solid waste emissions would be the same as the emissions calculated for the unmitigated project: 126 $MTCO_2E$ annually.

5.3~~2~~.2.6 Construction Emissions

The mitigated project construction emissions would be the same as the emissions calculated for the unmitigated project: 82 MTCO_2E annually.

5.~~2~~3.3 Significance of Impacts

Table 10~~9~~ summarizes the unmitigated and the mitigated project GHG emissions. As shown, the mitigated project would reduce unmitigated emissions by ~~16~~ 22 percent, thus achieving the ~~anticipated new~~2011 Scoping Plan GHG reduction goal. It is noted that if the LCFS was eliminated from this analysis, the project would still achieve the 16 percent reduction goal. ~~In accordance with this threshold, should it be adopted, impacts would be less than significant.~~

TABLE 10~~9~~
SUMMARY OF ESTIMATED UNMITIGATED AND MITIGATED GHG EMISSIONS (MTCO_2E)

Emission Source	Unmitigated Project	Mitigated Project	Percent Reduction
Transportation/Vehicles	2,149	~~1,997~~1,679	~~7%~~22%
Electricity Use	1,258	843	33%
Natural Gas Use	1,249	999	20%
Water Consumption	224	224	0%
Solid Waste Disposal	126	126	0%
Construction	82	82	0%
TOTAL	**5,088**	**~~4,272~~3,953**	**~~16%~~22%**

5.4~~3~~ Project Consistency with Adopted Plans, Policies, and Regulations

5.4~~3~~.1 Impacts

The regulatory plans and policies discussed extensively in Section 3.0 above aim to reduce national, state, and local GHG emissions by primarily targeting the largest emitters of GHGs: the transportation and energy sectors. Plan goals and regulatory standards are thus largely focused on the automobile industry and public utilities. For the transportation sector, the reduction strategy is generally three pronged: to reduce GHG emissions from vehicles by improving engine design; to reduce the carbon content of transportation fuels through research, funding and incentives to fuel suppliers; and to reduce the miles these vehicles travel through land use change and infrastructure investments.

For the energy sector, the reduction strategies aim to: reduce energy demand; impose emission caps on energy providers; establish minimum building energy and green building standards; transition to renewable non-fossil fuels; incentivize homeowners and builders; fully recover landfill gas for energy; expand research and development; and so forth.

5.4~~3~~.1.1 Local Plans

As discussed above in Section 5.1~~2~~.2, the project would achieve substantial GHG reductions through green building design that includes improved energy efficiency, water conservation, sustainable materials use, waste reduction, lumber conservation, and indoor air quality. Verification and commissioning of these features would occur through independent third party inspection and diagnostics.

~~However~~As shown in Section 5.1 above, implementation of these measures with the incorporation of the LCFS would ~~fall short of the~~result in the project meeting the City's current 28.3 percent GHG reduction goal. The project, in accordance with a 28.3 percent reduction relative to BAU goal, would thus be ~~in~~consistent with the City's General Plan, CPAP and Sustainable Building goals to achieve AB 32 compliance for private land use development.

If the LCFS litigation is successful and the LCFS was no longer enforced, then the project would fall short of the City's current 28.3 percent GHG reduction goal (see Section 5.2 above). It is anticipated that if the LCFS litigation was successful, then the City of San Diego would revise their GHG interim guidelines memorandum to reflect this condition and to match the 2011 CARB Scoping Plan (see Section 5.3). However, CARB is currently implementing the LCFS and this analysis scenario is provided for informational purposes only.~~However, as outlined in Section 5.2 above, the project, as evaluated in accordance with an updated 16 percent reduction relative to BAU goal, would be consistent in achieving a 16 percent reduction relative to an unmitigated project, and would thus be consistent with the City's General Plan and anticipated CMAP goals for private land use development, but only if the City decides to update its interim GHG threshold.~~

5.4~~3~~.1.2 State Plans

EO S-3-05 established GHG emission reduction targets for the state, and AB 32 launched the Climate Change Scoping Plan that outlined the reduction measures needed to reach these targets. The Scoping Plan and its implementing and complementary regulations are discussed at length in Section 3.2. In Section 5.1, per a

28.3 percent reduction relative to BAU goal as established in the 2008 Scoping Plan and City GHG Guidelines, the project was shown to provide a 25.6 percent reduction in BAU emissions, therefore not achieving the overall 28.3 percent reduction targeted in the original 2008 Scoping Plan/BAU 2020 Forecast.

As outlined in Section 5.2 above, the project, as evaluated per a 16 percent reduction goal relative to an unmitigated/baseline project, would be consistent in achieving the 16 percent reduction. As described in Section 4.1.1, the 16 percent reduction in GHG emissions goal relative to an unmitigated/baseline project is derived from CARB's 2010 updated 2020 emissions projections and revised 2011 Scoping Plan. The revised projections and Scoping Plan account for less overall growth and less energy/fuel consumption due to the long-term dampened economic conditions. CARB's revised baseline 2020 projection also accounts for the Pavley I and RPS 20 percent GHG reductions, which are two Scoping Plan measures that have since been adopted as regulations. Given a lower 2020 projected total emissions, and a fixed 1990 emissions level (as the target for 2020), CARB reduced the needed statewide reduction from 174 $MMTCO_2E$ to 80 $MMTCO_2E$. Thus, by achieving a 16 percent reduction relative to unmitigated/baseline project emissions, the project would be considered consistent with the revised 2011 Scoping Plan and AB 32's 2020 reduction target~~, but only if the City decides to update its interim GHG threshold~~.

5.4~~3~~.2 Significance of Impacts

As evaluated per the City's current GHG guidelines, the project would ~~not~~ achieve the City's GHG reduction goals~~,~~. Also, the project would achieve the 2011 CARB Scoping reduction goals based on the analysis completed in accordance with the CARB Scoping Plan. ~~and would~~ T~~t~~herefore, the project would ~~not~~ be consistent with the goals and strategies of local and state plans, policies, and regulations aimed at reducing GHG emissions from land use and development. Impacts would be less than significant~~ and unmitigated~~.

6.0 Conclusions and Recommendations

~~As summarized in Table 9, i~~Implementation of the project would result in a 30.2~~25.6~~ percent reduction in 2020 BAU project-equivalent emissions, thereby ~~not~~ reaching the 28.3 percent reduction target currently established by the City. The project's emissions reduction of ~~1,218~~2,110 $MTCO_2E$ would result from design features that substantially reduce energy and water use. The project would also achieve a 22 percent reduction in GHG emissions when compared to an unmitigated project using CARB's updated 2011 Scoping Plan. The project would be consistent with the goals and strategies of local and state plans, policies, and regulations aimed at reducing GHG emissions from land use and development. Thus, the project would result in less than significant impacts related to greenhouse gas emissions. The project does not require any additional GHG mitigation or GHG-reducing measures beyond those already included in the project. However, because these reductions would not meet the City's current 28.3 percent goal, impacts would remain significant and unmitigated.

Note that, as demonstrated above, the project would achieve a 16 percent reduction in GHG emissions when compared to an unmitigated project using CARB's updated 2011 Scoping Plan. Therefore, if the anticipated new threshold were to be adopted, project GHG emissions would be less than significant.

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ATTACHMENT 1

Understanding Global Climate Change

Understanding Global Climate Change

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Understanding Global Climate Change

The earth's climate is in a state of constant flux with periodic warming and cooling cycles. Extreme periods of cooling are termed "ice ages," which may then be followed by extended periods of warmth. For most of Earth's geologic history, these periods of warming and cooling have been the result of many complicated, interacting natural factors that include volcanic eruptions which spew gases and particles (dust) into the atmosphere, the amount of water, vegetation, and ice covering the earth's surface, subtle changes in the Earth's orbit, and the amount of energy released by the sun (sun cycles). However, since the beginning of the Industrial Revolution around 1750, the average temperature of the Earth has been increasing at a rate that is faster than can be explained by natural climate cycles alone.

With the Industrial Revolution came an increase in the combustion of carbon-based fuels such as wood, coal, oil, and "biofuels." Industrial processes have also created emissions of substances that are not found in nature. This in turn has led to a marked increase in the emissions of gases that have been shown to influence the world's climate. These gases, termed "greenhouse gases," influence the amount of heat that is trapped in the earth's atmosphere. Because recently observed increased concentrations of GHGs in the atmosphere are related to increased emissions resulting from human activity, the current cycle of "global warming" is generally believed to be largely due to human activity. Of late, "global warming" has arguably become the most important and widely debated environmental issue in the United States and the world.

1.0 The Greenhouse Effect

The presence of natural GHGs in the atmosphere is necessary for life on earth as we know it. The Earth absorbs and reflects incoming solar radiation. The Earth also emits terrestrial (thermal) radiation back out into space. On average, the absorbed solar radiation is balanced by the emitted thermal radiation, thus keeping the Earth at a relatively stable temperature. However, GHGs in the atmosphere absorb a portion of the terrestrial thermal radiation, thus "trapping" heat. The warming of the Earth's surface and atmosphere caused by this trapped heat is known as the "natural greenhouse effect" (United States Environmental Protection Agency [U.S. EPA] 2002). Figure 1 illustrates the "Greenhouse Effect."

Because GHGs "trap" heat in the atmosphere, the Earth's surface is warmer than it would be without the gases. Estimates indicate that without these natural GHGs, the Earth's surface would be about 60 degrees Fahrenheit (°F) colder (U.S. EPA 2007a).

Source: UNEP/GRID–Adrenal 2002a

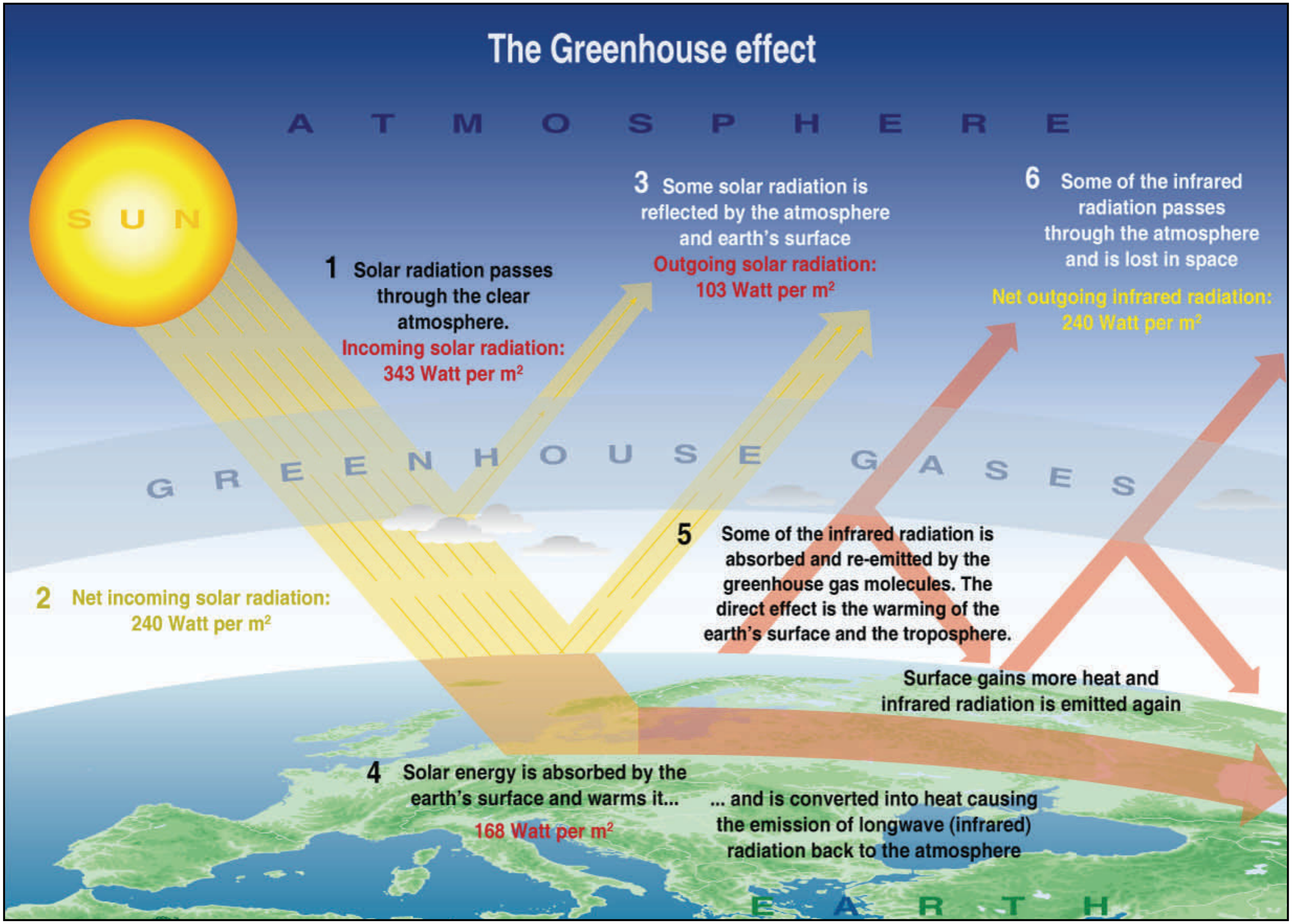

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FIGURE 1
Greenhouse Effect

2.0 Greenhouse Gases (GHGs)

There are numerous GHGs, both naturally occurring and manmade. Table 1 summarizes some of the most common.

TABLE 1
GLOBAL WARMING POTENTIALS (GWPs) AND ATMOSPHERIC LIFETIMES (YEARS) USED IN THE INVENTORY

Gas	Atmospheric Lifetime	100-year GWP[a]	20-year GWP	500-year GWP
Carbon Dioxide (CO_2)	50-200	1	1	1
Methane (CH_4)[b]	12±3	21	56	6.5
Nitrous oxide (N_20)	120	310	280	170
HFC-23	264	11,700	9,100	9,800
HFC-125	32.6	2,800	4,600	920
HFC-134a	14.6	1,300	3,400	420
HFC-143a	48.3	3,800	5,000	1,400
HFC-152a	1.5	140	460	42
HFC-227ea	36.5	2,900	4,300	950
HFC-236fa	209	6,300	5,100	4,700
HFC-4310mee	17.1	1,300	3,000	400
CF_4	50,000	6,500	4,400	10,000
C_2F_6	10,000	9,200	6,200	14,000
C_4F_{10}	2,600	7,000	4,800	10,100
C_6F_{14}	3,200	7,400	5,000	10,700
SF_6	3,200	23,900	16,300	34,900

Source: U.S. EPA 2002.
[a] GWPs used here are calculated over 100 year time horizon.
[b] The methane GWP includes the direct effects and those indirect effects due to the production of tropospheric ozone and stratospheric water vapor. The indirect effect due to the production of CO_2 is not included.

Of the gases listed in Table 1, carbon dioxide, methane, and nitrous oxide are produced by both natural and anthropogenic (human) sources. The remaining gases (hydrofluorocarbons [HFCs; such as HFC-23], perfluorocarbons [PFCs; such as CF_4], and sulfur hexafluoride [SF_6]) are the result of human processes.

The potential of a gas to trap heat and warm the atmosphere is measured by its "global warming potential" or GWP. Specifically, GWP is defined as the cumulative radiative forcing—both direct and indirect effects—integrated over a period of time from the emission of a unit mass of gas relative to some reference gas (U.S. EPA 2002).

