4.15 GREENHOUSE GAS EMISSIONS

This chapter discusses greenhouse gas (GHG) emissions in Butte County and evaluates the potential GHG emission impacts associated with General Plan 2030 and the Airport Land Use Compatibility Plan (ALUCP) override. This chapter is based on both a quantitative and spatial analysis, and assesses GHG levels that would result from the proposed project and impacts of projected climate change on Butte County.

A. Regulatory Framework

This section discusses the federal, State, and local policies and regulations that are relevant to the analysis of climate change in Butte County.

1. Federal Legislation and Policy

There is currently no federal overarching law or policy related to climate change or regulation of GHGs. However, recent activity suggests that regulation may be forthcoming, with the US Environmental Protection Agency (EPA) serving in a leadership role to implement such a program. However, EPA regulation may be pre-empted by congressional action should a cap and trade bill be passed prior to adoption of EPA regulation.

This section summarizes recent legal cases, legislation and policy related to climate change and GHG regulation.

a. Massachusetts et al. v. US Environmental Protection Agency (2007)

Twelve US states and cities including California, in conjunction with several environmental organizations, sued to force the EPA to regulate GHGs as a pollutant pursuant to the Clean Air Act (CAA) in *Massachusetts et al. v. Environmental Protection Agency 549 US 497* (2007). The court ruled that the plaintiffs had standing to sue, GHGs fit within the CAA's definition of a pollutant, and the EPA's reasons for not regulating GHGs were insufficiently grounded in the CAA.

b. Center for Biological Diversity v. National Highway Safety Administration (2008)

In November 2007 and August 2008, the Ninth Circuit US Court of Appeals ruled that a National Environmental Protection Act (NEPA) document must contain a detailed GHG analysis in *Center for Biological Diversity v. National Highway Safety Administration 508 F. 3d 508* (2007), which was vacated and replaced by *Center for Biological Diversity v. National Highway Safety Administration 2008 DJDAR 12954* (August 18, 2008). Despite the Supreme Court and Circuit Court rulings to date, there are no promulgated federal regulations limiting GHG emissions.

c. Energy Independence and Security Act of 2007

The federal government passed the Energy Independence and Security Act of 2007 which mandates a host of actions that would aid in the reduction of GHG emissions. These new actions include, but are not limited to: establishing a fuel economy standard of 35 miles per gallon by 2020, improving energy efficiency in lighting and appliances, and investing in efficient and renewable energy use.[1] Despite the passage of the Energy Independence and Security Act, there are no promulgated federal regulations to date directly limiting GHG emissions.

d. EPA Proposed Rule - Mandatory GHG Reporting

On March 10, 2009, the EPA proposed a rule that requires mandatory reporting of emissions of GHGs from large sources within the United States. The proposed rule includes emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydroflourocarbons (HFC), perflourocarbons (PFC), sulfur hexafluoride (SF_6), nitrogen trifluoride (NF_3), hydrofluorinated ethers (HFE), and select other fluorinated compounds. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions would be required to report annual emissions to the EPA. The rule was ap-

[1] US House, 110th Congress, *H.R. 6, Energy Independence and Security Act of 2007*, http://www.govtrack.us/congress/billtext.xpd?bill=h110-6, accessed September 25, 2009.

proved in September 2009 and will go into effect January 1, 2010. The first annual reports for the largest emitting facilities, covering calendar year 2010, will be submitted to the EPA in 2011.

e. EPA Finding of Endangerment

On April 17, 2009, the EPA issued a Proposed Endangerment and Cause or Contribution Finding for Greenhouse Gases under the Clean Air Act. Through this Finding of Endangerment, the EPA Administrator would propose that current and projected concentrations of CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6 threaten the public health and welfare of current and future generations. Additionally, the Administrator would propose that combined emissions of CO_2, CH_4, N_2O and HFCs from motor vehicles contribute to the atmospheric concentrations and thus to the threat of climate change. Although the Endangerment Finding in itself does not place requirements on industry, it is an important step in the EPA's process to develop regulation.

f. Update to Corporate Average Fuel Economy (CAFE) Standards

On May 19, 2009, President Obama issued a requirement to automakers to increase fuel efficiency of cars manufactured in the United States to 35.5 miles per gallon (mpg) by 2016, four years ahead of the schedule set by the Energy Independence and Security Act of 2007. The new CAFE standards incorporate stricter fuel economy standards promulgated by the State of California, which are discussed further in Section A.2.b below, into one uniform standard. Additionally, automakers are required to cut GHG emissions in new vehicles by roughly 25 percent. Rule-making to adopt these new standards is still in process and thus these standards are not yet in effect.

2. State Laws and Regulations

a. Senate Bill 527

Senate Bill (SB) 527, approved October 11, 2001, requires the California Climate Action Registry to coordinate with the State Energy Resources Conservation and Development Commission to adopt industry-specific GHG reporting metrics. The bill requires separate reporting of direct and indirect emissions by participants in the California Climate Action Registry, and re-

quires the Registry to periodically report the number of participating organizations, the percentage of total State emissions represented by participants, and any GHG reductions achieved by participating organizations. Under SB 527, the responsibilities of the California Climate Action Registry are adjusted to meet State goals to promote voluntary reporting and reduction of GHG emissions. The bill defines the terms "annual emissions results," "baseline," "certification," "emissions," "emissions inventory," "greenhouse gases," "material," and "de minimis emissions" as they pertain to climate change, the California Climate Action Registry and the California Air Resources Board (CARB).

b. Assembly Bill 1493

Assembly Bill (AB) 1493 (Pavley) of 2002 requires CARB to develop and adopt the nation's first GHG emission standards for automobiles. These standards are also known as "Pavley I." The California Legislature declared in AB 1493 that global warming is a matter of increasing concern for public health and the environment. It cites several risks that California faces from climate change including a reduction in the State's water supply, an increase in air pollution caused by higher temperatures, harm to agriculture, an increase in wildfires, damage to the coastline, and economic losses caused by higher food, water, energy, and insurance prices. The bill also states that technological solutions to reduce GHG emissions would stimulate California's economy and provide jobs.

In 2004, the State of California submitted a request for a waiver from federal clean air regulations, as the State is authorized to do under the CAA, to allow the State to require reduced tailpipe emissions of CO_2. In late 2007, the EPA denied California's waiver request and declined to promulgate adequate federal regulations limiting GHG emissions. In early 2008, the State brought suit against the EPA related to this denial.

In January 2009, President Obama instructed the EPA to reconsider the Bush Administration's denial of California's and 13 other states' requests to implement global warming pollution standards for cars and trucks. In June

2009, the EPA granted California's waiver request enabling the State to enforce its GHG emissions standards for new motor vehicles beginning with the current model year.

Also in 2009, President Obama announced a national policy aimed at both increasing fuel economy and reducing GHG pollution for all new cars and trucks sold in the United States. The new standards would cover model years 2012 to 2016 and would raise passenger vehicle fuel economy to a fleet average of 35.5 mpg by 2016. When the national program takes effect, California has committed to allowing automakers who show compliance with the national program to also be deemed in compliance with State requirements. California is committed to further strengthening these standards beginning in 2017 to obtain a 45 percent GHG reduction from the 2020 model year vehicles.

c. Senate Bill 812, Chapter 423, Statutes of 2002

SB 812 requires the California Climate Action Registry to cooperate with the CARB to develop and adopt protocols for reporting and certification of GHG emissions reductions from forestry conservation and conservation-based management projects. This bill also requires the registry to develop protocols for reporting and certifying GHG reduction projects of participants.

d. Senate Bill 1078/Senate Bill 107/Executive Order S-21-09—Renewable Portfolio Standard

Established in 2002 under SB 1078, and accelerated in 2006 under SB 107, California's Renewable Portfolio Standard (RPS) obligates investor-owned utilities, energy service providers and community choice aggregators to procure an additional 1 percent of retail sales per year from eligible renewable sources until 20 percent is reached, no later than 2010. The California Public Utilities Commission (CPUC) and the California Energy Commission (CEC) are jointly responsible for implementing the program.

In September, 2009, Governor Schwarzenegger issued Executive Order S-21-09 directing CARB to adopt regulation by July 31, 2010 requiring a RPS goal of 33 percent by 2020.

e. Executive Order S-3-05 – Greenhouse Gas Emission Reduction Targets

In 2005, Governor Schwarzenegger issued California Executive Order S-3-05 establishing the following GHG emission reduction targets for California:

- Reduce GHG emissions to 2000 levels by 2010.
- Reduce GHG emissions to 1990 levels by 2020.
- Reduce GHG emissions to 80 percent below 1990 levels by 2050.

Executive orders are binding only to State agencies. Accordingly, Executive Order S-3-05 will guide State agencies' efforts to control and regulate GHG emissions but have no direct binding effect on local efforts.

f. Executive Order S-01-07-Low Carbon Fuel Standard

Executive Order S-01-07 was enacted by Governor Schwarzenegger on January 18, 2007. The Order mandates the following:

- A statewide goal be established to reduce the carbon intensity of California's transportation fuels by at least 10 percent by 2020.
- A Low Carbon Fuel Standard (LCFS) for transportation fuels be established in California.