GHGs breakdown or are absorbed over time. Thus the potential of a gas to contribute to global warming is limited by the time it is in the atmosphere, its "atmospheric lifetime." To account for these effects, GWPs are calculated over a specific period of time, such as 20, 100, or 500 years. The parties to the United Nations (UN) Framework Convention on Climate Change (UNFCCC) agreed to use consistent GWPs based upon a 100-year time horizon

(U.S. EPA 2002). Because of its relative abundance in the atmosphere and its relatively long atmospheric lifetime, carbon dioxide (CO_2) has been designated the reference gas for comparing GWPs. Thus the 100-year GWP of CO_2 is equal to 1 (see Table 1).

The importance of these gases to climate change is expressed in terms of the amount (concentration) in the atmosphere and the gas' GWP. For comparison, emissions of all GHGs are often expressed in terms of teragrams of carbon dioxide equivalent (Tg CO_2 Eq.). The relationship between gigagrams (Gg) of a gas and Tg CO_2 Eq. is determined by the following (U.S. EPA 2002):

$$Tg\ CO_2\ Eq. = (Gg\ of\ gas)\ x\ (GWP)\ x \left(\frac{Tg}{1{,}000\,Gg} \right)$$

where:

Tg CO_2 Eq.	=	teragrams of carbon dioxide equivalents
Gg	=	gigagrams (equivalent to a thousand metric tons)
GWP	=	global warming potential
Tg	=	teragrams

In addition to those shown in Table 1, there are other GHGs typically not considered when evaluating the effects on global climate change. These are short-lived gases such as carbon monoxide, water vapor, tropospheric ozone, tropospheric aerosols (e.g. sulfur dioxide products and black carbon), and other ambient air pollutants such, as NO_X and non-methane volatile organic compounds (NMVOCs). Because they are short-lived, concentrations of these gases tend to vary spatially and it is difficult to determine their global radiative forcing impacts. Therefore, GWPs are typically not attributed to these short-lived, spatially inhomogeneous atmospheric gases (U.S. EPA 2002).

Descriptions of the main GHGs follow.

2.1 Non-Fluorinated Gases

These GHGs are created and emitted through both natural and human-associated activities.

2.1.1 Carbon Dioxide (CO_2)

Carbon dioxide is the most prevalent GHG. It is both emitted and absorbed through the "carbon cycle" whereby living organisms both utilize and expel CO_2. CO_2 is also emitted through the combustion of carbon based fuels, wildfires, and other processes. Deforestation contributes to increased atmospheric concentrations of CO_2 by removing CO_2 "sinks." In addition, certain specialized industrial production processes and product uses such as mineral production, metal production and the use of petroleum-based products can also lead to CO_2 emissions (U.S. EPA 2007b).

Processes that absorb CO_2 are known as "sinks," while processes that emit CO_2 are "sources." The primary "non-natural" source of CO_2 emissions is combustion of carbon-based fuels. The primary natural sources of CO_2 emissions are (U.S. EPA 2007b):

- Plant respiration, by which plants convert oxygen and nutrients into CO_2 and energy;
- Ocean–atmosphere exchange, in which the oceans absorb and release CO_2 at the sea surface; and
- Volcanic eruptions, which release carbon from rocks deep in the Earth's crust (this source is very small).

Humans and animals also produce CO_2 that is expelled during respiration (breathing). Natural sinks of CO_2 include:

- carbon dioxide used in plants during photosynthesis; and
- the exchange of CO_2 between the atmosphere and the oceans.

When in balance, natural sources and sinks keep CO_2 concentrations in the atmosphere relatively steady. However, since the Industrial Revolution, human activities have increased CO_2 concentrations in the atmosphere by about 35 percent relative to pre-Industrial Revolution levels, primarily related to carbon-based fuel combustion (U.S. EPA 2007b).

In addition to methods for directly reducing CO_2 emissions to the atmosphere (e.g., burning less fuel), a number of programs are being developed that are designed to remove CO_2 from the atmosphere. These human-influenced or -created carbon sinks include (U.S. EPA 2007b):

- *Geologic sequestration.* Rather than releasing CO_2 emissions to the atmosphere, CO_2 emissions from industrial or energy-related sources are separated and captured, transported to a storage location, and then injected deep underground for long-term isolation (storage) from the atmosphere.
- *Carbon sequestration.* In this process agricultural and forestry practices are used to remove CO_2 from the atmosphere. Plants on agricultural and forestry lands act as sinks that absorb CO_2 through natural photosynthesis. However, agricultural and forestry practices can also release CO_2 and other GHGs to the atmosphere. Sequestration activities can help prevent global climate change by enhancing carbon storage in trees and soils, preserving existing tree and soil carbon, and by reducing emissions of CO_2,

methane (CH_4) and nitrous oxide (N_2O). This sequestration generally only lasts as long as the plants are alive, after which their carbon may be released during decay.

2.1.2 Methane (CH_4)

Human-related sources of methane include fossil fuel production, animal husbandry (enteric [intestinal] fermentation in livestock and manure management) and other agricultural activities, rice cultivation, biomass burning, waste management (landfills), natural gas and petroleum systems, coal mining, stationary and mobile combustion, wastewater treatment, and certain industrial processes. It is estimated that 60 present of global methane emissions to the atmosphere are related to these human-related activities. Natural sources of methane include wetlands (biomass decomposition), gas hydrates, permafrost, termites, oceans, freshwater bodies, non-wetland soils, and other sources such as wildfires (U.S. EPA 2007c).

2.1.3 Nitrous Oxide (N_2O)

The primary human-related sources of N_2O are agricultural soil management (e.g., fertilizers), animal manure management, sewage treatment, mobile and stationary fuel combustion, adipic acid production (primarily used for the production of nylon), and nitric acid production. N_2O is also produced naturally from a wide variety of biological sources in soil and water, particularly microbial action in wet tropical forests (U.S. EPA 2007d).

2.2 Fluorinated Gases

The remaining gases listed in Table 1 are fluorinated gases that are solely created and emitted through human activities. These gases, also known as “High GWP Gases,” are considered the most potent because they have both high GWPs and extremely long atmospheric lifetimes. The result of these long atmospheric lifetimes is the essentially irreversible accumulation of these gases in the atmosphere once they are emitted (U.S. EPA 2007e). However, current concentrations of these gases in the atmosphere are relatively low.

2.2.1 Hydrofluorocarbons (HFCs)

HFCs are man-made chemicals primarily developed as alternatives to ozone-depleting substances for industrial, commercial, and consumer products. As seen in Table 1, the global warming potentials of HFCs range from 140 (HFC-152a) to 11,700 (HFC-23), while the atmospheric lifetime for HFCs varies from just over a year (HFC-152a) to over 260 years (HFC-23). Most of the commercially used HFCs have atmospheric lifetimes less than 15 years. For example, the atmospheric lifetime of HFC-134a, which is used in automobile air conditioning and refrigeration, is 14 years (U.S. EPA 2007e).

The only significant emissions of HFCs before 1990 were of the chemical HFC-23. Between 1978 and 1995, HFC-23 concentrations increased from 3 to 10 parts per trillion (ppt) and continue to rise. Since 1990, when it was almost undetectable, global average concentrations of HFC-134a have risen significantly to almost 10 ppt (parts per trillion). The abundance of certain HFCs is expected to continue to rise in line with their increasing use, particularly as refrigerants around the world (U.S. EPA 2007e).

2.2.2 Perfluorocarbons (PFCs)

The largest known man-made sources of PFCs are primary aluminum production and semiconductor manufacturing. PFCs are also minor substitutes for ozone depleting substances. PFCs are particularly troublesome as GHGs because, in addition to their high GWPs, they also have extremely stable molecular structures and are largely immune to the chemical processes in the lower atmosphere that break down most atmospheric pollutants. It is not until they reach the upper atmosphere (approximately 37 miles above the earth) that they are broken down by high-energy ultraviolet rays from the sun. Thus they have extremely long atmospheric lifetimes (up to tens of thousands of years). Recent relative rates of increase in atmospheric concentrations for two of the most important PFCs are 1.3 percent per year for CF_4 and 3.2 percent per year for C_2F_6 (U.S. EPA 2007e).

2.2.3 Sulfur Hexafluoride (SF_6)

Sulfur hexafluoride is considered the most potent GHG because it has a 100-year GWP of 23,900 coupled with an atmospheric lifetime of 3,200 years. Because of its excellent dielectric properties, SF_6 is used for insulation and current interruption in electric power transmission and distribution equipment. It is also used in the magnesium industry to protect molten magnesium from oxidation and potentially violent burning, in semiconductor manufacturing to create circuitry patterns on silicon wafers, and as a tracer gas for leak detection. Measurements of SF_6 show that its global average concentration has increased by about 7 percent per year during the 1980s and 1990s, from less than 1 ppt in 1980 to almost 4 ppt in the late 1990s (U.S. EPA 2007e).

3.0 Human Induced Climate Change

In 1988, in response to growing concern about the problem of potential global climate change, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC). The IPCC is open to all members of the UN and WMO.

The role of the IPCC is (IPCC 2007a):

> to assess on a comprehensive, objective, open and transparent basis 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. The IPCC does not carry out research nor does it monitor climate related data or other relevant parameters. It bases its assessment mainly on peer reviewed and published scientific/technical literature.

The IPCC recently published its findings that it is highly likely that observed increases in the globally averaged temperature since the mid-20^{th} century are due to human-caused increases in measured GHG concentrations (IPCC 2007b).

As indicated, GHGs are necessary to life as we know it, because they keep the planet's surface warmer than it otherwise would be. For example, Figure 2 shows how the average earth temperature has varied with CO_2 concentrations in the atmosphere over the last 400,000 years. As also evident by the data shown in this figure, there is a strong correlation between CO_2 concentrations in the atmosphere and the average global temperature.

However, concentrations of GHGs are continuing to increase in the atmosphere and it has been observed that the Earth's temperature is climbing above typical past levels. According to National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) data, the following observations have been made (U.S. EPA 2007f; NASA 2007):

- Since 1900, the average surface temperature has warmed by about 1.2–1.4 ºF.
- Since the mid 1970s, the average surface temperature has warmed about 1 ºF.
- The Earth's surface is currently warming at a rate of about 0.32 ºF/decade or 3.2 ºF/century.
- The five warmest years over the last century have likely been (in order from hottest to coolest): 2005, 1998, 2002, 2003, 2006. The top 10 warmest years have all occurred since 1990.

In addition to temperature increase, other aspects of the global climate are also changing such as rainfall patterns, snow and ice cover, and average sea levels.

In an attempt to evaluate and predict the relationship between GHG emissions and global temperature changes, atmospheric models have been created to simulate the atmospheric temperature changes that occur from both natural and human created emissions of GHGs. Figure 3 shows the results of some such simulations.

Source: UNEP/GRID–Adrenal 2000

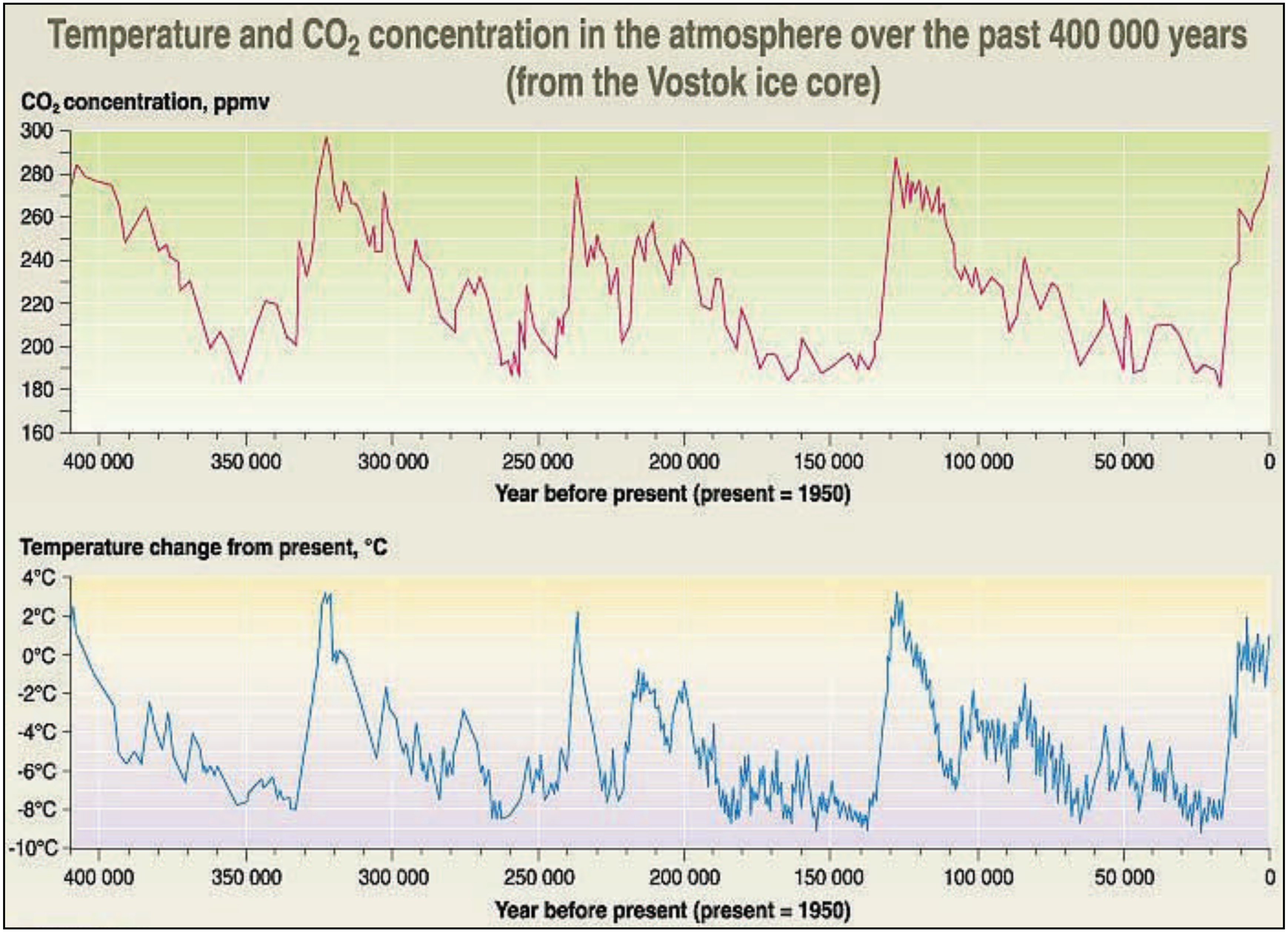

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FIGURE 2
Temperature and CO2 Concentration

Source: UNEP/GRID–Adrenal 2002b

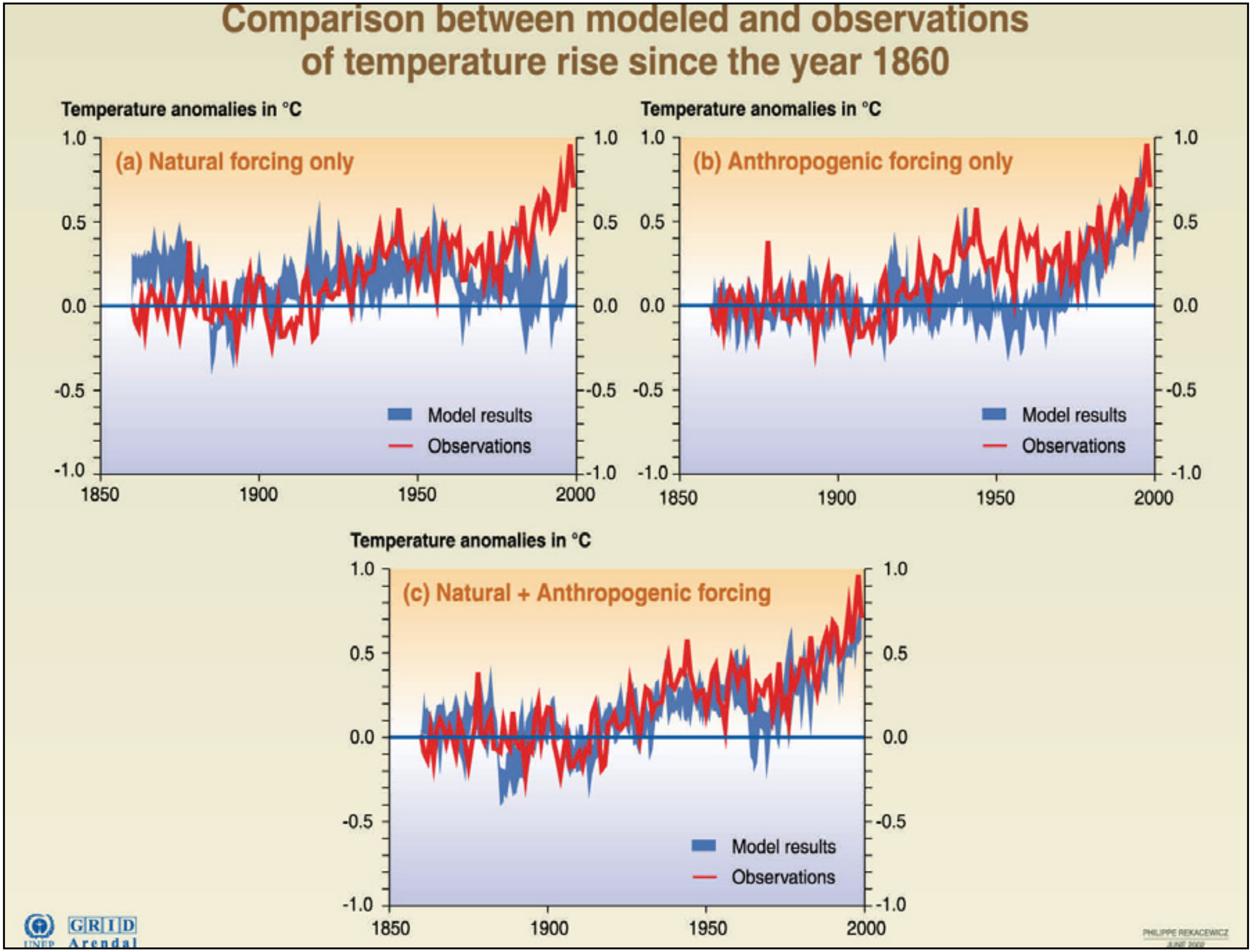

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FIGURE 3
Comparison between Modeled
and Observed Temperature

In Figure 3, simulation (a) only includes natural forcings: solar radiation and volcanic activity. As seen, when only natural forcings are included, modeled temperatures do not correlate well with observations, particularly since 1950. Simulation (b) only includes human-caused forcings: GHGs and sulfate aerosols. In this simulation the recent observed rise in temperature matches the modeled temperature fairly well, but modeled temperatures do not match observations around 1950.

Simulation (c) includes both natural and human-caused forcings. As seen, the best match occurs when both natural and human forcings are included.

The relationships between GHG emissions and global climate change are very complex. Therefore, much controversy and debate continues regarding the extent to which human caused GHG emissions are influencing global climate change. Nevertheless, as a result of observations and modeling simulations such as those indicated above, the IPCC has concluded that it is highly likely that most of the warming observed in recent decades is the result of human activities (IPCC 2007b).

4.0 Future Projections of Climate Change

In order to project anticipated future climate changes resulting from human-caused emissions of GHGs, the IPCC developed a series of GHG emission scenarios for use in driving global circulation models for developing climate change scenarios. The emission scenarios were originally released by the IPCC in 1992 and are referred to as the "IS92" scenarios. Subsequent re-evaluation of the scenarios in response to new understanding of possible future GHG emissions and their relationship to climate change led to the development and release of new emission scenarios in 2000. The emission scenarios are based on a number of very complex factors and include not only emission baselines, but also (IPCC 2000):

- Include the latest information on economic restructuring throughout the world;
- Examine different rates and trends in technological change; and
- Expand the range of different economic-development pathways, including narrowing of the income gap between developed and developing countries.

Thus the emissions scenarios cover a wide range of the main driving forces of future emissions, including demographic, technological, and economical factors. As required by IPCC assumptions, none of the scenarios include future policies aimed specifically at climate change. It is intended that the emissions scenarios developed encompass the range of possible emissions of all relevant GHGs, sulfur, and their driving forces (IPCC 2000). The development of the emission scenarios is documented in the IPCC Special Report on Emissions Scenarios (SRES; IPCC 2000). Emissions were developed using four qualitative "storylines" that yielded four sets of scenarios called "families": A1, A2, B1, and B2. The process resulted in a total of 40 SRES emission scenarios. The 40 emission scenarios were grouped into six scenario groups. All emission scenarios are considered equally valid with no assigned probability of occurrence (IPCC 2000). Figure 4 presents a schematic and narrative of the main characteristics of the SRES emission scenarios.

The emission scenario groups are used to estimate the future CO_2 and other GHG concentrations in the atmosphere. Figure 5 shows the past and projected CO_2 concentrations from the years 1000 to 2100. As seen in this figure, all scenarios project a marked increase in CO_2 concentrations by 2100 relative to past conditions. Figure 6 shows the projected variations in the earth's temperature, relative to the 1990 temperature, that correspond to the emission scenario groups. The results shown in this figure indicate that under best-case emissions, the earth's average temperature is projected to increase by approximately another 2.5 °F by the year 2100. Under worst-case emissions, the earth's average temperature is projected to increase by as much as 10 °F.

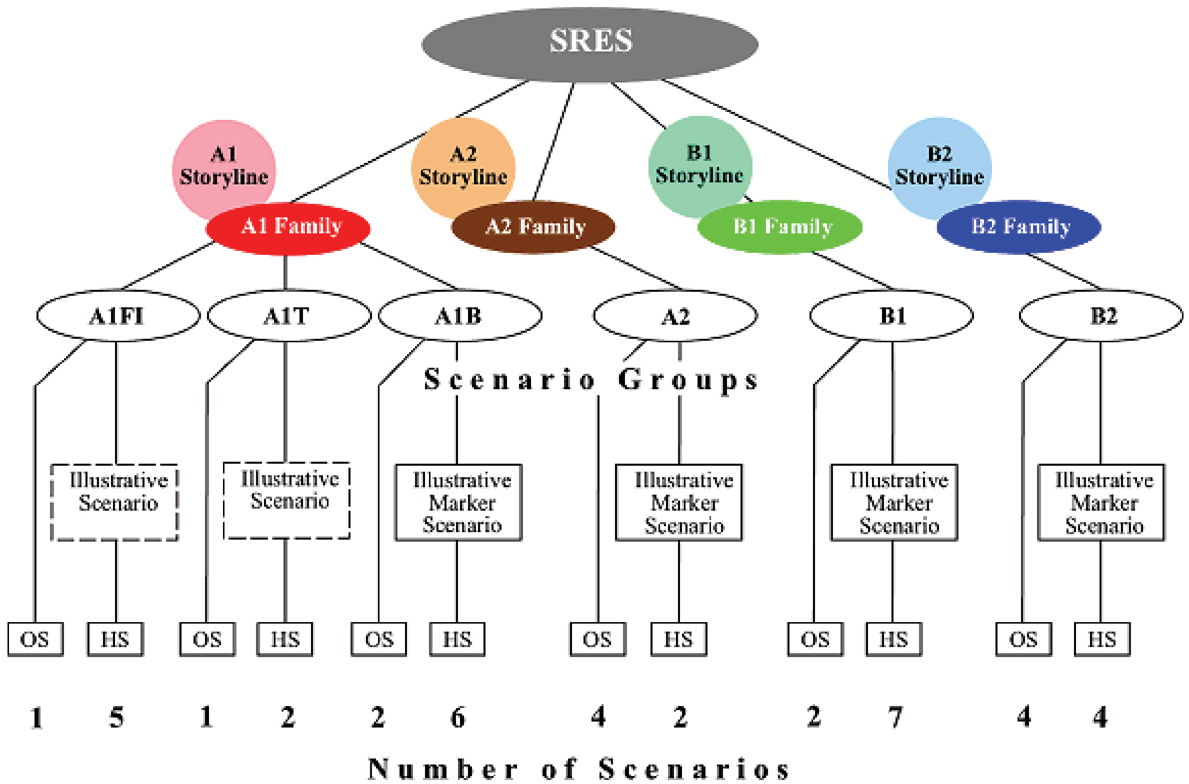
5.0 Implications of Climate Change

The increase in the earth's temperature is expected to have wide ranging effects on the environment. Although global climate change is anticipated to affect all areas of the globe, there are numerous implications of direct importance to California. Statewide average temperatures are anticipated to increase by between 3 and 10.5 °F by 2100. Some climate models indicate that this warming may be greater in the summer than in the winter. This could result in widespread adverse impacts to ecosystem health, agricultural production, water use and supply, and energy demand. A report prepared by the California Climate Change Center focuses on these potential impacts, which are summarized below (State of California 2006a).

- **Precipitation and Water Resources.** Projections indicate that total annual precipitation and rainfall statewide patterns are anticipated to change little over the next century. The predominantly Mediterranean precipitation pattern of most precipitation occurring in the winter months is expected to continue. It is also possible that the intensity and frequency of extreme storm events could increase, thus affecting the balance between water storage and the need for flood control.

  Although most of the precipitation falls during the winter months, water demand is greatest during the summer months. Much of California is reliant on the winter Sierra Nevada snowpack. If temperatures continue to rise as expected, more precipitation will fall as rain instead of snow. Further, that snow which does fall will melt earlier reducing the spring snowpack by as much as 70 to 90 percent. This has potentially major implications for water supply, agriculture, and hydropower generation. This also would adversely impact the economies of communities reliant on winter recreational activities.

Source: IPCC 2000



Schematic illustration of SRES scenarios. Four qualitative storylines yield four sets of scenarios called "families": A1, A2, B1, and B2. Altogether 40 SRES scenarios have been developed by six modeling teams. All are equally valid with no assigned probabilities of occurrence. The set of scenarios consists of six scenario groups drawn from the four families: one group each in A2, B1, B2, and three groups within the A1 family, characterizing alternative developments of energy technologies: A1FI (fossil fuel intensive), A1B (balanced), and A1T (predominantly non-fossil fuel). Within each family and group of scenarios, some share "harmonized" assumptions on global population, gross world product, and final energy. These are marked as "HS" for harmonized scenarios. "OS" denotes scenarios that explore uncertainties in driving forces beyond those of the harmonized scenarios. The number of scenarios developed within each category is shown. For each of the six scenario groups an illustrative scenario (which is always harmonized) is provided. Four illustrative marker scenarios, one for each scenario family, were used in draft form in the 1998 SRES open process and are included in revised form in this report. Two additional illustrative scenarios for the groups A1FI and A1T are also provided and complete a set of six that illustrate all scenario groups. All are equally sound.

By 2100 the world will have changed in ways that are difficult to imagine - as difficult as it would have been at the end of the 19th century to imagine the changes of the 100 years since. Each storyline assumes a distinctly different direction for future developments, such that the four storylines differ in increasingly irreversible ways. Together they describe divergent futures that encompass a significant portion of the underlying uncertainties in the main driving forces. They cover a wide range of key "future" characteristics such as demographic change, economic development, and technological change. For this reason, their plausibility or feasibility should not be considered solely on the basis of an extrapolation of current economic, technological, and social trends.

The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B)[3] .

The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing global population. Economic development is primarily regionally oriented and per capita economic growth and technological change are more fragmented and slower than in other storylines.

The B1 storyline and scenario family describes a convergent world with the same global population that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid changes in economic structures toward a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional climate initiatives.

The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social, and environmental sustainability. It is a world with continuously increasing global population at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented toward environmental protection and social equity, it focuses on local and regional levels.

FIGURE 4
The Main Characteristics of the Four
SRES Storylines and Scenario Families