In response, CARB adopted a LCFS standard in April 2009 and is currently considering implementing regulations for the LCFS.

g. Senate Bill 97 Chapter 185, Statutes of 2007 and Office of Planning and Research Guidelines

SB 97 requires that the Governor's Office of Planning and Research (OPR) prepare guidelines to submit to the California Resources Agency regarding the analysis and mitigation of GHG emissions in CEQA documents and feasible mitigation of GHG emissions or the effects of GHG emissions as required by CEQA.

Consistent with SB 97, OPR released a Technical Advisory on CEQA and Climate Change, which was developed in cooperation with the Resources Agency, California EPA, and CARB. The Technical Advisory offered informal interim guidance regarding the steps lead agencies should take to address climate change in their CEQA documents until CEQA guidelines are developed pursuant to SB 97 on how State and local agencies should analyze, and when necessary, mitigate GHG emissions.

According to the technical advisory, lead agencies should determine whether GHGs may be generated by a proposed project, and if so, quantify or estimate the GHG emissions by type and source. In addition, the lead agency must assess whether those emissions are individually or cumulatively significant. When assessing whether a project's effects on climate change are cumulatively considerable, even though its GHG contribution may be individually limited, the lead agency must consider the impact of the project when viewed in connection with the effects of past, current, and probable future projects. Finally, if the lead agency determines that the GHG emissions from the project as proposed are potentially significant, it must investigate and implement ways to avoid, reduce, or otherwise mitigate the impacts of those emissions.

OPR released proposed changes in the CEQA Guidelines on April 13, 2009, requiring inclusion of GHG analyses in CEQA documents, quantification of emissions, determination of a threshold, and if significant emissions would occur, adoption of mitigation to address significant emissions. The OPR-proposed guideline changes do not include a quantitative threshold. Although CARB and local air districts are considering potential CEQA thresholds, to date they have not adopted formal thresholds. Based on OPR's recommendations, the California Resources Agency initiated formal rulemaking on July 3, 2009, for certifying and adopting these amendments pursuant to Public Resources Code Section 21083.05. If adopted, the proposed amendments would become effective on January 1, 2010.

h. Senate Bill 1368 – Greenhouse Gas Emissions Performance Standards

In 2006, SB 1368 was signed into law. The bill limits long-term investments in baseload generation by the State's utilities to power plants that meet an emissions performance standard (EPS) jointly established by the CEC and CPUC.

i. California's Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24)

The Energy Efficiency Standards for Residential and Nonresidential Buildings were established in Title 24, Part 6, of the California Code of Regulations (CCR) in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to allow consideration and possible incorporation of new energy efficiency technologies and methods. New standards were adopted by the Commission in 2001 as mandated by AB 970 to reduce California's electricity demand. The new standards went into effect June 1, 2001. The standards have saved an estimated $56 billion in electricity and natural gas costs since 1978 and are projected to result in an additional $23 billion in savings by 2013.[2]

j. Global Warming Solutions Act of 2006 (AB 32)

AB 32, the Global Warming Solutions Act of 2006, codifies the State's GHG emissions target by directing CARB to reduce the State's global warming emissions to 1990 levels by 2020. CARB regulations are required to begin phasing in by 2012. AB 32 was signed and passed into law by Governor Schwarzenegger on September 27, 2006. Since that time, the CARB, CEC, CPUC, and Building Standards Commission have all been developing regulations that will help meet the goals of AB 32 and Executive Order S-3-05.

A Scoping Plan for AB 32 was adopted by CARB in December 2008. It contains the State's main strategies to reduce GHGs from business-as-usual emissions projected for 2020 to 1990 levels. Business-as-usual (BAU) is the pro-

[2] Title 24, Part 6, of the California Code of Regulations, June 29, 2009, *California's Energy Efficiency Standards for Residential and Nonresidential Buildings*, http://www.energy.ca.gov/title24/, accessed September 25, 2009.

jected emissions for 2020, including increases in emissions caused by growth, without any GHG reduction measures. The Scoping Plan has a range of GHG reduction actions, including direct regulations, alternative compliance mechanisms, monetary and non-monetary incentives, voluntary actions, and market-based mechanisms such as a cap-and-trade system. It requires CARB and other State agencies to develop and adopt regulations and other initiatives reducing GHGs by 2012.

As directed by AB 32, CARB has also approved a statewide GHG emissions limit. On December 6, 2007, CARB staff resolved an amount of 427 million metric tons of carbon dioxide equivalent ($MMTCO_2e$) as the total statewide GHG 1990 emissions level and 2020 emissions limit. The limit is a cumulative statewide limit, not a sector- or facility-specific limit.

CARB is also conducting rulemaking, culminating in rule adoption by January 1, 2011 for reducing GHG emissions to achieve the emissions cap by 2020. The rules must take effect no later than 2012. In designing emission reduction measures, CARB must aim to minimize costs, maximize benefits, improve and modernize California's energy infrastructure, maintain electric system reliability, maximize additional environmental and economic co-benefits for California, and complement the State's efforts to improve air quality.

In addition, landfill gas capture and control was identified as an early adoption measure for AB 32, and CARB has proposed a rule requiring gas capture and collection for landfills having at least 450,000 tons of waste in place and establishing performance standards for systems already installed.

k. Transportation, Land Use, and the California Environmental Quality Act

On September 30, 2008, Governor Schwarzenegger signed into law SB 375 (Steinberg). SB 375 focuses on housing and transportation planning decisions to reduce fossil fuel consumption and conserve farmlands and habitat. This legislation is important to achieving AB 32 goals because GHG emissions

associated with land use, which includes transportation, are the single largest sector of emissions in California. Furthermore, SB 375 provides a path for improved planning by providing incentives to locate housing developments closer to where people work and go to school, allowing them to reduce vehicle miles traveled every year. Finally, SB 375 provides certain exemptions under CEQA law for projects that are proposed consistent with local plans developed under SB 375.

The first step in the implementation of SB 375 involves setting GHG reduction goals for regions throughout the state. These regions are to be defined by the borders of Metropolitan Planning Organizations (MPOs). CARB is currently coordinating a Regional Targets Advisory Committee (RTAC) to develop the GHG reduction goals, and they provided recommendations to CARB in 2009 that address methodologies, procedures and policies to establish the GHG goals. CARB must propose GHG reduction goals by June 30, 2010 and must finalize them by September 30, 2010.

l. AB 939, Titles 14 and 27

GHG emissions from landfills are regulated under AB 939, Titles 14 and 27. AB 939 mandates local jurisdictions to meet waste diversion goals of 25 percent by 1995 and 50 percent by 2000. In addition, AB 939 establishes an integrated statewide system for compliance and program implementation. Titles 14 and 27 contain detailed rules on daily operations, handling of specific waste types, monitoring, closure, and record-keeping.

3. Local Regulations and Policies

The Butte County Air Quality Management District (BCAQMD) does not currently have any regulations related to climate change mitigation or to the CEQA analysis of climate change.

Other Air Quality Management Districts have begun processes to establish thresholds of significance for climate change-related impacts.

The Sacramento Metro Air Quality Management District (SMAQMD) has released guidelines concerning climate change. The SMAQMD recommends that thresholds of significance for GHG emissions should be related to AB 32's GHG reduction goals. For example, a possible threshold of significance could be to determine whether a proposed general or area plan's emissions would substantially hinder the State's ability to attain the goals identified in AB 32 (i.e. reduction of statewide GHG emissions to 1990 levels by 2020). In this example, a numeric GHG reduction target representative of 1990 levels, despite planned population and employment growth, should be adopted as a policy within the lead agency's general or area plan. Emission reduction measures to achieve the target could then be developed within the general or area plan, or within a companion Climate Action Plan.

The Bay Area Air Quality Management District (BAAQMD) is in the process of updating its CEQA Air Quality Guidelines. The BAAQMD released the latest draft version of its revised CEQA Air Quality Guidelines in December 2009. For operational-related plan-level impacts, such as impacts from general or area plans, the BAAQMD recommends the following GHG significance thresholds: 1) Climate Action Plan for the plan area with a reduction goal consistent with AB 32 and meeting all CEQA requirements, or 2) a plan that achieves a GHG efficiency of 6.6 $MTCO_2e$ per service population[3] per year.

The San Joaquin Valley Air Pollution Control District (SJVAPCD) adopted GHG significance thresholds in December 2009 and concluded that the most appropriate option for development of a significant determination is implementation of Best Performance Standards or a reduction of emissions by 29 percent compared to business as usual (2002 to 2004) conditions.

In late 2008, the South Coast Air Quality Management District (SCAQMD) Governing Board adopted the staff proposal for an interim GHG significance threshold for stationary source projects where the SCAQMD is lead agency. These interim thresholds will be used for determining significant impacts for proposed projects, and include a 10,000 annual $MMTCO_2e$ threshold for sta-

[3] Service population is defined as the total of residents plus employment.

tionary sources. SCAQMD is considering a threshold for residential and commercial projects but has not formally proposed a threshold at this time.