Source: UNEP/GRID–Adrenal 2005a

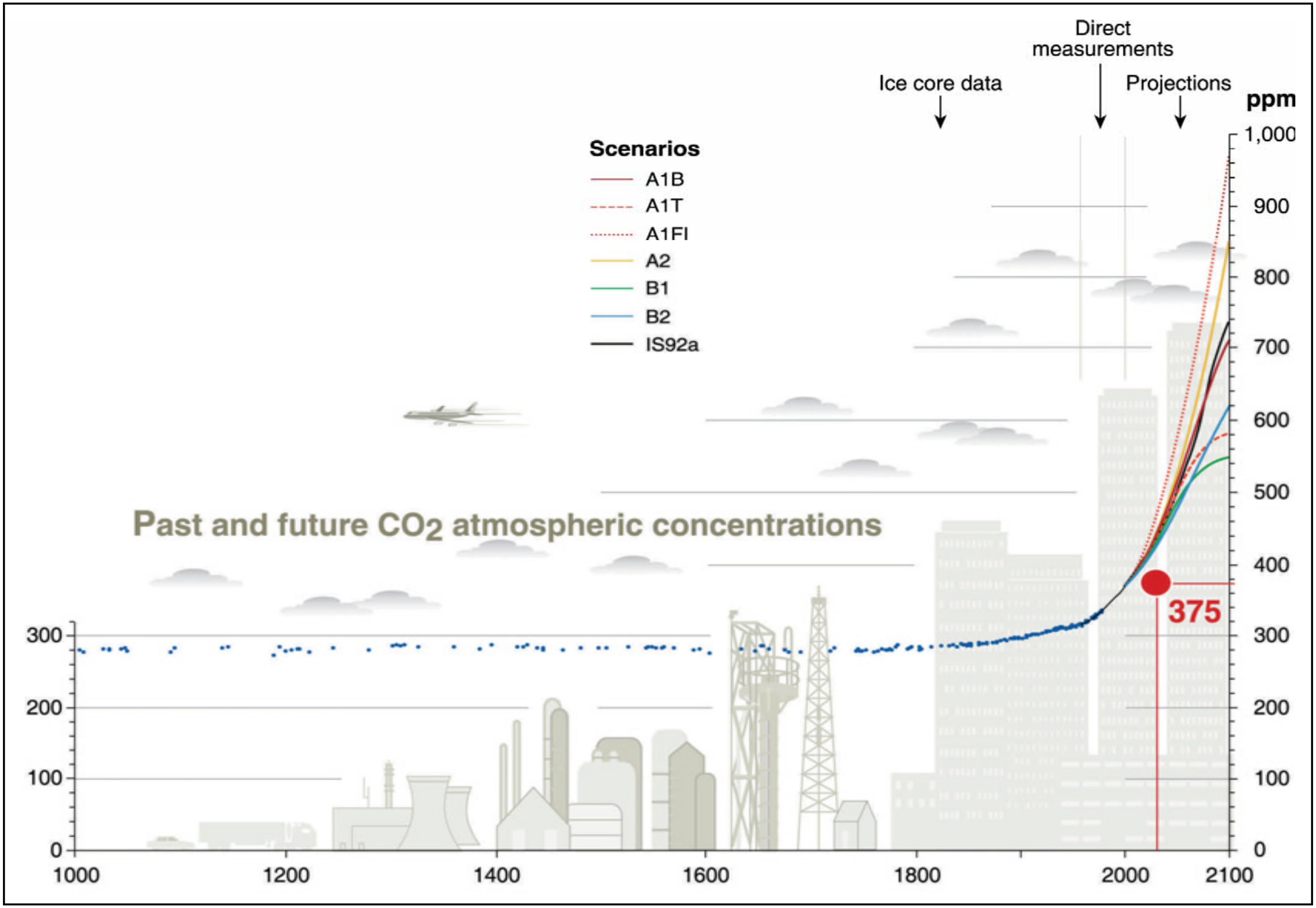


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FIGURE 5
CO_2 Scenarios

Source: UNEP/GRID–Adrenal 2005b

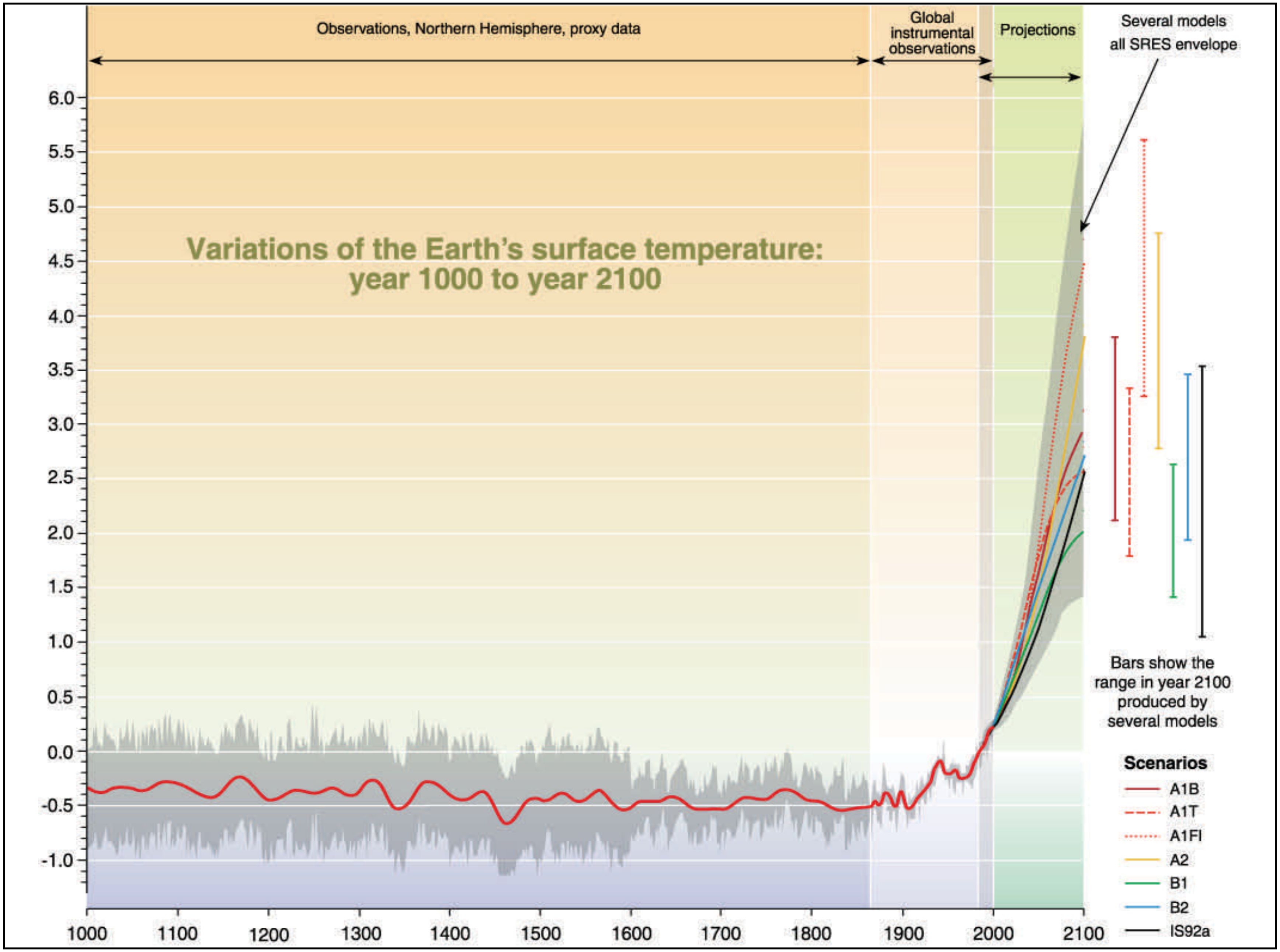

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FIGURE 6
Surface Temperature Scenarios

Water supplies could also be adversely affected by saltwater intrusion associated with anticipated sea level rises (see below).

- **Public Health.** Although the change in statewide average temperature may not appear to be large, the incidence of extreme temperature events, particularly high temperatures, is anticipated to increase. It is these extreme conditions that pose the greatest health risk. Higher temperatures are expected to increase the frequency, duration, and severity of conditions conducive to the formation of air pollutants, particularly ozone. Furthermore, increased temperatures will be favorable for conditions that lead to increases in wildfires, which emit large quantities of particulate matter.

  By 2100, models indicate that under the worst-case emission trends there could be up to 100 more days with temperatures over 90 °F in Los Angeles and over 95 °F in Sacramento. Such temperature extremes, particularly in densely populated urban centers, could cause a marked increase in heat-related death, particularly due to dehydration, heat stroke/exhaustion, heart attack, stroke, and respiratory diseases. Increased demand for air conditioning would put additional stresses on the state's energy supplies. Increased temperatures could also lead to increases in disease vectors such as mosquitoes.

- **Agriculture.** California agriculture is the largest and most diverse industry in the nation producing more than half of the country's fruits and vegetables. The anticipated climate changes will have widespread affects on the quantity and quality of agricultural products produced in the state. Many fruit and nut trees are particularly sensitive to changes in temperature. High temperatures can stress dairy cows reducing milk production. Rising temperatures will affect the State's ecosystems and will likely shift or increase the range of noxious and invasive weeds. Further, increased temperatures would be beneficial to certain pests and pathogens that otherwise do not survive the winter months, thus leading to an increase in areas subject to infestation as well as increasing the frequency and severity of damaging outbreaks.

- **Forests and Landscapes.** Global climate change is expected to increase the frequency and severity of wildfires, and to alter the distribution and character of natural vegetation. Alpine and sub-alpine ecosystems are the most threatened in the state and are expected to decline by as much as 60 to 80 percent by the end of the century as temperatures continue to increase. Conifer forests may decline by as much as 18 percent by the end of the century, with corresponding economic impacts resulting from decreased forest production and recreation. Overall, much of California's native ecosystems may transition to plants and animals more suited to warmer conditions.

- **Sea Level Rise.** California has more than 1,100 miles of coastline along the Pacific Ocean. These coastlines are also home to unique ecosystems that are considered some of the world's most threatened. These regions will be increasingly threatened by rising sea levels, more intense coastal storms, and warmer water temperatures. Sea levels have risen about seven inches in the last century. Projections indicate that with increased global temperatures sea levels could rise between 22 and 35 inches by the end of the century. Sea level increases of this magnitude would inundate coastal areas with salt water, accelerate coastal erosion, threaten vital levees and inland water systems, and disrupt wetlands and vital habitats.

Increased sea levels combined with storm surges from severe storms could cause widespread damage along the coast, including levee breaches in low-lying areas such as the San Francisco Bay Delta. Rising sea levels will also reduce beach areas. Increased storms could also accelerate beach erosion leading to significant monetary expenditures on beach replenishment projects in an attempt to maintain the beaches.

It is also important to note that even if GHG emissions were to be eliminated or dramatically reduced, it is projected that the effect of those emissions would continue to affect global climate for centuries. Figure 7 schematically illustrates this persistence effect.

All of the effects outlined above could dramatically impact the economy of the State through increased costs associated with water management strategies, public health costs, agricultural losses or increased pest management costs, and damage resulting from severe storms, wildfires, and sea level rises. Such effects are not limited to the state and similar or related effects are anticipated for other parts of the country and around the earth. These effects are anticipated to impact both national and worldwide population distributions and economies as populations attempt to shift from areas that become uninhabitable or infertile, or in response to disease outbreaks and shortages. Overall, continued global climate change will likely affect every person on the planet in some way.

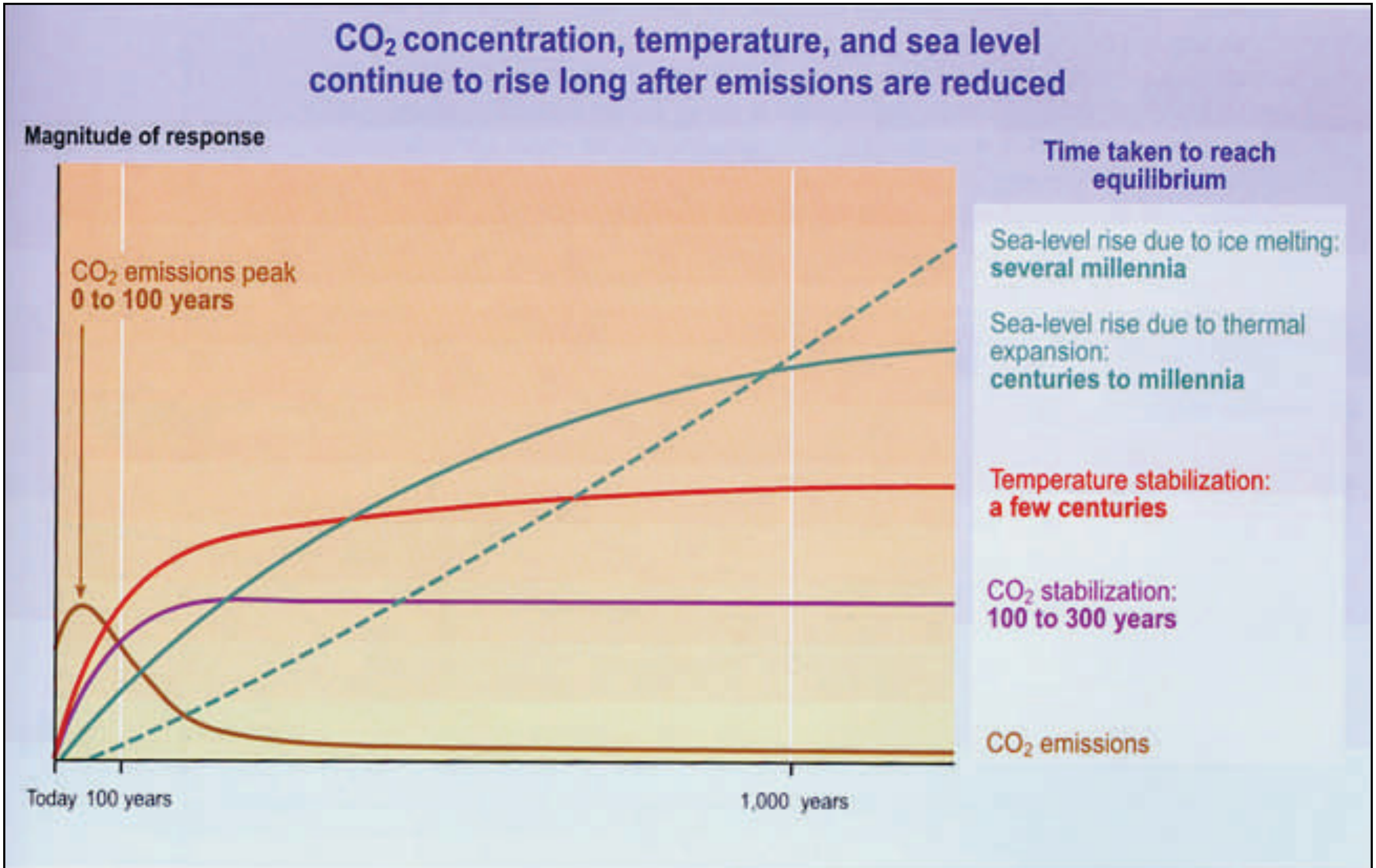
6.0 Global, National, and State GHG Emissions

Estimates of global emissions of GHGs are provided by the UNFCCC for nations that are and are not included in Annex I to the Convention (Annex I and Non-Annex I Parties; see discussion in Section 3.1 below). Given the complexity of estimating global emissions, emission estimates are not available for all countries for all years. Table 2 shows the total equivalent CO_2 emissions for all parties included in Annex I to the Convention (Annex I Parties, made up of 41 nations) for the years 1990, 1995, and 2000 through 2004 (UNFCCC 2006).

TABLE 2
TOTAL AGGREGATE ANTHROPOGENIC EMISSIONS OF CO_2, CH_4, N_2O, HFCs, PFCs, AND SF_6 INCLUDING EMISSIONS/REMOVALS FROM LAND USE, LAND-USE CHANGE, AND REFORESTRY (Tg CO_2 Equivalent)

1990	1995	2000	2001	2002	2003	2004
16,516	15,500	15,709	15,538	15,267	15,291	16,077

Source: IPCC 2001



After CO_2 emissions are reduced and atmospheric concentrations stabilize, surface air temperature continues to rise by a few tenths of a degree per century for a century or more. Thermal expansion of the ocean continues long after CO_2 emissions have been reduced, and melting of ice sheets continues to contribute to sea-level rise for many centuries. This figure is a generic illustration for stabilization at any level between 450 and 1,000 ppm, and therefore has no units on the response axis. Responses to stabilization trajectories in this range show broadly similar time courses, but the impacts become progressively larger at higher concentrations of CO_2.

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FIGURE 7
Persistence Effect

Land-use change and forestry often act as sinks, thus reducing a nation's total GHG emissions. Because nations that are not included in Annex I to the Convention (Non-Annex I Parties comprised of 122 nations) are largely developing countries, emissions data for these countries are more sporadic and incomplete. The most recent emissions data from non-Annex I Parties indicate that total emissions from these nations were approximately 11,931 Tg CO_2 equivalent, including land use-change and forestry (UNFCCC 2005). As such, using the most recent data available for Annex I and Non-Annex I Parties, 2004 global emissions of GHGs were approximately 28,008 Tg CO_2 equivalent, including land-use change and forestry.

Each year, the U.S. EPA prepares an inventory of GHG emissions and sinks report. The report provides information on GHG emissions and sink sources and is used to develop policies and track progress. Inventories are submitted to the UN. The most recent final report, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2007*, was completed in April 2009 (U.S. EPA 2009). The 2010 update is currently undergoing public review. The U.S. EPA also provides guidance for states to develop GHG inventories. The *Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004* completed in December 2006, including subsequent revisions to the in-state electricity production estimates, is the most recent report for California (State of California 2006b, 2007). Tables 3 and 4 summarize the national GHG emissions in 1990, 1995, 2000, and 2005 through 2007, and State GHG emissions from 1990 through 2004, respectively.

TABLE 3
NET NATIONAL GHG EMISSIONS
(Tg CO_2 Equivalent)

Year	CO_2	CH_4	N_2O	HFCs, PFCs, and SF_6[1]	Total[2]	National Population[3]	Total (Mg CO_2 Eq) per Capita
1990	4,235.3	616.6	315.0	90.5	5,257.3	249,464,396	21.1
1995	4,556.9	615.8	334.1	105.5	5,612.3	262,803,276	21.4
2000	5,237.7	591.1	329.2	132.8	6,290.7	282,194,308	22.3
2005	4,968.1	561.7	315.9	140.2	5,985.9	295,895,897	20.2
2006	4,964.4	582.0	312.1	142.1	6,000.6	298,754,819	20.1
2007	5,040.8	585.3	311.9	149.5	6,087.5	301,621,157	20.2

SOURCE: U.S. EPA 2009
[1]Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride
[2]Totals may vary from the sum of the sources due to independent rounding
[3]U.S. Census Bureau 2009
Tg = terragrams = one million metric tons; Mg = megagrams = one metric ton

TABLE 4
NET CALIFORNIA GHG EMISSIONS
($Tg\ CO_2$ Equivalent)

Year	CO_2	CH_4	N_2O	HFCs, PFCs, and SF_6[1]	Total[2]	California Population[3]	Total (Mg CO_2 Eq) per Capita
1990	301.6	26.0	32.7	7.1	367.4	29,950,111	12.3
1991	293.4	24.9	30.4	7.4	356.1	30,414,114	11.7
1992	299.9	23.8	30.5	7.9	362.2	30,875,920	11.7
1993	295.3	25.4	31.5	8.4	360.5	31,147,208	11.6
1994	313.9	25.4	30.0	8.9	378.2	31,317,179	12.1
1995	297.7	26.2	31.9	9.3	365.1	31,493,525	11.6
1996	302.3	25.5	30.8	11.4	370.0	31,780,829	11.6
1997	312.3	24.2	28.8	12.6	378.0	32,217,708	11.7
1998	330.3	25.3	29.2	8.9	393.7	32,682,794	12.0
1999	333.3	26.3	29.4	9.9	398.9	33,145,121	12.0
2000	352.6	26.4	31.4	10.5	420.9	34,004,051	12.4
2001	357.8	26.7	30.8	11.2	426.5	34,525,902	12.4
2002	351.0	27.1	34.5	12.0	424.6	34,963,856	12.1
2003	328.4	27.5	33.9	12.9	402.7	35,376,833	11.4
2004	342.9	27.9	33.3	14.2	418.3	35,721,991	11.7

SOURCE: State of California 2007
[1]Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride
[2]Totals may vary from the sum of the sources due to independent rounding
[3]US Census Bureau 2009
Tg = terragrams = one million metric tons; Mg = megagrams = one metric ton

Net GHG emissions are gross emissions minus GHG sinks. As seen in Tables 3 and 4, in 2000, California emitted approximately 421 million metric tons of GHGs compared to approximately 6,291 million metric tons of GHG emissions for the nation as a whole, or about 6.7 percent of the nation's emissions. Tables 3 and 4 also illustrate that although California emits a substantial portion of the nation's GHGs, California's per capita emissions are roughly half the national average. In fact, as illustrated in Figure 8, California has the fourth lowest emission per capita of CO_2 in the nation. According to the data presented in Tables 3 and 4, per capita emissions over the 15-year period illustrated have remained relatively flat. This would imply that the increase in total GHG emissions over time is primarily a result of the increasing population of the state and country, and not due to increased per capita emissions.

Figure 8 compares total GHG emissions from California and the United States to other major emitting countries in the world.

As seen in Figure 9, in 2002 the United States was the largest emitter of GHGs in the world, with China ranking second and California ranking as the 16th largest emitter of GHGs globally. Recent data indicate that China may have surpassed the United States as the greatest emitter of GHGs globally (Environmental News Network 2007), although on a per

Source: State of California 2006b

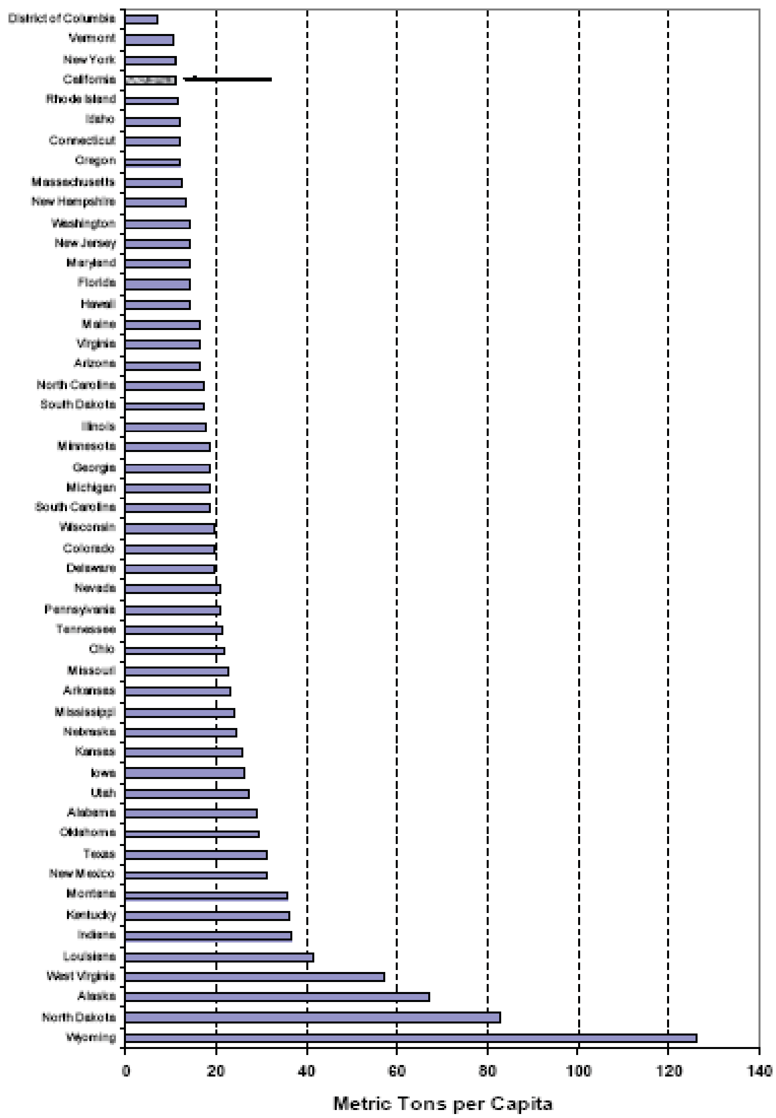

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FIGURE 8
CO_2 Emissions from
Fossil Fuels per Capita (2001)

Source: State of California 2006b

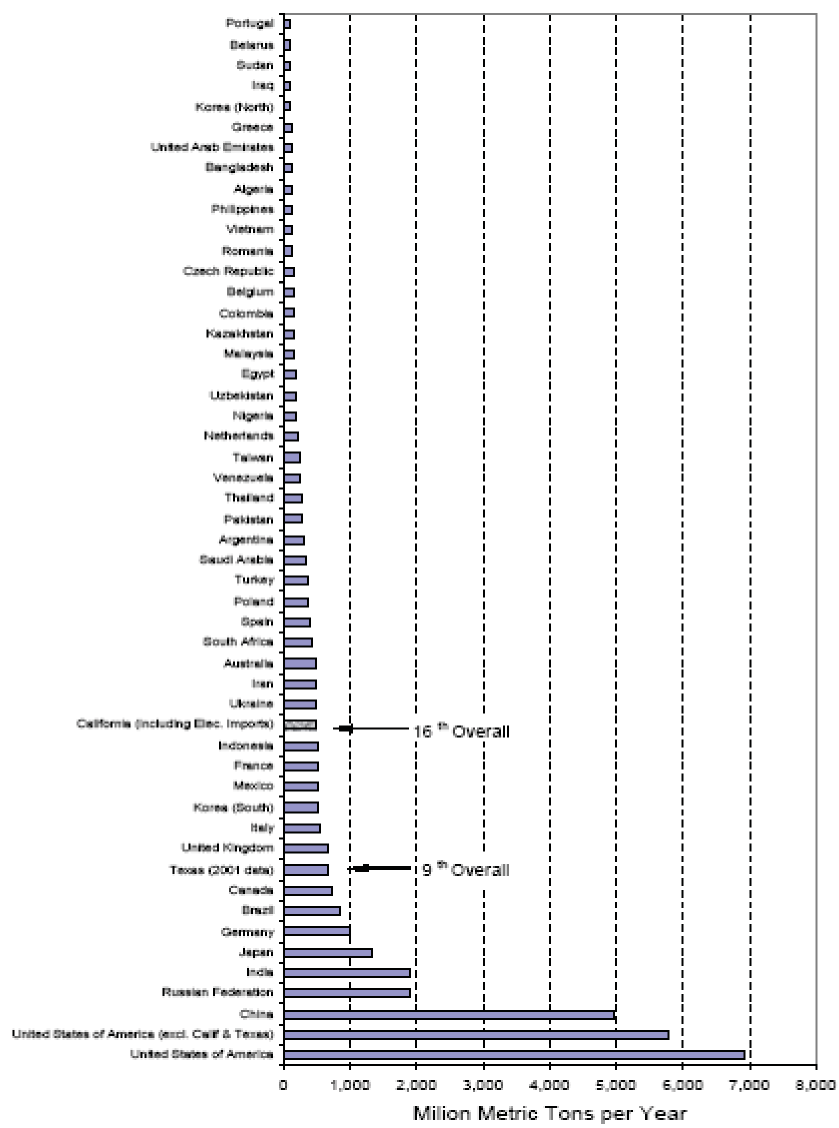

FIGURE 9

Global Greenhouse Gas Emission Comparison (2002 data) capita basis China remains well below the United States and California with a per capital CO_2 emission rate around 3 metric tons per year in 2001 (State of California 2006b).

It is important to note that given the global nature of global climate change, it is the total emissions of GHGs to the atmosphere that is important, not necessarily the per capita or total emissions from any single country. However, per capita emissions provide a relative benchmark by which to evaluate emissions.

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ATTACHMENT 2

GHG Emissions Calculations – Proposed Project and BAU

PROJECT WITHOUT GHG-REDUCING DESIGN FEATURES

Emission Source	CO2	N20	CH4	Total CO2 Eq Emissions (metric tons/year)
Vehicular Emissions	3,176.28	10.07	1.88	3,188.22
Electricity Usage Emissions	1,841.02	8.18	0.32	1,849.52
Natural Gas Usage Emissions	1,460.13	8.30	0.59	1,469.02
Water Usage Emissions	279.17	1.24	0.05	280.46
Solid Waste Emissions				126.49
Construction Emissions				82.11
Total CO2 Eq Emissions				**6,995.81**

PROJECT WITH GHG-REDUCING DESIGN FEATURES WITHOUT LCFS

Emission Source	CO2	N20	CH4	Total CO2 Eq Emissions (metric tons/year)
Vehicular Emissions	2,604.55	8.25	1.54	2,614.34
Electricity Usage Emissions	1,196.66	5.32	0.21	1,202.19
Natural Gas Usage Emissions	949.08	5.39	0.38	954.86
Water Usage Emissions	223.34	0.99	0.04	224.37
Solid Waste Emissions				126.49
Construction Emissions				82.11
Total CO2 Eq Emissions				**5,204.36**
PERCENT REDUCTION				25.61

PROJECT WITH GHG-REDUCING DESIGN FEATURES WITH LCFS

Emission Source	CO2	N20	CH4	Total CO2 Eq Emissions (metric tons/year)
Vehicular Emissions	2,286.92	7.25	1.54	2,295.52
Electricity Usage Emissions	1,196.66	5.32	1.35	1,202.19
Natural Gas Usage Emissions	949.08	5.39	0.38	954.86
Water Usage Emissions	223.34	0.99	0.04	224.37
Solid Waste Emissions				126.49
Construction Emissions				82.11
Total CO2 Eq Emissions				**4,885.54**
PERCENT REDUCTION				30.16

VEHICLE EMISSIONS CALCULATIONS

Parameters

Average Fuel Economy:	18.80	miles per gallon (mpg)
Average Daily Traffic (ADT):	4,450.00	trips
Average Trip Length:	5.80	miles
VMT per Day:	25,810.00	miles
VMT per Year:	6,729,035.71	miles
Total Gallons of Fuel:	357,927.43	gallons

Vehicle Emission Factors (pounds/gallon)

CO2	19.56400
CH4	0.00055
N2O	0.00020

Vehicle Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	7,002,492.27	2,204.62	3,176.28	1.00	3,176.28
CH4	196.86	2,204.62	0.09	21.00	1.88
N2O	71.59	2,204.62	0.03	310.00	10.07
TOTAL metrics tons of CO2 Eq per Year:					3,188.22

REDUCTIONS WITHOUT LCFS

Pavley — Reduce emissions across passenger fleet by 18 percent

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	5,742,043.66	2,204.62	2,604.55	1.00	2,604.55
CH4	161.43	2,204.62	0.07	21.00	1.54
N2O	58.70	2,204.62	0.03	310.00	8.25
TOTAL metrics tons of CO2 Eq per Year:					2,614.34

REDUCTIONS WITH LCFS

Pavley — Reduce emissions across passenger fleet by 18 percent
LCFS — Reduce emissions across passenger fleet by 10 percent

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	5,041,794.44	2,204.62	2,286.92	1.00	2,286.92
CH4	141.74	2,204.62	0.06	21.00	1.35
N2O	51.54	2,204.62	0.02	310.00	7.25
TOTAL metrics tons of CO2 Eq per Year:					2,295.52

ELECTRICITY EMISSIONS CALCULATIONS

PROJECT WITHOUT GHG-REDUCING DESIGN FEATURES

Average Monthly Consumption:	587.00	kWh per consumer per month
Annual Consumption:	7,044.00	kWh per consumer per year
Number of Units:	430.00	units
Total kWh:	3,028,920.00	kWh
Total MWh:	3,028.92	MWh

Electricity Generation Emission Factors (pounds/MWh)

CO2	1,340.0000
CH4	0.0111
N2O	0.0192

Emissions	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	4,058,752.80	2,204.62	1,841.02	1.00	1,841.02
CH4	33.62	2,204.62	0.02	21.00	0.32
N2O	58.16	2,204.62	0.03	310.00	8.18
TOTAL metrics tons of CO2 Eq per Year:					1,849.52

PROJECT WITH GHG-REDUCING DESIGN FEATURES

Average Monthly Consumption:	587.00	kWh per consumer per month
Annual Consumption:	7,044.00	kWh per consumer per year
Total Square Feet:	430.00	square feet
Total kWh:	3,028,920.00	kWh
Total MWh:	3,028.92	MWh
Exceed Title 24, Year 2005 by 35%:	1,968.80	MWh