B. Existing Conditions

This section discusses the existing conditions pertaining to GHG emissions in Butte County.

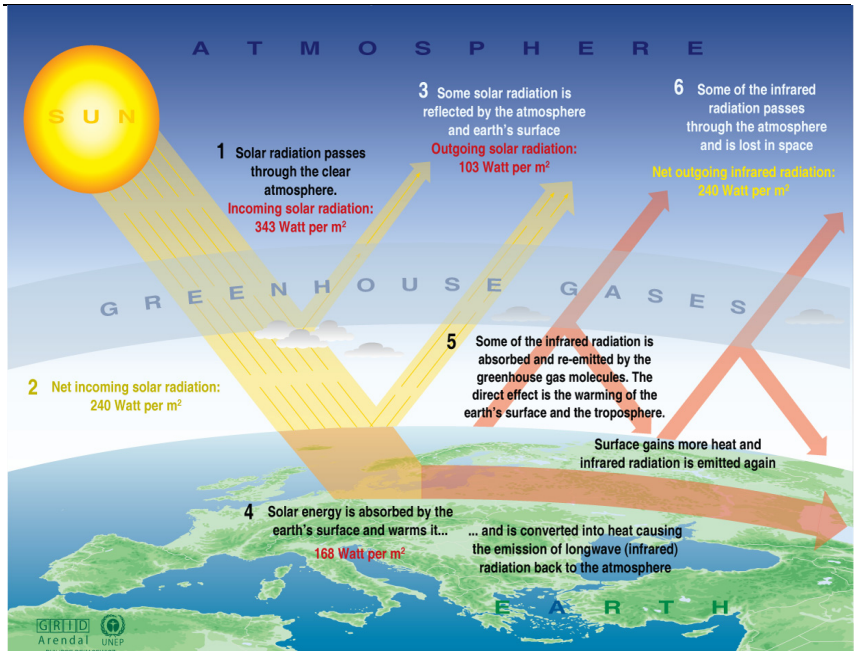
1. Global Warming/Climate Change

The phenomenon known as the greenhouse effect keeps the earth's atmosphere near the surface warmer than it would be otherwise, allowing for successful habitation by humans and other forms of life. GHGs present in the earth's lower atmosphere play a critical role in maintaining the earth's temperature by trapping some of the longwave infrared radiation emitted from the earth's surface which otherwise would have escaped to space, as shown in Figure 4.15-1. The primary naturally occurring GHGs are CO_2, water vapor (H_2O), CH_4, tropospheric ozone (O_3) and N_2O. Each is discussed in detail below.

The combustion of fossil fuels and deforestation release carbon, in the form of CO_2, into the atmosphere that historically has been stored underground in sediments or in surface vegetation. With the accelerated increase of fossil fuel combustion and deforestation since the industrial revolution of the 19th century, concentrations of GHGs have increased exponentially in the atmosphere. Increases in the atmospheric concentrations of GHGs in excess of natural ambient concentrations contribute to the enhancement of the natural greenhouse effect.

This enhanced greenhouse effect has contributed to global warming, which is an increased rate of warming of the earth's surface temperature. Specifically, increases in GHGs lead to increased absorption of longwave infrared radiation by the earth's atmosphere and warm the lower atmosphere further, increasing evaporation rates and temperatures near the surface. Warming of the earth's lower atmosphere induces large-scale changes in ocean circulation

FIGURE 4.15-1 **THE GREENHOUSE EFFECT**



Source: UNEP/GRID-Arendal, http://maps.grida.no/go/graphic/greenhouse_effect.

patterns, precipitation patterns, global ice cover, biological distributions, and other large-scale changes to the earth system that are collectively referred to as climate change.

The Intergovernmental Panel on Climate Change (IPCC) has been established by the World Meteorological Organization and United Nations Environment Programme to assess scientific, technical, and socioeconomic information relevant to the understanding of climate change, its potential impacts, and options for adaptation and mitigation. The IPCC estimates that the average global temperature rise between the years 2000 and 2100 could range from 1.1°C, with no increase in GHG emissions above year 2000 levels, to 6.4°C,

with substantial increase in GHG emissions.[4] Large increases in global temperatures could have massive deleterious impacts on natural and human environments.

Scientific studies, best represented by the IPCC's periodic reports, demonstrate that climate change is already occurring due to past GHG emissions. Forecasting of future growth and related GHG emissions under BAU[5] conditions indicates large increases in those GHG emissions accompanied by an increasing severity of changes in global climate. Thus, the best scientific evidence concludes that global emissions must be reduced below current levels.

The CEC recently released the following report: *The Future is Now: An Update on Climate Change Science Impacts and Response Options for California*.[6] The report documents the impacts that climate change could have in California, and is intended to achieve the following goals: synthesize existing knowledge with new scientific findings; dispel any lingering doubts about the human influence on the observed changes in the climate and the natural envi-

[4] IPCC, 2007, *Climate Change 2007: Synthesis Report*, Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A.(eds.)], IPCC, Geneva, Switzerland.

[5] "Business as usual" (BAU) conditions are defined as population and economic growth in the future using current (2009) building practices and current (2009) regulatory standards. For this EIR, reference to BAU conditions are specifically defined as including current mandatory requirements, such as Title 24 (Energy Efficiency Standards); current federal vehicle mileage standards; California AB 1493 vehicle emission standards; current renewable portfolio standards, including RPS (SB 1078 and SB 107) for California regulated utilities; current County water efficiency requirements; and other existing local and State requirements. BAU conditions presume no improvements in energy efficiency, water efficiency, fuel efficiency beyond that existing today or as required by existing (2009) statute. Specifically, BAU conditions do not include the GHG reduction measures included in the CARB Draft Scoping Plan from June 2008, which are not yet enacted in statute.

[6] California Energy Commission, May 2009, *The Future is Now – An update on climate change science impacts and response options for California*, CEC-500-2008-071.

ronment; and underscore the increasingly urgent need for a dual approach to managing California's climate change risks, in which GHG emissions are reduced to minimize and slow down global warming, and adaptation plans are prepared to deal with the impacts that are already underway and unavoidable.

The report details potential impacts in a variety of resource areas. These impacts include, but are not limited to, the following:

- Increased transmission of mosquito-borne diseases such as West Nile Virus and encephalitis.
- Decreased snowpack by the end of the century (20 to 40 percent under different emissions scenarios).
- Increased risk of winter flooding.
- Decreased hydropower generation (under dry warming).
- Decreased productivity of almonds, cotton and dairy products.
- Increased pest range and viability.
- Increased number of large wildfires by 12 to 53 percent statewide, depending on emissions scenario, with larger increases in Northern California.
- Likely sea level increase by up to 35 inches by 2100, depending on the magnitude of climate warming.
- Increased frequency and duration of extreme heat events.

2. Greenhouse Gases

GHGs are emitted by both natural and anthropogenic processes. GHGs include water vapor, CO_2, CH_4, N_2O, halogenated chlorofluorocarbons (HCFC), O_3, PFCs, SF_6, and HFCs. HCFCs, HFCs, PFCs, and SF_6 have no known natural sources, and their levels in the atmosphere are due entirely to human activities. Although CO_2, CH_4, and N_2O have natural sources, the rapid and significant increase in their atmospheric concentrations in recent

decades can be attributed with a high degree of certainty to human activities.[7] Some GHGs, such as water vapor, occur naturally and are emitted to the atmosphere through natural processes, as well as through human activities. Water vapor, although the most abundant GHG, is not included in the IPCC's reports or those of other governmental entities focused on climate change because natural concentrations and fluctuations far outweigh anthropogenic influences.

Climate change is a global problem, and GHGs are global pollutants, making them substantively different than criteria air pollutants. Criteria air pollutants, such as O_3 precursors and toxic air contaminants (TAC), are pollutants solely of regional and local concern, and local concentrations respond to locally-implemented control measures. The long atmospheric lifetimes of GHGs allow them to be transported long distances from sources and to become well-mixed, unlike criteria air pollutants, which typically exhibit strong concentration gradients away from point sources.

To simplify reporting and analysis, methods have been set forth to describe emissions of GHGs in terms of a single gas, CO_2. The most commonly accepted method to compare GHG emissions is the global warming potential (GWP). The IPCC[8] defines the GWP of various GHG emissions on a normalized scale that recasts all GHG emissions in terms of carbon dioxide equivalents (CO_2e), which compares the gas in question to that of the same

[7] IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt,M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[8] IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt,M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

mass of CO_2. CO_2 has a GWP of 1 by definition. Generally, GHG emissions are quantified in terms of metric tons of CO_2 emitted per year.