Electricity Generation Emission Factors (pounds/MWh)

CO2	1,340.0000
CH4	0.0111
N2O	0.0192

Emissions	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	2,638,189.32	2,204.62	1,196.66	1.00	1,196.66
CH4	21.85	2,204.62	0.01	21.00	0.21
N2O	37.80	2,204.62	0.02	310.00	5.32
TOTAL metrics tons of CO2 Eq per Year:					1,202.19

NATURAL GAS EMISSIONS CALCULATIONS

PROJECT WITHOUT GHG-REDUCING DESIGN FEATURES

Consumption per Unit per Year:	62,384.40	cubic feet per year
Number of Units:	430.00	units
Total Consumption (cubic feet):	26,825,292.00	cubic feet per year
Total Consumption (million cubic feet):	26.83	million cubic feet per year

Natural Gas Combustion Emission Factors (pounds/million cubic feet)

CO_2	120,000.0
CH_4	2.3
N_2O	2.2

Emissions	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO_2	3,219,035.04	2,204.62	1,460.13	1.00	1,460.13
CH_4	61.70	2,204.62	0.03	21.00	0.59
N_2O	59.02	2,204.62	0.03	310.00	8.30
TOTAL metrics tons of CO2 Eq per Year:					1,469.02

PROJECT WITH GHG-REDUCING DESIGN FEATURES

Consumption per Unit per Year:	62,384.40	cubic feet per year
Number of Units:	430.00	units
Total Consumption (cubic feet):	26,825,292.00	cubic feet per year
Total Consumption (million cubic feet):	26.83	million cubic feet per year
Exceed Title 24, Year 2005 by 35%:	17.44	million cubic feet per year

Natural Gas Combustion Emission Factors (pounds/million cubic feet)

CO_2	120,000.0
CH_4	2.3
N_2O	2.2

Emissions	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO_2	2,092,372.78	2,204.62	949.08	1.00	949.08
CH_4	40.10	2,204.62	0.02	21.00	0.38
N_2O	38.36	2,204.62	0.02	310.00	5.39
TOTAL metrics tons of CO2 Eq per Year:					954.86

WATER EMISSIONS CALCULATIONS

PROJECT WITHOUT GHG-REDUCING DESIGN FEATURES

Average Monthly Consumption:	10,472.00	gallons per household per month
Annual Consumption:	125,664.00	gallons per household per year
Number of Units:	430.00	units
Total Water Use:	54,035,520.00	gallons per year
Embodied Energy:	0.0085	kWh per gallon
Total Water Energy Use (kWh):	459,301.92	kWh
Total Water Energy Use (MWh):	459.30	MWh

Electricity Generation Emission Factors (pounds/MWh)

CO2	1,340.0000
CH4	0.0111
N2O	0.0192

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	615,464.57	2,204.62	279.17	1.00	279.17
CH4	5.10	2,204.62	0.00	21.00	0.05
N2O	8.82	2,204.62	0.00	310.00	1.24
TOTAL metrics tons of CO2 Eq per Year:					280.46

PROJECT WITH GHG-REDUCING DESIGN FEATURES

Average Monthly Consumption:	10,472.00	gallons per household per month
Annual Consumption:	125,664.00	gallons per household per year
Number of Units:	430.00	units
Total Water Use:	54,035,520.00	gallons per year
Reduce Water Use by 20%:	43,228,416.00	gallons per year
Embodied Energy:	0.0085	kWh per gallon
Total Water Energy Use (kWh):	367,441.54	kWh
Total Water Energy Use (MWh):	367.44	MWh

Electricity Generation Emission Factors (pounds/MWh)

CO2	1,340.0000
CH4	0.0111
N2O	0.0192

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	492,371.66	2,204.62	223.34	1.00	223.34
CH4	4.08	2,204.62	0.00	21.00	0.04
N2O	7.05	2,204.62	0.00	310.00	0.99
TOTAL metrics tons of CO2 Eq per Year:					224.37

SOLID WASTE EMISSIONS CALCULATIONS

Tons Generated per Day:	11.400	pounds per unit per day
Tons Generated per Year:	4,161.000	pounds per unit per year
Number of Units:	430.00	units
Total Pounds Generated per Year:	1,789,230.00	pounds per year
Total Tons Generated per Year:	894.62	tons per year

Material	WARM Input Catergory	Percent Generated	Percent Recovered	Percent Landfilled
Paper	Mixed Paper (General)	31.0%	55.5%	44.5%
Glass	Glass	4.9%	23.1%	76.9%
Metals	Mixed Metals	8.4%	34.6%	65.4%
Plastics	Mixed Plastics	12.0%	7.1%	92.9%
Rubber and Leather	Mixed MSW	3.0%	0.0%	100.0%
Textiles	Mixed MSW	5.0%	0.0%	100.0%
Wood	Dimensional Lumber	6.6%	9.6%	90.4%
Other	Mixed MSW	1.7%	0.0%	100.0%
Food Scraps	Food Scraps	13%	2.5%	97.5%
Yard Trimming	Yard Trimmings	13.2%	64.7%	35.3%
Miscellaneous Inorganic Waste	Mixed MSW	1.5%	0.0%	100.0%
TOTAL		100.0%		

Material	WARM Input Catergory	Tons Generated	Tons Recovered	Tons Landfilled
Paper	Mixed Paper (General)	277.3	153.9	123.4
Glass	Glass	43.8	10.1	33.7
Metals	Mixed Metals	75.1	26.0	
Plastics	Mixed Plastics	107.4	7.6	99.7
Rubber and Leather	Mixed MSW	26.8	0.0	26.8
Textiles	Mixed MSW	44.7	0.0	44.7
Wood	Dimensional Lumber	59.0	5.7	53.4
Other	Mixed MSW	15.2	0.0	15.2
Food Scraps	Food Scraps	113.6	2.8	110.8
Yard Trimming	Yard Trimmings	118.1	76.4	41.7
Miscellaneous Inorganic Waste	Mixed MSW	13.4	0.0	13.4
TOTAL		895	283	563

Material	**Landfilling, Energy Recovery MTCO2E/Ton**	**Tons Landfilled**	**MTCO2E**
Glass	0.04	33.7	1.348399513
Dimensional Lumber	-0.49	53.4	-26.15439159
Food Scraps	0.72	110.8	79.75850571
Yard Trimmings	-0.22	41.7	-9.170805719
Mixed Paper (primarily residential)	0.25	123.4	30.85303481
Mixed Metals	0.04	0.0	0
Mixed Plastics	0.04	99.7	3.989267208
Mixed MSW	0.42	100.2	42.0826896
TOTAL			122.7066995

Average Fuel Economy:	6.06	miles per gallon (mpg)
Total Trips:	112.00	trips
Trip Length:	20.00	miles
Total VMT:	2,240.00	miles
Gallons of Fuel:	369.64	gallons

Vehicle Emission Factors (pounds/gallon)

CO_2	22.37000
CH_4	0.00128
N_2O	0.00057

On-Road Diesel Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO_2	8,268.78	2,204.62	3.75	1.00	3.75
CH_4	0.47	2,204.62	0.00	21.00	0.00
N_2O	0.21	2,204.62	0.00	310.00	0.03
TOTAL metrics tons of CO2 Eq:					3.78

TOTAL 126.49 MTCO2E per year

	CO2 Eq
Construction Equipment	2,173.17
On-Road Diesel	235.22
Worker Commute	55.04
TOTAL	2,463.43
Averaged over 30 Years:	82.11

									Total Emissions pounds		
									CO2	CH4	N2O
Phase	**Equipment**	**Amount**	**Hours per Day**	**Duration (days)**	**Fuel Consumption Rate (gal/hr)**	**Fuel Consumption (gal/day)**	**Total Fuel Consumption**	**Emission Factor (lb/gal):**	**22.37**	**0.00128**	**0.00057**
Mass Site Grading	Excavator	1	8	55	14	112	6160		137799.2	7.8848	3.5112
	Grader	1	8	55	14	112	6160		137,799.20	7.88	3.51
	Rubber Tired Dozer	1	8	55	14	112	6160		137,799.20	7.88	3.51
	Scrapers	2	8	55	14	224	12320		275,598.40	15.77	7.02
	Tractor/Loader/Backhoe	3	8	55	14	336	18480		413,397.60	23.65	10.53
	Water Truck	1	8	55	14	112	6160		137,799.20	7.88	3.51
								PHASE TOTAL:	1,102,393.60	63.08	28.09
Fine Site Grading	Excavator	1	8	25							
	Grader	1	8	25	14	112	2800		62,636.00	3.58	1.60
	Rubber Tired Dozer	1	8	25	14	112	2800		62,636.00	3.58	1.60
	Scrapers	2	8	25	14	224	5600		125,272.00	7.17	3.19
	Tractor/Loader/Backhoe	3	8	25	14	336	8400		187,908.00	10.75	4.79
	Water Truck	1	8	25	14	112	2800		62,636.00	3.58	1.60
								PHASE TOTAL:	501,088.00	28.67	12.77
Trenching	Excavators	2	8	10	14	224	2240		50,108.80	2.87	1.28
	Other General Industrial Equipment	1	8	10	14	112	1120		25,054.40	1.43	0.64
	Tractor/Loader/Backhoe	1	8	10	14	112	1120		25,054.40	1.43	0.64
								PHASE TOTAL:	100,217.60	5.73	2.55
Paving	Paver	1	8	10	14	112	1120		25,054.40	1.43	0.64
	Paving Equipment	2	8		14	224	0		0.00	0.00	0.00
	Roller	2	6	10	14	168	1680		37,581.60	2.15	0.96
								PHASE TOTAL:	62,636.00	3.58	1.60
Building Construction	Crane	1	7	140	14	98	13720		306,916.40	17.56	7.82
	Forlifts	3	8	140	14	336	47040		1,052,284.80	60.21	26.81
	Generator Sets	1	8	140	14	112	15680		350,761.60	20.07	8.94
	Tractor/Loader/Backhoe	3	7	140	14	294	41160		920,749.20	52.68	23.46
	Welders	1	8	140	14	112	15680		350,761.60	20.07	8.94
								PHASE TOTAL:	2,981,473.60	170.60	75.97
								GRAND TOTAL (pounds):	4,747,808.80	271.67	120.98
								Pounds per Metric Ton:	2,204.62	2,204.62	2,204.62
								Metric Tons:	2,153.57	0.12	0.05
								GWP:	1.00	21.00	310.00
								CO2 Eq:	2,153.57	2.59	17.01

TOTAL
2,173.17 **metric tons CO2 Eq**

72.43903892 **metric tons CO2 over 30 years**

ON-ROAD DIESEL EMISSIONS CALCULATIONS

Parameters

Average Fuel Economy:	6.06	miles per gallon (mpg)	
Acres to be Paved:	25.70	acres	
Square yards to be Paved:	124,439.40	square yards	
Asphalt Thickness:	3.00	inches	
Asphalt Thickness:	0.08	yards	
Amount of Asphalt Required:	10,369.95	cubic yds	
Truck Capacity:	20.00	cubic yds	
Asphalt Trips:	518.50	trips	
Average Trip Length:	20.00	miles	
Total Asphalt VMT:	10,369.95	miles	
Building Vendor Round Trips per Day:	46.00	trips	0.11 trips per unit
Average Trip Length:	20.00	miles	
Building VMT per Day:	920.00	miles	
Length of Building Phase:	140.00	days	
Total Building VMT:	128,800.00	miles	
TOTAL ON-ROAD DIESEL VMT:	139,169.95	miles	
Gallons of Fuel:	22,972.92	gallons	

Vehicle Emission Factors (pounds/gallon)

CO2	22.37000
CH4	0.00128
N2O	0.00057

On-Road Diesel Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	513,904.22	2,204.62	233.10	1.00	233.10
CH4	29.41	2,204.62	0.01	21.00	0.28
N2O	13.09	2,204.62	0.01	310.00	1.84
TOTAL metrics tons of CO2 Eq:					235.22

VEHICLE EMISSIONS CALCULATIONS

Parameters

Average Fuel Economy:	18.80	miles per gallon (mpg)	
Round Trip Length:	40.00	miles	
Mass Grading Worker Trips:	619.00	trips	1.25 workers/equipment*days
Fine Grading Worker Trips:	282.00	trips	1.25 workers/equipment*days
Trenching Worker Trips:	50.00	trips	1.25 workers/equipment*days
Paving Worker Trips:	63.00	trips	1.25 workers/equipment*days
Building Worker Trips:	1,575.00	trips	1.25 workers/equipment*days
Coatings Worker Trips:	315.00	trips	20% building construction trips
TOTAL Trips:	2,904.00	trips	
TOTAL VMT:	116,160.00	miles	
Worker Gallons of Fuel:	6,178.72	gallons	

Vehicle Emission Factors (pounds/gallon)

CO2	19.56400
CH4	0.00055
N2O	0.00020

Vehicle Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	120,880.54	2,204.62	54.83	1.00	54.83
CH4	3.40	2,204.62	0.00	21.00	0.03
N2O	1.24	2,204.62	0.00	310.00	0.17
TOTAL metrics tons of CO2 Eq:					55.04

ATTACHMENT 3

GHG Emissions Calculations—Unmitigated and Mitigated Project

MITIGATED PROJECT - 2020

Emission Source	CO2	N20	CH4	Total CO2 Eq Emissions (metric tons/year)
Vehicular Emissions	1,672.31	5.30	0.99	1,678.60
Electricity Usage Emissions	838.77	3.73	0.15	842.64
Natural Gas Usage Emissions	992.89	5.64	0.40	998.93
Water Usage Emissions	223.34	0.99	0.04	224.37
Solid Waste Emissions				126.49
Construction Emissions				82.11
Total CO2 Eq Emissions				**3,953.14**

Unmitigated Project	5,088.17
Mitigated Project	3,953.14
Percent Reduction	22.3%

VEHICLE EMISSIONS CALCULATIONS

Parameters

Average Fuel Economy:	18.80	miles per gallon (mpg)
Average Daily Traffic (ADT):	4,450.00	trips
Average Trip Length:	5.80	miles
VMT per Day:	25,810.00	miles
VMT per Year:	6,729,035.71	miles
Total Gallons of Fuel:	357,927.43	gallons

Vehicle Emission Factors (pounds/gallon)

CO2	19.56400
CH4	0.00055
N2O	0.00020

Vehicle Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	7,002,492.27	2,204.62	3,176.28	1.00	3,176.28
CH4	196.86	2,204.62	0.09	21.00	1.88
N2O	71.59	2,204.62	0.03	310.00	10.07
TOTAL metrics tons of CO2 Eq per Year:					3,188.22

REDUCTIONS

Pavley I	Reduce emissions across passenger fleet by 32.6 percent (26.1 MMTCO2E/80 MMTCO2E * 100)
Pavley II	Reduce emissions across passenger fleet by 4.75 percent (3.8 MMTCO2E/80 MMTCO2E * 100)
LCFS	Reduce emissions across passenger fleet by 10 percent

Reduced Vehicle Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	3,686,812.18	2,204.62	1,672.31	1.00	1,672.31
CH4	103.65	2,204.62	0.05	21.00	0.99
N2O	37.69	2,204.62	0.02	310.00	5.30
TOTAL metrics tons of CO2 Eq per Year:					1,678.60