Table 4.15-1 lists the GWP of each GHG, as well as its lifetime and abundance in the atmosphere in parts per trillion (ppt). Units commonly used to describe the concentration of GHGs in the atmosphere are parts per million (ppm), parts per billion (ppb) and ppt, referring to the number of molecules of the GHG in a sampling of 1 million, 1 billion, or 1 trillion molecules of air. Collectively, HFCs, PFCs, and SF_6 are referred to as high global warming potential gases (HGWPG). CO_2 is by far the largest component of worldwide CO_2e emissions, followed by CH_4, N_20, and HGWPGs, in order of decreasing contribution to CO_2e. Table 4.15-2 lists the anthropogenic contribution of GHGs in terms of CO_2e for the year 2004.

The GHGs determined by the IPCC as being released largely or entirely due to human activity, including CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6, are explained in greater detail below, in order of abundance in the atmosphere.

a. Carbon Dioxide

CO_2 is the most important anthropogenic GHG and accounts for more than 75 percent of all anthropogenic GHG emissions. Its long atmospheric lifetime, on the order of decades to centuries, ensures that atmospheric concentrations of CO_2 will remain elevated for decades after GHG mitigation efforts to reduce GHG concentrations are promulgated.[9]

Increasing concentrations of CO_2 in the atmosphere are largely attributable to emissions from the burning of fossil fuels, gas flaring, cement production, and land use changes. Anthropogenic emissions of CO_2 have increased concentrations in the atmosphere most notably since the industrial revolution. The

[9] IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

TABLE 4.15-1 **LIFETIMES, GLOBAL WARMING POTENTIALS, AND ABUNDANCES OF SEVERAL SIGNIFICANT GREENHOUSE GASES**

Gas	Global Warming Potential (100 Years)	Lifetime (Years)
CO_2	1	50–200
CH_4	21	12
N_20	310	114
HFC-23	11,700	270
HFC-134a	1,300	14
HFC-152a	140	1.4
CF_4[b]	6,500	50,000
C_2F_6[b]	9,200	10,000
SF_6	23,900	3,200

Source: IPCC, 1996, Technical Summary. In *Climate Change 1995: The Science of Climate Change*, Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T. et al. (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

concentration of CO_2 has increased from about 280 to 379 ppm over the last 250 years, an increase of over 35 percent. IPCC estimates that the present atmospheric concentration of CO_2 has not been exceeded in the last 650,000 years and is likely to be the highest ambient concentration in the last 20 million years.[10]

[10] IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B.

TABLE 4.15-2 **GLOBAL ANTHROPOGENIC GREENHOUSE GAS EMISSIONS IN 2004 BY SECTOR**

Source	CO_2 Equivalent Percentage
Energy Supply	25.9
Industry	19.4
Forestry	17.4[a]
Agriculture[b]	13.5
Transport[c]	13.1
Residential and Commercial Buildings	7.9
Waste and Wastewater	2.8

[a] Includes deforestation, decomposition of above ground biomass remaining after logging, peat fires and decay of peat soils.
[b] Includes agriculture waste burning and savannah burning.
[c] Includes international transport but excludes fisheries and off-road vehicles.
Source: IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Sinks of CO_2, which absorb, rather than produce CO_2, include uptake by vegetation and dissolution into the ocean. Worldwide GHG production greatly exceeds the absorption capacity of natural sinks and, as a result, concentrations of GHG in the atmosphere are on the rise.[11]

Averyt, M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[11] California Energy Commission, December 2006, *Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004*, CEC-600-2006-013-SF, available at

b. Methane

CH_4, the main component of natural gas, is the second largest contributor to anthropogenic GHG emissions and has a GWP of 25.[12]

Anthropogenic emissions of CH_4 are the result of growing rice, raising cattle, combusting natural gas, and mining coal.[13] Atmospheric CH_4 has increased from a pre-industrial concentration of 715 to 1900 ppb in 2005.[14]

c. Nitrous Oxide

N_2O is a powerful GHG, with a GWP of 298.[15] Anthropogenic sources of N_2O include agricultural processes, nylon production, fuel-fired power plants, nitric acid production and vehicle emissions. N_2O also is used in rocket engines, racecars, and as an aerosol spray propellant. Agricultural processes that

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http://www.energy.ca.gov/2006publications/CEC-600-2006-013/CEC-600-2006-013-SF.PDF.

[12] IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[13] NOAA, August 20, 2008, *National Climatic Data Center – Greenhouse Gases Frequently Asked Questions*, http://lwf.ncdc.noaa.gov/oa/climate/gases.html#m, accessed September 25, 2009.

[14] IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[15] IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

result in anthropogenic N_2O emissions are fertilizer use and microbial processes in soil and water.[16]

N_2O concentrations in the atmosphere have increased from pre-industrial levels of 270 to 320 ppb in 2005, an 18 percent increase.[17]

d. Hydroflourocarbons

HFCs are human-made chemicals used in commercial, industrial and consumer products and have high GWPs.[18] HFCs generally are used as substitutes for ozone-depleting substances (ODS) in automobile air conditioners and refrigerants. As seen in Table 4.15-1, the most abundant HFCs, in order from most abundant to least, are HFC-134a (35 ppt), HFC-23 (17.5 ppt), and HFC-152a (3.9 ppt).

e. Perflourocarbons

The most abundant PFCs are CF_4 (PFC-14) and C_2F_6 (PFC-116). These human-made chemicals are emitted largely from aluminum production and semiconductor manufacturing processes. PFCs are extremely stable compounds that are destroyed only by very high-energy ultraviolet rays, which results in the very long lifetimes of these chemicals, as shown in Table 4.15-1.[19]

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[16] NOAA, August 20, 2008, *National Climatic Data Center – Greenhouse Gases Frequently Asked Questions*, http://lwf.ncdc.noaa.gov/oa/climate/gases.html#m, accessed September 25, 2009.

[17] IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[18] US Environmental Protection Agency, 2006, *High Global Warming Potential (GWP) Gases*, http://www.epa.gov/highgwp/index.html, accessed September 4, 2009.

[19] US Environmental Protection Agency, 2006, *High Global Warming Potential (GWP) Gases*, http://www.epa.gov/highgwp/index.html, accessed September 4, 2009

f. Sulfur Hexafluoride

SF_6, another human-made chemical, is used as an electrical insulating fluid for power distribution equipment in the magnesium industry, in semiconductor manufacturing and also as a trace chemical for study of oceanic and atmospheric processes.[20] In 1998, atmospheric concentrations of SF_6 were 4.2 ppt and steadily increasing in the atmosphere.

SF_6 is the most powerful of all GHGs listed in IPCC studies, with a GWP of 22,800.[21]

3. GHG Inventories

A GHG inventory is a quantification of all GHG emissions and sinks within a selected physical and/or economic boundary. GHG inventories can be performed on a large scale, such as for global and national entities, or on a small scale, such as for a particular building or person.

GHG emission and sink specifications are complicated by the fact that the natural processes may dominate the carbon cycle. Though some emission sources and processes are easily characterized and well understood, components of the way in which GHGs operate are not known with accuracy. As such, GHG protocols are currently under development and ad-hoc tools must be developed to quantify emissions from certain sources and sinks.

The following sections outline the global, national, and statewide GHG inventories to put into context the relative magnitude of the project-related emissions.

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[20] US Environmental Protection Agency, 2006, *High Global Warming Potential (GWP) Gases*, http://www.epa.gov/highgwp/index.html, accessed September 4, 2009

[21] IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

a. IPCC Inventory

In the 2007 Intergovernmental Panel on Climate Change Synthesis Report, global anthropogenic GHG emissions were estimated to be 49,000 $MMTCO_2e$ in 2004, which is 70 percent above 1970 emissions levels. CO_2 contributed to 76.7 percent of total emissions; CH_4 accounted for 14.3 percent; N_2O contributed 7.9 percent; and fluorinated gases (HFCs, PFCs, and SF_6) contributed to the remaining 1.1 percent of global emissions. Energy supply was the sector responsible for the greatest amount of GHG emissions at 25.9 percent, followed by industry at 19.4 percent, forestry at 17.4 percent, agriculture at 13.5 percent, and transport at 13.1 percent.[22]

b. EPA National GHG Inventory

The EPA estimates that total US GHG emissions for 2007 amounted to 7,150 $MMTCO_2e$, which is 17 percent greater than 1990 levels.[23] US GHG emissions were responsible for 22 percent of global GHG emissions in 2007.[24] Table 4.15-3 summarizes the contribution of each GHG to total US GHG emissions in 2007, based on CO_2e. The largest contributors to US GHG emissions in 2007 by economic sector were the electric industry, transportation, and the industrial sector.[25]

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[22] IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[23] US Environmental Protection Agency, April 2009, *2009 U.S. Greenhouse Gas Inventory Report - Inventory of U.S. Greenhouse Gas Inventories and Sinks 1990-2007*, http://epa.gov/climatechange/emissions/usinventoryreport.html, accessed September 25, 2009.

[24] US Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting, 2008, *Emissions of Greenhouse Gases in the United States 2007*, Washington, DC.