ELECTRICITY EMISSIONS CALCULATIONS

MITIGATED PROJECT - 2005 TITLE 24

Average Monthly Consumption:	587.00	kWh per consumer per month
Annual Consumption:	7,044.00	kWh per consumer per year
Number of Units:	430.00	units
Total kWh:	3,028,920.00	kWh
Total MWh:	3,028.92	MWh

Electricity Generation Emission Factors (pounds/MWh)

CO2	1,340.0000
CH4	0.0111
N2O	0.0192

Emissions	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	4,058,752.80	2,204.62	1,841.02	1.00	1,841.02
CH4	33.62	2,204.62	0.02	21.00	0.32
N2O	58.16	2,204.62	0.03	310.00	8.18
TOTAL metrics tons of CO2 Eq per Year:					1,849.52

MITIGATED PROJECT - 2008 TITLE 24

Average Monthly Consumption:	587.00	kWh per consumer per month
Annual Consumption:	7,044.00	kWh per consumer per year
Total Square Feet:	430.00	square feet
Total kWh:	3,028,920.00	kWh
Total MWh:	3,028.92	MWh
Improved Efficiency over 2005 Title 24 (15%):	2,574.58	MWh
Renewables Portfolio Standard (20%):	2,059.67	MWh

Electricity Generation Emission Factors (pounds/MWh)

CO2	1,340.0000
CH4	0.0111
N2O	0.0192

Emissions	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	2,759,951.90	2,204.62	1,251.89	1.00	1,251.89
CH4	22.86	2,204.62	0.01	21.00	0.22
N2O	39.55	2,204.62	0.02	310.00	5.56
TOTAL metrics tons of CO2 Eq per Year:					1,257.67

NATURAL GAS EMISSIONS CALCULATIONS

MITIGATED PROJECT - 2005 TITLE 24

Consumption per Unit per Year:	62,384.40	cubic feet per year
Number of Units:	430.00	units
Total Consumption (cubic feet):	26,825,292.00	cubic feet per year
Total Consumption (million cubic feet):	26.83	million cubic feet per year

Natural Gas Combustion Emission Factors (pounds/million cubic feet)

CO_2	120,000.0
CH_4	2.3
N_2O	2.2

Emissions	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	3,219,035.04	2,204.62	1,460.13	1.00	1,460.13
CH4	61.70	2,204.62	0.03	21.00	0.59
N2O	59.02	2,204.62	0.03	310.00	8.30
TOTAL metrics tons of CO2 Eq per Year:					1,469.02

MITIGATED PROJECT - 2008 TITLE 24

Consumption per Unit per Year:	62,384.40	cubic feet per year
Number of Units:	430.00	units
Total Consumption (cubic feet):	26,825,292.00	cubic feet per year
Total Consumption (million cubic feet):	26.83	million cubic feet per year
Improved Efficiency over 2005 Title 24 (15%):	22.80	million cubic feet per year

Natural Gas Combustion Emission Factors (pounds/million cubic feet)

CO_2	120,000.0
CH_4	2.3
N_2O	2.2

Emissions	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	2,736,179.78	2,204.62	1,241.11	1.00	1,241.11
CH4	52.44	2,204.62	0.02	21.00	0.50
N2O	50.16	2,204.62	0.02	310.00	7.05
TOTAL metrics tons of CO2 Eq per Year:					1,248.66

WATER EMISSIONS CALCULATIONS

MITIGATED PROJECT - 2005 TITLE 24

Average Monthly Consumption:	10,472.00	gallons per household per month
Annual Consumption:	125,664.00	gallons per household per year
Number of Units:	430.00	units
Total Water Use:	54,035,520.00	gallons per year
Embodied Energy:	0.0085	kWh per gallon
Total Water Energy Use (kWh):	459,301.92	kWh
Total Water Energy Use (MWh):	459.30	MWh

Electricity Generation Emission Factors (pounds/MWh)

CO2	1,340.0000
CH4	0.0111
N2O	0.0192

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	615,464.57	2,204.62	279.17	1.00	279.17
CH4	5.10	2,204.62	0.00	21.00	0.05
N2O	8.82	2,204.62	0.00	310.00	1.24
TOTAL metrics tons of CO2 Eq per Year:					280.46

MITIGATED PROJECT - 2008 TITLE 24

Average Monthly Consumption:	10,472.00	gallons per household per month
Annual Consumption:	125,664.00	gallons per household per year
Number of Units:	430.00	units
Total Water Use:	54,035,520.00	gallons per year
Reduce Water Use by 20%:	43,228,416.00	gallons per year
Embodied Energy:	0.0085	kWh per gallon
Total Water Energy Use (kWh):	367,441.54	kWh
Total Water Energy Use (MWh):	367.44	MWh

Electricity Generation Emission Factors (pounds/MWh)

CO2	1,340.0000
CH4	0.0111
N2O	0.0192

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	492,371.66	2,204.62	223.34	1.00	223.34
CH4	4.08	2,204.62	0.00	21.00	0.04
N2O	7.05	2,204.62	0.00	310.00	0.99
TOTAL metrics tons of CO2 Eq per Year:					224.37

SOLID WASTE EMISSIONS CALCULATIONS

Tons Generated per Day:	11.400	pounds per unit per day
Tons Generated per Year:	4,161.000	pounds per unit per year
Number of Units:	430.00	units
Total Pounds Generated per Year:	1,789,230.00	pounds per year
Total Tons Generated per Year:	894.62	tons per year

Material	WARM Input Catergory	Percent Generated	Percent Recovered	Percent Landfilled
Paper	Mixed Paper (General)	31.0%	55.5%	44.5%
Glass	Glass	4.9%	23.1%	76.9%
Metals	Mixed Metals	8.4%	34.6%	65.4%
Plastics	Mixed Plastics	12.0%	7.1%	92.9%
Rubber and Leather	Mixed MSW	3.0%	0.0%	100.0%
Textiles	Mixed MSW	5.0%	0.0%	100.0%
Wood	Dimensional Lumber	6.6%	9.6%	90.4%
Other	Mixed MSW	1.7%	0.0%	100.0%
Food Scraps	Food Scraps	13%	2.5%	97.5%
Yard Trimming	Yard Trimmings	13.2%	64.7%	35.3%
Miscellaneous Inorganic Waste	Mixed MSW	1.5%	0.0%	100.0%
TOTAL		100.0%		

Material	WARM Input Catergory	Tons Generated	Tons Recovered	Tons Landfilled
Paper	Mixed Paper (General)	277.3	153.9	123.4
Glass	Glass	43.8	10.1	33.7
Metals	Mixed Metals	75.1	26.0	
Plastics	Mixed Plastics	107.4	7.6	99.7
Rubber and Leather	Mixed MSW	26.8	0.0	26.8
Textiles	Mixed MSW	44.7	0.0	44.7
Wood	Dimensional Lumber	59.0	5.7	53.4
Other	Mixed MSW	15.2	0.0	15.2
Food Scraps	Food Scraps	113.6	2.8	110.8
Yard Trimming	Yard Trimmings	118.1	76.4	41.7
Miscellaneous Inorganic Waste	Mixed MSW	13.4	0.0	13.4
TOTAL		895	283	563

Material	**Landfilling, Energy Recovery MTCO2E/Ton**	**Tons Landfilled**	**MTCO2E**
Glass	0.04	33.7	1.348399513
Dimensional Lumber	-0.49	53.4	-26.15439159
Food Scraps	0.72	110.8	79.75850571
Yard Trimmings	-0.22	41.7	-9.170805719
Mixed Paper (primarily residential)	0.25	123.4	30.85303481
Mixed Metals	0.04	0.0	0
Mixed Plastics	0.04	99.7	3.989267208
Mixed MSW	0.42	100.2	42.0826896
TOTAL			122.7066995

Average Fuel Economy:	6.06	miles per gallon (mpg)
Total Trips:	112.00	trips
Trip Length:	20.00	miles
Total VMT:	2,240.00	miles
Gallons of Fuel:	369.64	gallons

Vehicle Emission Factors (pounds/gallon)

CO2	22.37000
CH4	0.00128
N2O	0.00057

On-Road Diesel Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	8,268.78	2,204.62	3.75	1.00	3.75
CH4	0.47	2,204.62	0.00	21.00	0.00
N2O	0.21	2,204.62	0.00	310.00	0.03
TOTAL metrics tons of CO2 Eq:					3.78

TOTAL 126.49 MTCO2E per year

	CO2 Eq
Construction Equipment	2,173.17
On-Road Diesel	235.22
Worker Commute	55.04
TOTAL	2,463.43
Averaged over 30 Years:	82.11

									Total Emissions pounds		
									CO2	CH4	N2O
Phase	**Equipment**	**Amount**	**Hours per Day**	**Duration (days)**	**Fuel Consumption Rate (gal/hr)**	**Fuel Consumption (gal/day)**	**Total Fuel Consumption**	**Emission Factor (lb/gal):**	**22.37**	**0.00128**	**0.00057**
Mass Site Grading	Excavator	1	8	55	14	112	6160		137799.2	7.8848	3.5112
	Grader	1	8	55	14	112	6160		137,799.20	7.88	3.51
	Rubber Tired Dozer	1	8	55	14	112	6160		137,799.20	7.88	3.51
	Scrapers	2	8	55	14	224	12320		275,598.40	15.77	7.02
	Tractor/Loader/Backhoe	3	8	55	14	336	18480		413,397.60	23.65	10.53
	Water Truck	1	8	55	14	112	6160		137,799.20	7.88	3.51
								PHASE TOTAL:	1,102,393.60	63.08	28.09
Fine Site Grading	Excavator	1	8	25							
	Grader	1	8	25	14	112	2800		62,636.00	3.58	1.60
	Rubber Tired Dozer	1	8	25	14	112	2800		62,636.00	3.58	1.60
	Scrapers	2	8	25	14	224	5600		125,272.00	7.17	3.19
	Tractor/Loader/Backhoe	3	8	25	14	336	8400		187,908.00	10.75	4.79
	Water Truck	1	8	25	14	112	2800		62,636.00	3.58	1.60
								PHASE TOTAL:	501,088.00	28.67	12.77
Trenching	Excavators	2	8	10	14	224	2240		50,108.80	2.87	1.28
	Other General Industrial Equipment	1	8	10	14	112	1120		25,054.40	1.43	0.64
	Tractor/Loader/Backhoe	1	8	10	14	112	1120		25,054.40	1.43	0.64
								PHASE TOTAL:	100,217.60	5.73	2.55
Paving	Paver	1	8	10	14	112	1120		25,054.40	1.43	0.64
	Paving Equipment	2	8		14	224	0		0.00	0.00	0.00
	Roller	2	6	10	14	168	1680		37,581.60	2.15	0.96
								PHASE TOTAL:	62,636.00	3.58	1.60
Building Construction	Crane	1	7	140	14	98	13720		306,916.40	17.56	7.82
	Forlifts	3	8	140	14	336	47040		1,052,284.80	60.21	26.81
	Generator Sets	1	8	140	14	112	15680		350,761.60	20.07	8.94
	Tractor/Loader/Backhoe	3	7	140	14	294	41160		920,749.20	52.68	23.46
	Welders	1	8	140	14	112	15680		350,761.60	20.07	8.94
								PHASE TOTAL:	2,981,473.60	170.60	75.97
								GRAND TOTAL (pounds):	4,747,808.80	271.67	120.98
								Pounds per Metric Ton:	2,204.62	2,204.62	2,204.62
								Metric Tons:	2,153.57	0.12	0.05
								GWP:	1.00	21.00	310.00
								CO2 Eq:	2,153.57	2.59	17.01
								TOTAL			
								2,173.17	**metric tons CO2 Eq**		
								72.43903892	**metric tons CO2 over 30 years**		

ON-ROAD DIESEL EMISSIONS CALCULATIONS

Parameters

Average Fuel Economy:	6.06	miles per gallon (mpg)	
Acres to be Paved:	25.70	acres	
Square yards to be Paved:	124,439.40	square yards	
Asphalt Thickness:	3.00	inches	
Asphalt Thickness:	0.08	yards	
Amount of Asphalt Required:	10,369.95	cubic yds	
Truck Capacity:	20.00	cubic yds	
Asphalt Trips:	518.50	trips	
Average Trip Length:	20.00	miles	
Total Asphalt VMT:	10,369.95	miles	
Building Vendor Round Trips per Day:	46.00	trips	0.11 trips per unit
Average Trip Length:	20.00	miles	
Building VMT per Day:	920.00	miles	
Length of Building Phase:	140.00	days	
Total Building VMT:	128,800.00	miles	
TOTAL ON-ROAD DIESEL VMT:	139,169.95	miles	
Gallons of Fuel:	22,972.92	gallons	

Vehicle Emission Factors (pounds/gallon)

CO2	22.37000
CH4	0.00128
N2O	0.00057

On-Road Diesel Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	513,904.22	2,204.62	233.10	1.00	233.10
CH4	29.41	2,204.62	0.01	21.00	0.28
N2O	13.09	2,204.62	0.01	310.00	1.84
TOTAL metrics tons of CO2 Eq:					235.22

VEHICLE EMISSIONS CALCULATIONS

Parameters

Average Fuel Economy:	18.80	miles per gallon (mpg)	
Round Trip Length:	40.00	miles	
Mass Grading Worker Trips:	619.00	trips	1.25 workers/equipment*days
Fine Grading Worker Trips:	282.00	trips	1.25 workers/equipment*days
Trenching Worker Trips:	50.00	trips	1.25 workers/equipment*days
Paving Worker Trips:	63.00	trips	1.25 workers/equipment*days
Building Worker Trips:	1,575.00	trips	1.25 workers/equipment*days
Coatings Worker Trips:	315.00	trips	20% building construction trips
TOTAL Trips:	2,904.00	trips	
TOTAL VMT:	116,160.00	miles	
Worker Gallons of Fuel:	6,178.72	gallons	

Vehicle Emission Factors (pounds/gallon)

CO2	19.56400
CH4	0.00055
N2O	0.00020

Vehicle Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	120,880.54	2,204.62	54.83	1.00	54.83
CH4	3.40	2,204.62	0.00	21.00	0.03
N2O	1.24	2,204.62	0.00	310.00	0.17
TOTAL metrics tons of CO2 Eq:					55.04

UNMITIGATED PROJECT - 2020

Emission Source	CO2	N20	CH4	Total CO2 Eq Emissions (metric tons/year)
Vehicular Emissions	2,140.81	6.78	1.26	2,148.86
Electricity Usage Emissions	1,251.89	5.56	0.22	1,257.67
Natural Gas Usage Emissions	1,241.11	7.05	0.50	1,248.66
Water Usage Emissions	223.34	0.99	0.04	224.37
Solid Waste Emissions				126.49
Construction Emissions				82.11
Total CO2 Eq Emissions				**5,088.17**

VEHICLE EMISSIONS CALCULATIONS

Parameters

Average Fuel Economy:	18.80	miles per gallon (mpg)
Average Daily Traffic (ADT):	4,450.00	trips
Average Trip Length:	5.80	miles
VMT per Day:	25,810.00	miles
VMT per Year:	6,729,035.71	miles
Total Gallons of Fuel:	357,927.43	gallons