[25] US Environmental Protection Agency, April 2009, *2009 U.S. Greenhouse Gas Inventory Report - Inventory of U.S. Greenhouse Gas Inventories and Sinks 1990-2007*, http://epa.gov/climatechange/emissions/usinventoryreport.html, accessed September 25, 2009.

TABLE 4.15-3 **US GHG INVENTORY: 2007 ANTHROPOGENIC GHG EMISSIONS (CO_2 EQUIVALENT) BY SOURCE GAS**

Gas	Percentage
CO_2	85.4
CH_4	8.2
N_2O	4.4
HFCs, PFCs, and SF_6	2.10

Source: US Environmental Protection Agency, April 2009, 2009, *U.S. Greenhouse Gas Inventory Report - Inventory of U.S. Greenhouse Gas Inventories and Sinks 1990-2007*, http://epa.gov/climatechange/emissions/usinventoryreport.html, accessed September 25, 2009.

Total US GHG emissions in 2007 were 1.4 percent above the 2006 total.[26] Figure 4.15-2 presents 2007 US GHG emissions by gas.

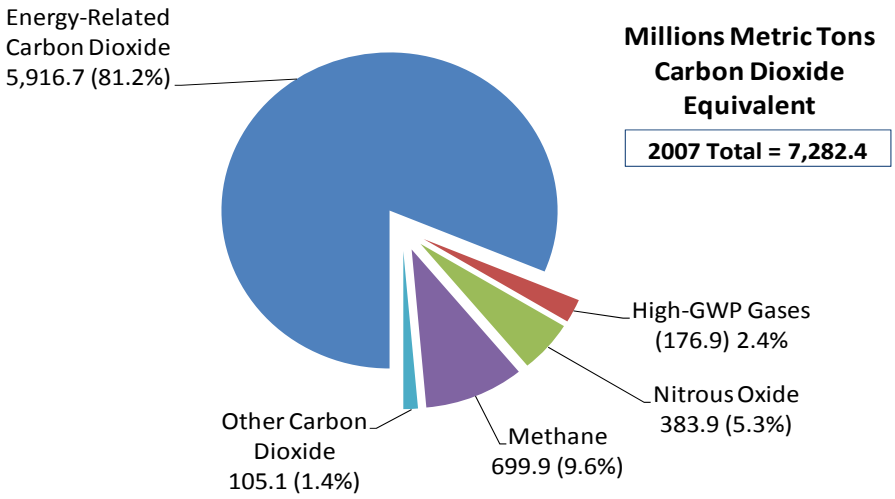
Total emissions growth from 2006 to 2007 was largely the result of a 75.9-$MMTCO_2e$ increase in CO_2 emissions. There were larger percentage increases in emissions of other GHGs, but their absolute contributions to total emissions growth were relatively small: 13.0 $MMTCO_2e$ for CH_4, 8.2 $MMTCO_2e$ for N_2O, and 5.6 $MMTCO_2e$ for high-GWP gases.[27]

The increase in US CO_2 emissions in 2007 resulted primarily from two factors: unfavorable weather conditions, which increased demand for heating

[26] US Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting, 2008, *Emissions of Greenhouse Gases in the United States 2007*, Washington, DC.

[27] US Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting, 2008, *Emissions of Greenhouse Gases in the United States 2007*, Washington, DC.

FIGURE 4.15-2 **US GREENHOUSE GAS EMISSIONS BY GAS, 2007**



Note: High-GWP Gases include HFCs, PFCs, and SF_6.
Source: EIA estimates from Emissions of Greenhouse Gases in the United States, 2007.

and cooling in buildings; and a drop in hydropower availability that led to greater reliance on fossil fuel energy sources such as coal and natural gas for electricity generation, increasing the carbon intensity of the power supply.[28] CH_4 emissions increased in the energy, waste management, and agriculture sectors. In addition, N_2O emissions from 2006 to 2007 increased.[29] This increase is attributed primarily to an increase in corn production and a decrease in soy production between 2006 and 2007 in the United States, since corn production produces relatively more N_2O than soy production. However, despite this short-term trend, N_2O emissions from this source have not

[28] US Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting, 2008, *Emissions of Greenhouse Gases in the United States 2007*, Washington, DC.

[29] US Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting, 2008, *Emissions of Greenhouse Gases in the United States 2007*, Washington, DC.

shown any long-term trend as the N_2O emissions are highly sensitive to the amount of nitrogen applied to soils, to weather patterns, and to crop type, each of which varies considerably, depending on local conditions.[30]

c. California Statewide GHG Inventory

CEC's *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2004* estimates that California is the second-largest state emitter of GHG emissions in the United States, behind Texas in absolute emissions. However, the state has relatively low carbon intensity when considering GHG emissions per person or GHG emissions per unit gross state product. Worldwide, California is estimated to be the 12th to 16th largest emitter of CO_2 and is responsible for approximately 2 percent of the world's CO_2 emissions.[31]

CARB released estimates of California's 1990 emissions inventory, which amounted to 433.29 $MMTCO_2e$.[32] CARB has also estimated that 2006 emissions levels were 483.87 $MMTCO_2e$. Factoring in the reduction in GHG emissions due to the functioning of existing forests and rangeland as carbon sinks, California's GHG emissions in 2006 were 479.80 $MMTCO_2e$. As shown in Figure 4.15-3, 2006 GHG emissions for California were apportioned to the following sectors: transportation (38.4 percent), electric power (21.9 percent), commercial and residential energy usage (9.2 percent), industrial (19.9 percent), recycling and waste (1.3 percent), high GWP gases (3.1 percent), agriculture (6.2 percent) and forestry (0.04 percent).

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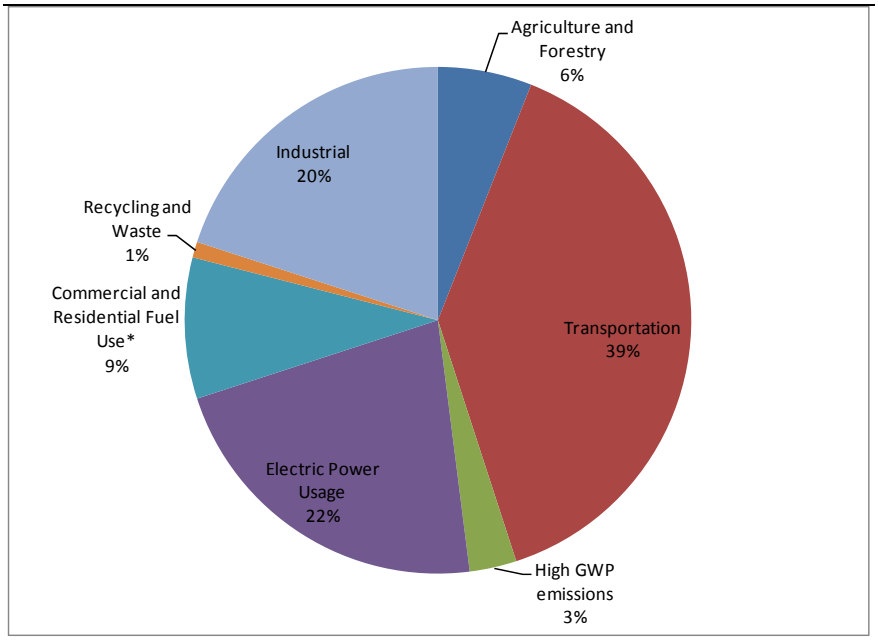
[30] US Environmental Protection Agency, April 2009, *2009 U.S. Greenhouse Gas Inventory Report - Inventory of U.S. Greenhouse Gas Inventories and Sinks 1990-2007*, http://epa.gov/climatechange/emissions/usinventoryreport.html, accessed September 25, 2009.

[31] California Energy Commission, December 2006, *Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004*, CEC-600-2006-013-SF, available at http://www.energy.ca.gov/2006publications/CEC-600-2006-013/CEC-600-2006-013-SF.PDF.

[32] California Air Resources Board, May 22, 2009, *California Greenhouse Gas Emissions Inventory 2000-2006*, http://www.arb.ca.gov/cc/inventory/data/data.htm, accessed September 25, 2009.

FIGURE 4.15-3 **CALIFORNIA GREENHOUSE GAS INVENTORY, 2006**



Source: California Air Resources Board.

d. Butte County Emissions

The 2006 GHG inventory for Butte County is provided in Table 4.15-4 and a brief discussion provided in this section. Additional discussion of the current inventory as it compares to the 2020 and 2030 GHG forecast can be found in Section D. Full methodology and a detailed discussion of the inventory and forecast are included in Appendix F.

In 2006, GHG emissions in Butte County totaled 601,266 $MTCO_2e$. On-road vehicles contributed 295,750 $MTCO_2e$, or 49.2 percent, and off-road equipment contributed an additional 6.8 percent, or 40,939 $MTCO_2e$. Approximately 28.1 percent of the 2006 GHG emissions can be attributed to electricity and natural gas used to power or heat residences, homes and industries. Industrial sources (stationary sources) related to the burning of other fuels or fugitive emissions accounted for 4,093 $MTCO_2e$, or 0.7 percent. Waste gen-

erated by Butte County residents in 2006 will produce 17,873 metric tons of GHGs (due to landfill methane) over the next 30 years, roughly the decompositional lifetime of the landfilled waste. Emissions from this source are included for informational purposes only and are not included in the total GHG emissions for the County. Waste currently in place at the Neal Road Recycling and Waste Facility will result in 14,247 $MTCO_2e$ in the form of landfill methane that year; this is 2.4 percent of the 2006 total. The burning of fuel to power agricultural equipment in 2006 contributed 77,019 $MTCO_2e$; this is roughly 10 percent of the on-road vehicle emissions and 12.8 percent of the county total for 2006.

C. Standards of Significance

As discussed above, the State of California has not yet adopted any specific standards of significance for GHG impacts. As with any environmental impact, lead agencies must determine what constitutes a significant impact. In the absence of regulatory standards for GHG emissions or other scientific data to clearly define what constitutes a significant impact, individual lead agencies may undertake a project-by-project analysis, consistent with available guidance and current CEQA practice.

However, preliminary guidance from OPR, the California Resources Agency, the Attorney General and other State entities indicates that CEQA review documents must consider two fundamental questions regarding climate change:

- What is the impact of the GHG emissions of a project?
- What is the impact of climate change on the project?

Climate change is the result of cumulative global emissions. There is no single project, when taken in isolation, that can "cause" global warming because a single project's emissions are insufficient to change the radiative balance of the atmosphere. Because global warming is the result of GHG emissions, and GHGs are emitted by innumerable sources worldwide, global climate change

TABLE 4.15-4 **BUTTE COUNTY GREENHOUSE GAS EMISSIONS ESTIMATE, 2006**

Source	GHG Emissions ($MTCO_2e$)	Percent of Total
On-Road Vehicles	295,570	49.2
Off-Road Vehicles and Equipment	40,939	6.8
Natural Gas	62,241	10.3
Electricity	106,977	17.8
Stationary sources	4,093	0.7
Landfills (Waste in Place)	14,247	2.4
Single Year (Future Waste Commitment)[a]	17,873	Not included
Agricultural Vehicles and Equipment	77,019	12.8
Total	**601,266**	**100.0**

[a] Uses 2008 data and assumes all waste was deposited at facilities with a gas capture system.
Source: ICF Jones & Stokes, 2009.

is a significant cumulative impact of human development and activity. The global increase in GHG emissions that has occurred and will occur in the future are the result of the actions and choices of individuals, businesses, local governments, states, and nations. Thus, the discussion below references analysis of cumulative contributions to a significant global impact.

On a State level, AB 32 identified that an acceptable level of GHG emissions in California in 2020 is 427 $MMTCO_2e$, which is the same as the 1990 GHG emissions level. This level is also approximately 15 percent less than current

GHG emissions and approximately 28 percent less than projected 2020 BAU conditions.[33]

In order to achieve these GHG reductions, there will have to be widespread reductions of GHG emissions from sources in many various sectors across the California economy. Some of those reductions will need to come from the existing sources of emissions in the form of changes in vehicle emissions and mileage, changes in the sources of electricity, and increases in energy efficiency by existing residential, commercial, industrial and agricultural development, as well as other measures. In the upcoming years, the State will be adopting comprehensive regulations to reduce the GHG emissions from vehicles, industry, buildings and other sources. These regulations are expected to play a major part in reaching the goal of reducing currently projected 2020 emissions levels by 15 percent compared to current levels.

While County actions can help to promote GHG reductions from the existing economy, existing development is not under the discretionary land use authority of the County, and thus most of these reductions will come as the result of State and federal mandates. The remainder of the necessary GHG reductions will need to come from requiring new development to have a lower carbon intensity than BAU conditions. County land use discretion can substantially influence the GHG emissions from new development.

In terms of determining whether GHG emissions in Butte County will be cumulatively considerable, this EIR evaluates whether Butte County is doing its part to ensure that California, cumulatively, meets the AB 32 target. CARB specifically recommended in the adopted Scoping Plan that municipalities adopt a goal of reducing emissions by 15 percent compared to current levels.[34] While there can and likely will be variation in how much reduction each city, county or region can realistically achieve by 2020, on the average

[33] California Air Resources Board, May 22, 2009, Greenhouse Gas Inventory 2020 Forecast, http://www.arb.ca.gov/cc/inventory/data/forecast.htm, accessed September 25, 2009.

[34] California Air Resources Board, December 2008, *AB 32 Scoping Plan*.

each jurisdiction must reduce emissions by approximately 15 percent compared to current conditions.

For the purposes of this EIR, General Plan 2030 and the ALUCP override would result in a cumulatively considerable contribution if GHG emissions in 2020 associated with unincorporated Butte County are greater than 85 percent of current GHG emissions. If they are, Butte County would contribute considerably to global GHG emissions and related climate change effects. If the emissions of new development allowed by General Plan 2030, combined with the on-going emissions of existing development, are less than 85 percent of current GHG emissions, then General Plan 2030 would not contribute considerably to global GHG emissions and related climate change effects.

Although the General Plan planning horizon is in 2030, this EIR only analyzes emissions to the 2020 horizon for several reasons. First, the State has only established legal mandates out to the year 2020 that apply to the entire state. Although Executive Order S-03-05 established goals for 2050, executive orders only apply to the agencies of State government and do not establish a mandate for local government or private actions. Second, there will need to be further GHG emission reductions beyond 2020 worldwide in order to avoid the more catastrophic aspects of unchecked climate change. The means to affect substantial reductions beyond 2020 are not clearly defined and will depend to a large extent on the ability to stop the rise in emissions and start to reduce emissions as soon as possible. Thus, the 2020 goal is an interim goal that will need to be revisited in future planning at the County and State level, but the basis for establishing a 2030 goal will need to be developed over time. In the mitigation measures described in Section F, a process is suggested to ensure adoption of a 2030 goal and a 2030 reduction plan prior to 2020.

A certain amount of environmental change is inevitable in Butte County due to current GHG emissions and unavoidable future increases in GHG emissions worldwide. Change on a local basis to Butte County agriculture, water supplies, flooding, wildfire potential, environmental health, and other areas is reasonably foreseeable, although not necessarily unquantifiable in all aspects

as present. New development allowed by General Plan 2030 could place persons and property at higher levels of risk to climate change effects if they do not anticipate reasonably foreseeable changes in environmental conditions.

Thus, for this EIR, the proposed project would result in a cumulatively considerable contribution to a significant impact if development allowed by General Plan 2030 and the ALUCP override is unprepared for reasonably foreseeable environmental changes that will occur due to climate change, and thus subject property and persons to additional risk of physical harm related to flooding, public health, wildfire risk and other impacts.

For the purposes of this EIR, General Plan 2030 and the ALUCP override would result in a cumulatively significant contribution to climate change if they would:

- Result in GHG emissions that do not achieve a 15 percent reduction from current levels by 2020.
- Subject property and persons to additional risk of physical harm related to flooding, public health, wildfire risk and other impacts resulting from climate change.

D. Impact Discussion

The following discussion provides an analysis of the project's cumulative contribution to GHG emission and climate change impacts that could occur as a result of implementation of General Plan 2030. In addition, this discussion includes an analysis of the potential GHG emissions from residential land uses that would be allowed in the ALUCP area under the ALUCP override, which is a very small fraction of the projected 2030 buildout that would contribute to GHG emissions.

In addition, a summary of the 2006 GHG inventory and 2030 projection is included, as well as a brief description of the methodology used for the inven-

tory and forecast. A complete discussion of the inventory, forecast, and associated methodologies can be found in Appendix F of this EIR.

1. Methodology

An inventory of existing GHG emissions was prepared for the inventory year, which is 2006. A GHG emissions forecast was prepared accounting for development allowed within unincorporated Butte County as part of General Plan 2030. For existing and future 2030 scenarios, GHG emissions were estimated from the following general sectors: transportation; electricity and natural gas consumption related to new residential, commercial, and industrial development; stationary sources; waste; and agricultural vehicles and equipment. A separate inventory was not performed for County government operations. Appendix F of this EIR contains a detailed description of the technical approach used to develop the inventory and 2030 forecast.

2. Project Impacts

a. Result in GHG emissions that do not achieve a 15 percent reduction from current levels by 2020.

The assessment of GHG emissions in this section is based on a quantitative analysis of impacts resulting from the projected 2030 buildout of General Plan 2030. The estimate of GHG emissions in 2020 is based on projected 2030 buildout, adjusted to the year 2020. As discussed below, General Plan 2030 and the ALUCP override will result in cumulatively considerable GHG emissions that exceed the significance criteria noted above.

GHG emissions for the inventory year 2006 and projections for 2020 and 2030, including development allowed by General Plan 2030, are shown in Tables 4.15-4 and 4.15-5. Current emissions are summarized in Section B.3.d and compared with projected emissions below.