Vehicle Emission Factors (pounds/gallon)

CO2	19.56400
CH4	0.00055
N2O	0.00020

Vehicle Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	7,002,492.27	2,204.62	3,176.28	1.00	3,176.28
CH4	196.86	2,204.62	0.09	21.00	1.88
N2O	71.59	2,204.62	0.03	310.00	10.07
TOTAL metrics tons of CO2 Eq per Year:					3,188.22

REDUCTIONS

Pavley I — Reduce emissions across passenger fleet by 32.6 percent (26.1 MMTCO2E/80 MMTCO2E * 100)

Reduced Vehicle Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	4,719,679.79	2,204.62	2,140.81	1.00	2,140.81
CH4	132.68	2,204.62	0.06	21.00	1.26
N2O	48.25	2,204.62	0.02	310.00	6.78
TOTAL metrics tons of CO2 Eq per Year:					2,148.86

ELECTRICITY EMISSIONS CALCULATIONS

UNMITIGATED PROJECT - 2005 TITLE 24

Average Monthly Consumption:	587.00	kWh per consumer per month
Annual Consumption:	7,044.00	kWh per consumer per year
Number of Units:	430.00	units
Total kWh:	3,028,920.00	kWh
Total MWh:	3,028.92	MWh

Electricity Generation Emission Factors (pounds/MWh)

CO2	1,340.0000
CH4	0.0111
N2O	0.0192

Emissions	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	4,058,752.80	2,204.62	1,841.02	1.00	1,841.02
CH4	33.62	2,204.62	0.02	21.00	0.32
N2O	58.16	2,204.62	0.03	310.00	8.18
TOTAL metrics tons of CO2 Eq per Year:					1,849.52

UNMITIGATED PROJECT - 2008 TITLE 24

Average Monthly Consumption:	587.00	kWh per consumer per month
Annual Consumption:	7,044.00	kWh per consumer per year
Total Square Feet:	430.00	square feet
Total kWh:	3,028,920.00	kWh
Total MWh:	3,028.92	MWh
Improved Efficiency over 2005 Title 24 (15%):	2,574.58	MWh
Renewables Portfolio Standard (20%):	2,059.67	MWh

Electricity Generation Emission Factors (pounds/MWh)

CO2	1,340.0000
CH4	0.0111
N2O	0.0192

Emissions	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	2,759,951.90	2,204.62	1,251.89	1.00	1,251.89
CH4	22.86	2,204.62	0.01	21.00	0.22
N2O	39.55	2,204.62	0.02	310.00	5.56
TOTAL metrics tons of CO2 Eq per Year:					1,257.67

NATURAL GAS EMISSIONS CALCULATIONS

UNMITIGATED PROJECT - 2005 TITLE 24

Consumption per Unit per Year:	62,384.40	cubic feet per year
Number of Units:	430.00	units
Total Consumption (cubic feet):	26,825,292.00	cubic feet per year
Total Consumption (million cubic feet):	26.83	million cubic feet per year

Natural Gas Combustion Emission Factors (pounds/million cubic feet)

CO_2	120,000.0
CH_4	2.3
N_2O	2.2

Emissions	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO_2	3,219,035.04	2,204.62	1,460.13	1.00	1,460.13
CH_4	61.70	2,204.62	0.03	21.00	0.59
N_2O	59.02	2,204.62	0.03	310.00	8.30
TOTAL metrics tons of CO2 Eq per Year:					1,469.02

UNMITIGATED PROJECT - 2008 TITLE 24

Consumption per Unit per Year:	62,384.40	cubic feet per year
Number of Units:	430.00	units
Total Consumption (cubic feet):	26,825,292.00	cubic feet per year
Total Consumption (million cubic feet):	26.83	million cubic feet per year
Improved Efficiency over 2005 Title 24 (15%):	22.80	million cubic feet per year

Natural Gas Combustion Emission Factors (pounds/million cubic feet)

CO_2	120,000.0
CH_4	2.3
N_2O	2.2

Emissions	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO_2	2,736,179.78	2,204.62	1,241.11	1.00	1,241.11
CH_4	52.44	2,204.62	0.02	21.00	0.50
N_2O	50.16	2,204.62	0.02	310.00	7.05
TOTAL metrics tons of CO2 Eq per Year:					1,248.66

WATER EMISSIONS CALCULATIONS

UNMITIGATED PROJECT - 2005 TITLE 24

Average Monthly Consumption:	10,472.00	gallons per household per month
Annual Consumption:	125,664.00	gallons per household per year
Number of Units:	430.00	units
Total Water Use:	54,035,520.00	gallons per year
Embodied Energy:	0.0085	kWh per gallon
Total Water Energy Use (kWh):	459,301.92	kWh
Total Water Energy Use (MWh):	459.30	MWh

Electricity Generation Emission Factors (pounds/MWh)

CO2	1,340.0000
CH4	0.0111
N2O	0.0192

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	615,464.57	2,204.62	279.17	1.00	279.17
CH4	5.10	2,204.62	0.00	21.00	0.05
N2O	8.82	2,204.62	0.00	310.00	1.24
TOTAL metrics tons of CO2 Eq per Year:					280.46

UNMITIGATED PROJECT - 2008 TITLE 24

Average Monthly Consumption:	10,472.00	gallons per household per month
Annual Consumption:	125,664.00	gallons per household per year
Number of Units:	430.00	units
Total Water Use:	54,035,520.00	gallons per year
Reduce Water Use by 20%:	43,228,416.00	gallons per year
Embodied Energy:	0.0085	kWh per gallon
Total Water Energy Use (kWh):	367,441.54	kWh
Total Water Energy Use (MWh):	367.44	MWh

Electricity Generation Emission Factors (pounds/MWh)

CO2	1,340.0000
CH4	0.0111
N2O	0.0192

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	492,371.66	2,204.62	223.34	1.00	223.34
CH4	4.08	2,204.62	0.00	21.00	0.04
N2O	7.05	2,204.62	0.00	310.00	0.99
TOTAL metrics tons of CO2 Eq per Year:					224.37

SOLID WASTE EMISSIONS CALCULATIONS

Tons Generated per Day:	11.400	pounds per unit per day
Tons Generated per Year:	4,161.000	pounds per unit per year
Number of Units:	430.00	units
Total Pounds Generated per Year:	1,789,230.00	pounds per year
Total Tons Generated per Year:	894.62	tons per year

Material	WARM Input Catergory	Percent Generated	Percent Recovered	Percent Landfilled
Paper	Mixed Paper (General)	31.0%	55.5%	44.5%
Glass	Glass	4.9%	23.1%	76.9%
Metals	Mixed Metals	8.4%	34.6%	65.4%
Plastics	Mixed Plastics	12.0%	7.1%	92.9%
Rubber and Leather	Mixed MSW	3.0%	0.0%	100.0%
Textiles	Mixed MSW	5.0%	0.0%	100.0%
Wood	Dimensional Lumber	6.6%	9.6%	90.4%
Other	Mixed MSW	1.7%	0.0%	100.0%
Food Scraps	Food Scraps	13%	2.5%	97.5%
Yard Trimming	Yard Trimmings	13.2%	64.7%	35.3%
Miscellaneous Inorganic Waste	Mixed MSW	1.5%	0.0%	100.0%
TOTAL		100.0%		

Material	WARM Input Catergory	Tons Generated	Tons Recovered	Tons Landfilled
Paper	Mixed Paper (General)	277.3	153.9	123.4
Glass	Glass	43.8	10.1	33.7
Metals	Mixed Metals	75.1	26.0	
Plastics	Mixed Plastics	107.4	7.6	99.7
Rubber and Leather	Mixed MSW	26.8	0.0	26.8
Textiles	Mixed MSW	44.7	0.0	44.7
Wood	Dimensional Lumber	59.0	5.7	53.4
Other	Mixed MSW	15.2	0.0	15.2
Food Scraps	Food Scraps	113.6	2.8	110.8
Yard Trimming	Yard Trimmings	118.1	76.4	41.7
Miscellaneous Inorganic Waste	Mixed MSW	13.4	0.0	13.4
TOTAL		895	283	563

Material	**Landfilling, Energy Recovery MTCO2E/Ton**	**Tons Landfilled**	**MTCO2E**
Glass	0.04	33.7	1.348399513
Dimensional Lumber	-0.49	53.4	-26.15439159
Food Scraps	0.72	110.8	79.75850571
Yard Trimmings	-0.22	41.7	-9.170805719
Mixed Paper (primarily residential)	0.25	123.4	30.85303481
Mixed Metals	0.04	0.0	0
Mixed Plastics	0.04	99.7	3.989267208
Mixed MSW	0.42	100.2	42.0826896
TOTAL			122.7066995

Average Fuel Economy:	6.06	miles per gallon (mpg)
Total Trips:	112.00	trips
Trip Length:	20.00	miles
Total VMT:	2,240.00	miles
Gallons of Fuel:	369.64	gallons

Vehicle Emission Factors (pounds/gallon)

CO2	22.37000
CH4	0.00128
N2O	0.00057

On-Road Diesel Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	8,268.78	2,204.62	3.75	1.00	3.75
CH4	0.47	2,204.62	0.00	21.00	0.00
N2O	0.21	2,204.62	0.00	310.00	0.03
TOTAL metrics tons of CO2 Eq:					3.78

TOTAL 126.49 MTCO2E per year

	CO2 Eq
Construction Equipment	2,173.17
On-Road Diesel	235.22
Worker Commute	55.04
TOTAL	2,463.43
Averaged over 30 Years:	82.11

									Total Emissions pounds		
									CO2	CH4	N2O
Phase	**Equipment**	**Amount**	**Hours per Day**	**Duration (days)**	**Fuel Consumption Rate (gal/hr)**	**Fuel Consumption (gal/day)**	**Total Fuel Consumption**	**Emission Factor (lb/gal):**	**22.37**	**0.00128**	**0.00057**
Mass Site Grading	Excavator	1	8	55	14	112	6160		137799.2	7.8848	3.5112
	Grader	1	8	55	14	112	6160		137,799.20	7.88	3.51
	Rubber Tired Dozer	1	8	55	14	112	6160		137,799.20	7.88	3.51
	Scrapers	2	8	55	14	224	12320		275,598.40	15.77	7.02
	Tractor/Loader/Backhoe	3	8	55	14	336	18480		413,397.60	23.65	10.53
	Water Truck	1	8	55	14	112	6160		137,799.20	7.88	3.51
								PHASE TOTAL:	1,102,393.60	63.08	28.09
Fine Site Grading	Excavator	1	8	25							
	Grader	1	8	25	14	112	2800		62,636.00	3.58	1.60
	Rubber Tired Dozer	1	8	25	14	112	2800		62,636.00	3.58	1.60
	Scrapers	2	8	25	14	224	5600		125,272.00	7.17	3.19
	Tractor/Loader/Backhoe	3	8	25	14	336	8400		187,908.00	10.75	4.79
	Water Truck	1	8	25	14	112	2800		62,636.00	3.58	1.60
								PHASE TOTAL:	501,088.00	28.67	12.77
Trenching	Excavators	2	8	10	14	224	2240		50,108.80	2.87	1.28
	Other General Industrial Equipment	1	8	10	14	112	1120		25,054.40	1.43	0.64
	Tractor/Loader/Backhoe	1	8	10	14	112	1120		25,054.40	1.43	0.64
								PHASE TOTAL:	100,217.60	5.73	2.55
Paving	Paver	1	8	10	14	112	1120		25,054.40	1.43	0.64
	Paving Equipment	2	8		14	224	0		0.00	0.00	0.00
	Roller	2	6	10	14	168	1680		37,581.60	2.15	0.96
								PHASE TOTAL:	62,636.00	3.58	1.60
Building Construction	Crane	1	7	140	14	98	13720		306,916.40	17.56	7.82
	Forlifts	3	8	140	14	336	47040		1,052,284.80	60.21	26.81
	Generator Sets	1	8	140	14	112	15680		350,761.60	20.07	8.94
	Tractor/Loader/Backhoe	3	7	140	14	294	41160		920,749.20	52.68	23.46
	Welders	1	8	140	14	112	15680		350,761.60	20.07	8.94
								PHASE TOTAL:	2,981,473.60	170.60	75.97
								GRAND TOTAL (pounds):	4,747,808.80	271.67	120.98
								Pounds per Metric Ton:	2,204.62	2,204.62	2,204.62
								Metric Tons:	2,153.57	0.12	0.05
								GWP:	1.00	21.00	310.00
								CO2 Eq:	2,153.57	2.59	17.01

TOTAL
2,173.17 **metric tons CO2 Eq**

72.43903892 **metric tons CO2 over 30 years**

ON-ROAD DIESEL EMISSIONS CALCULATIONS

Parameters

Average Fuel Economy:	6.06	miles per gallon (mpg)	
Acres to be Paved:	25.70	acres	
Square yards to be Paved:	124,439.40	square yards	
Asphalt Thickness:	3.00	inches	
Asphalt Thickness:	0.08	yards	
Amount of Asphalt Required:	10,369.95	cubic yds	
Truck Capacity:	20.00	cubic yds	
Asphalt Trips:	518.50	trips	
Average Trip Length:	20.00	miles	
Total Asphalt VMT:	10,369.95	miles	
Building Vendor Round Trips per Day:	46.00	trips	0.11 trips per unit
Average Trip Length:	20.00	miles	
Building VMT per Day:	920.00	miles	
Length of Building Phase:	140.00	days	
Total Building VMT:	128,800.00	miles	
TOTAL ON-ROAD DIESEL VMT:	139,169.95	miles	
Gallons of Fuel:	22,972.92	gallons	

Vehicle Emission Factors (pounds/gallon)

CO2	22.37000
CH4	0.00128
N2O	0.00057

On-Road Diesel Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	513,904.22	2,204.62	233.10	1.00	233.10
CH4	29.41	2,204.62	0.01	21.00	0.28
N2O	13.09	2,204.62	0.01	310.00	1.84
TOTAL metrics tons of CO2 Eq:					235.22

VEHICLE EMISSIONS CALCULATIONS

Parameters

Average Fuel Economy:	18.80 miles per gallon (mpg)	
Round Trip Length:	40.00 miles	
Mass Grading Worker Trips:	619.00 trips	1.25 workers/equipment*days
Fine Grading Worker Trips:	282.00 trips	1.25 workers/equipment*days
Trenching Worker Trips:	50.00 trips	1.25 workers/equipment*days
Paving Worker Trips:	63.00 trips	1.25 workers/equipment*days
Building Worker Trips:	1,575.00 trips	1.25 workers/equipment*days
Coatings Worker Trips:	315.00 trips	20% building construction trips
TOTAL Trips:	2,904.00 trips	
TOTAL VMT:	116,160.00 miles	
Worker Gallons of Fuel:	6,178.72 gallons	

Vehicle Emission Factors (pounds/gallon)

CO2	19.56400
CH4	0.00055
N2O	0.00020

Vehicle Emissions

	Pounds	Pounds per Metric Ton	Metric Tons	GWP	CO2 Eq
CO2	120,880.54	2,204.62	54.83	1.00	54.83
CH4	3.40	2,204.62	0.00	21.00	0.03
N2O	1.24	2,204.62	0.00	310.00	0.17
TOTAL metrics tons of CO2 Eq:					55.04