Population growth and associated development in Butte County will result in additional GHG emissions primarily from on-road vehicles, electricity and natural gas consumption by homes and businesses, and increased emissions associated with landfilling of solid waste. The overall balance of GHG

TABLE 4.15-5 **2020 AND 2030 GREENHOUSE GAS EMISSIONS SUMMARY**

Source	2020 GHG Emissions ($MTCO_2e$)	Percent of 2020 Total	2030 GHG Emissions ($MTCO_2e$)	Percent of 2030 Total
On-Road Vehicles	355,386 (281,466)[a]	49.7	394,258 (312,252)[a]	49.1
Off-Road Vehicles and Equipment	51,105 (47,681)[b]	7.2	63,695 (59,428)[b]	7.9
Natural Gas	75,668	10.6	87,167	10.9
Electricity	130,055 (110,157)[c]	18.2	149,819 (126,896)[c]	18.6
Stationary Sources	4,906	0.7	5,540	0.7
Landfills (Waste in Place)	21,295	3.0	27,232	3.4
Single Year (Future Waste Commitment)[d]	21,729	Not included	25,030	Not included
Agricultural Vehicles and Equipment	76,025 (70,931)[b]	10.6	75,870 (70,787)[b]	9.4
Total	**714,440**	**100.0**	**803,582**	**100.0**

[a] Accounts for Pavley I, II and Low Carbon Fuel standards and assumes no strengthening of these standards between 2020 and 2030.
[b] Accounts for Low Carbon Fuel standards.
[c] Accounts for the adopted SB 1078/SB 107 Renewable Portfolio Standards.
[d] Included for informational purposes only and assumes all waste is deposited at facilities with gas capture systems.
Source: ICF Jones & Stokes, 2009.

emissions and sinks in Butte County is also impacted by the conversion of agricultural, wild or timber land to urban land. GHG emissions due to land use change were not quantified here for the reasons discussed below in Section D.2.a.viii.

The following subsections describe projected emissions in specific sectors. Each subsection discusses relevant General Plan 2030 policies aimed at reducing GHG emissions. Additional policies that are included in Section D.2.a.ix

address focusing growth in a limited number of communities that can provide services, jobs and housing in order to reduce vehicle miles traveled and limit the conversion of agricultural land to residential and commercial development.

The impact significance determination is provided in Section D.2.a.xi. As discussed in detail below, although the proposed General Plan policies and actions provide a comprehensive framework for reducing GHG emissions, they do not ensure that the County can meet the reduction goal. Thus, this EIR concludes that buildout under the General Plan will result in a cumulatively significant and unavoidable impact related to greenhouse gas emissions.

i. Transportation Emissions (On-Road and Off-Road Vehicles and Equipment)

New residential, commercial, industrial, and public service development, a consequence of population growth in the unincorporated county that would be accommodated under General Plan 2030, will induce growth in annual vehicle miles traveled (VMT). GHG emissions are proportional to fuel consumed for on-road transportation. As described in Appendix F, the EMFAC model (EMFAC 2007) was used to estimate average fuel economy for various vehicle types in 2020 and 2030 as well as the expected fleet mix for Butte County in 2020 and 2030. The results of the EMFAC 2007 modeling indicate that vehicular traffic within Butte County with implementation of General Plan 2030, without consideration of incorporated municipality or adjacent county growth, would increase CO_2e emissions by 2020 and 2030. Emissions from vehicular traffic in 2020 would increase above 2006 levels by 59,636 $MTCO_2e$, or approximately 20 percent, and emissions in 2030 would increase above 2006 levels by 98,508 $MTCO_2e$, or approximately 33 percent. These projected vehicle emissions do not account for future legislative actions that would reduce emissions.

Forecast emissions that do account for measures included in the AB 32 Scoping Plan are shown in parentheses in Table 4.15-5. Given recent legislative and legal action on national and statewide fuel economy standards, which are discussed further in Section A, significant increases in fuel economy beyond

AB 1493 for future scenarios seem likely, but are not accounted for in the GHG forecast presented in Table 4.15-5. The GHG emissions from on-road traffic are based on data provided by the traffic engineer. The VMT estimates provided by the traffic model for current and future year included "pass-through" trips, i.e. trips that are likely not due to Butte County residents and do not originate or terminate within Butte County.

AB 1493 (Pavley I standards) has already been adopted by the California legislature. Taking into account the adopted AB 1493 standards for GHG emissions and anticipated strengthening of these standards (Pavley II)[35] in the future, there could be a reduction of 31.7 MMT CO_2e from light duty vehicles by 2020,[36] a reduction of roughly 14 percent from the transportation sector as compared to the 2020 BAU projection. This reduction has also been applied to the 2030 mobile source emissions, even if it is likely that reductions by 2030 could be larger. In April 2009, CARB approved a low carbon fuel standard that will reduce GHG emissions from vehicles by an additional 6.7 percent beyond Pavley by 2020, based on data in the AB 32 Scoping Plan. Therefore, the increased emissions from on-road vehicles for 2020 would be 281,466 $MTCO_2e$ instead of 355,386 $MTCO_2e$, and the increased emissions for 2030 would be 312,252 $MTCO_2e$ instead of 394,258 $MTCO_2e$. Projected emissions from mobile sources in 2020 and 2030, including the Pavley and low carbon fuel standard, are shown in parentheses in Table 4.15-5.

Emissions also result from the operation of off-road vehicles and equipment, including recreational equipment, lawn and garden equipment, construction and mining equipment, light commercial equipment, industrial equipment, airport ground equipment, equipment associated with rail yards and oil drilling, and pleasure crafts. Agricultural equipment is discussed separately in Section D.2.a.vii below. GHG emissions from off-road equipment in 2006

[35] Although Pavley II standards have not been formally adopted, they are quantified in the AB32 Scoping Plan. They will be considered by CARB in 2010.

[36] California Air Resources Board, February 25, 2008, *Comparison of Greenhouse Gas Reductions for the United States and Canada under U.S. CAFÉ standards and California Air Resources Board Greenhouse Gas Regulations*.

were 40,939 $MTCO_2e$. These emissions are estimated to be 51,105 $MTCO_2e$ in 2020 and 63,695 $MTCO_2e$ in 2030. The low carbon fuel standard will affect vehicles of all types, as opposed to the Pavley standards, which are targeted only at light duty vehicles. Reductions in future off-road vehicle GHG emissions due to the implementation of the low carbon fuel standard are shown in parentheses.

The proposed General Plan 2030's transportation policies related to reduction of GHGs support public transportation and alternative transportation modes and reduce vehicle miles traveled. Specific circulation-related General Plan 2030 policies are discussed below.

Policies CIR-P2.1, CIR-P2.2, and COS-P1.7, and Action COS-A1.6 provide specific measures to encourage carpooling and trip reduction. Policy CIR-P2.4 encourages employers to provide transit subsidies, bicycle facilities, telecommuting and other options to reduce commute trips. Policy CIR-P2.5 states that transit funding shall be prioritized relative to street and road construction and maintenance. Policy COS-P1.7 requires that new commercial and institutional development projects provide prioritized parking for carpools. Action COS-A1.6 directs the County to cooperate with the school districts to develop school access plans that substantially reduce automobile trips to schools and surrounding congestion.

Policies under Goal CIR-3 promote alternative modes of transportation. Policies CIR-P3.1 and CIR-P3.3 support improved connections to regional transportation services and an integrated, coordinated, and balanced multi-modal transportation system. Policy CIR-P3.2 requires that a safe, continuous, integrated and accessible pedestrian network be provided in urbanized areas to encourage walking, which will support replacement of vehicle trips with walking and bicycling. Policies CIR-P3.4 and CIR-P3.5 encourage new development to provide for alternative modes of transportation and pedestrian, bicycle, and multi-use facilities that integrate circulation and recreational use. Policy CIR-P3.6 requires that new neighborhoods provide bike and pedestrian connectivity between streets. Policy CIR-P3.9 requires that public fa-

cilities be located and designed to allow for convenient access from public transit and/or bicycle and pedestrian facilities.

Policies under Goal CIR-4 support public transit. Policy CIR-P4.1 supports public transit as a viable and attractive alternative to the use of single occupant motor vehicles. Policy CIR-P4.2 supports improved public transit service. Policy CIR-P4.3 supports public transportation programs that promote access to shopping, employment, education, healthcare, and recreation. Policy CIR-P4.6 requires that new development in areas served by existing or planned transit provide fixed transit facilities such as bus shelters and pull-outs, according to expected demand.

Policies under Goal CIR-5 support bicycling as a viable transportation mode. Policy CIR-P5.3 directs the County to integrate the bicycle system with other transportation modes by connecting bicycle routes and transit stops, providing secure bicycle parking facilities, and supporting efforts to expand accommodation of bicycles aboard buses. Policy CIR-P5.5 requires that construction or expansion of major arterials incorporate Class II bicycle facilities whenever feasible and consider Class III Bike routes where appropriate.

Policies and actions in the Conservation and Open Space Element promote fuel efficiency. Specifically, Policy COS-P1.7 requires that new commercial and institutional development projects provide prioritized parking for electric vehicles, hybrid vehicles, and alternative fuel vehicles. Action COS-A1.5 directs the County to prepare an anti-idling ordinance that will reduce idling by heavy duty vehicles.

In addition, the General Plan 2030 Land Use Element helps to reduce VMT through the land use map and policies. In particular, high density and intense uses are directed to the areas surrounding the incorporated municipalities on the land use map, and much of the outlying areas are designated for agriculture. In support of the land use map, Policy LU-P15.1 directs the County to prevent scattered development patterns and focus development in existing urbanized areas and within unincorporated communities, and in particular

areas that have access to public services and infrastructure. Policy LU-P1.9 directs the County to allow commercial services and retail within unincorporated communities. Policy LU-P15.2 requires that new urban development be primarily located in or immediately adjoining already urbanized areas. Policy LU-P4.3 directs higher density housing along collector and arterial streets and within easy walking distance of public facilities. Policy LU-P15.3 encourages efficient urban infill development within municipal limits, municipal spheres of influence (SOIs), and existing unincorporated communities where development can readily be served by public infrastructure facilities. Finally, Policy LU-P8.3 encourages development on sites served by existing public facilities to develop at the highest allowable density and intensity.

The proposed Land Use Element also includes policies related to growth boundaries, which encourage infill development. Specifically, Goal LU-13 and its associated policies maintain the Chico Greenline, which limits urban expansion west of Chico. In addition, Policy LU-P2.4 directs the County to engage willing and interested unincorporated communities in community planning processes to set a community vision, which may include the development of urban growth boundaries, community boundaries and SOIs.

ii. Natural Gas

In the context of this inventory, direct energy consumption refers to natural gas usage in homes and businesses for heating, cooking or other purposes. These emissions are direct because the burning of natural gas takes place directly at the facility (i.e., homes and businesses), as opposed to at an off-site power plant. Emissions associated with fossil fuels burned to produce electricity are discussed in the Section D.2.a.ii and are described as "indirect emissions."

New buildings allowed by General Plan 2030 would consume natural gas for heating, cooking, and other processes. In 2006, direct energy consumption comprised 10.3 percent of the GHG budget for the county. By 2020, residential, commercial and industrial development allowed by General Plan 2030

would result in estimated new annual CO_2 emissions of 75,668 metric tons, and by 2030, 87,167 metric tons.

There are no policies in General Plan 2030 that specifically address natural gas consumption. However, numerous policies and actions address energy conservation as a whole, and these are discussed in Section D.2.a.iii, below.

iii. Electricity

New buildings allowed by General Plan 2030 would also consume electricity. Using the 2006 emission factors for current energy providers in Butte County, by 2020, residential and commercial development allowed by General Plan 2030 would result in an estimated increase in annual indirect GHG emissions of 23,078 $MTCO_2e$ related to electricity under BAU conditions. This is a 22 percent increase above current conditions. In addition, by 2030, residential and commercial development allowed by General Plan 2030 would result in an estimated increase in annual indirect GHG emissions of 42,842 $MTCO_2e$ related to electricity under BAU conditions, which is a 40 percent increase above current conditions.

The AB 32 Scoping Plan, which is discussed in Section A.2.j, and Executive Order S-21-09, which is discussed in Section A.2.d, call for an increase in Renewable Portfolio Standards (RPS) to 33 percent by 2020, which is estimated to result in a 15.3 percent reduction in GHG emissions compared to current conditions. Taking into account the adopted SB 1078/SB 107 RPS standards, GHG emissions related to electricity consumption in the project area in 2020 and 2030 are 110,157 $MTCO_2e$ and 126,896 $MTCO_2e$, respectively, as shown in parentheses in Table 4.15-5.

GHG emissions due to the consumption of electricity in California are controlled by a variety of factors and vary considerably from year to year. The carbon intensity of electricity consumed in Butte County is related to the ratio of power produced within California to that purchased from out of state sources. Currently, power produced within California is of a lower carbon intensity than the national average. During years when California power

providers must purchase a larger portion of power from outside the state, the associated GHG emissions are higher. Factors influencing the ability of in-state power availability to meet instate demands include water resources for hydropower and peak summer temperatures. Even if California power providers significantly increase the portion of renewable power within their portfolio, the true GHG reductions from year-to-year may largely depend on power demand in the state.

General Plan 2030 includes numerous policies and actions that promote the development of alternative energy and conservation of energy within Butte County.

Policies and actions under Goal COS-2 promote green building, planning and business. Policy COS-P2.2 requires new development to comply with Green Building Standards adopted by the California Building Standards Commission. Policy COS-P2.3 requires all new County buildings to meet LEED-Silver or an equivalent rating system and to use these buildings to demonstrate green building practices to builders, developers, and homeowners. Policy COS-P2.4 encourages all new subdivisions and developments to meet green planning standards. In addition, Action COS-A2.1 directs the County to design and publish handouts and web-based information describing green building practices and explaining relevant County permitting approval processes, Action COS-A2.2 directs the County to develop and publicize a certified green business/institution program, Action COS-A2.3 directs the County to develop and adopt incentives for the construction of green building, and Action COS-A2.4 directs the County to train all plan review and inspection staff in green building materials, techniques and practices. In addition, Action COS-A2.5 directs the County to prepare and adopt a Green Building Ordinance within 24 months of the adoption of the General Plan 2030.

Policies and actions under Goal COS-3 promote a sustainable energy supply. Policies COS-P3.1 and COS-P3.2 encourage the expansion and increased efficiency of hydroelectric power plants and the development of renewable fuel

sources in the county, provided that such plants and fuel sources can be expanded and developed without degrading the natural environment and that any significant adverse environmental impacts associated with such plants can be successfully mitigated. Policy COS-P3.4 encourages solar-oriented and renewable design and grid-neutral development. Policy COS-P3.5 requires developers to give homebuyers the option of having renewable heat and power incorporated into new homes. Policy COS-P3.6 requires that alternative energy sources continue to be used for County facilities. In addition, Action COS-A3.1 directs the County to prepare an Alternative Energy Promotion Study.

Policies under Goal COS-4 promote energy efficiency. Policy COS-P4.1 promotes and rewards energy efficiency efforts of local businesses. Policy COS-P4.3 requires that new development meet the guidelines of the California Energy Star New Homes Program, or equivalent, and demonstrate detailed energy conservation measures. Policy COS-P4.4 requires that site and structure designs for new development projects maximize energy efficiency.

General Plan 2030 also includes other policies and actions related to renewable energy and energy conservation. Economic Development Action ED-A1.1 recommends that, as part of a countywide economic development plan, the County promote sustainable business and new economic opportunities related to renewable energy. Policy ED-P2.7 supports programs and projects that utilize agricultural by-products for green building material production and/or renewable energy production. Circulation Element Policy CIR-P2.5 requires that transportation corridors for renewable energy transmission be preserved. In addition, Action COS-A1.3 directs the County to consider contractual assessment programs in addition to AB 811 that promote the installation of renewable power systems by residential and commercial property owners.

iv. Stationary Sources

Currently, 1,400 acres are used for industrial purposes in unincorporated Butte County. Sectors that drive the industrial activities in Butte County

include agriculture, oil, gas, and timber; these sectors also support manufacturing, transportation and warehousing.[37] Small industrial and commercial complexes, such as feed or machinery sales, well-drilling services, spray operations, and food processing, are also dispersed throughout the area. Data for permitted stationary sources within Butte County indicate that industrial process emissions in 2006 are 4,093 $MMCO_2e$,[38] and account for 0.7 percent of the 2006 inventory.

New industries allowed by General Plan 2030 would consume fossil fuels, thereby emitting GHGs. Specific industrial processes may also release GHGs in addition to those related to the burning of fuel. The specific nature of new industrial development is unknown; however, an estimate of industrial emissions in 2030 was made by scaling the current industrial GHG emissions by the projected 2030 buildout for the proposed project. Based on this projection, there would be an increase of industrial facilities by 21 percent by 2020 and 35 percent by 2030. Thus, increased GHG emissions in 2020 and 2030 due to new growth are estimated to be 4,906 $MTCO_2e$ and 5,540 $MTCO_2e$, respectively. Currently, industrial emissions account for 0.7 percent of Butte County's inventory and are projected to remain a small portion of 2020 and 2030 GHG emissions.

General Plan 2030 includes policies that would help to reduce GHG emissions from industrial development. Land Use Element Policy LU-P8.1 requires that industry be located near major transportation facilities, and Policy LU-P8.4 encourages new industrial development to be located within existing industrial use areas until such areas have been fully utilized. Policy LU-P5.2 requires that industrial and heavy commercial uses be grouped into industrial parks. Policy LU-P5.3 requires that new industrial uses be designed to reduce

[37] Dun & Bradstreet and the Center for Economic Development at California State University, Chico, 2009, *Business/Organization Sales in Unincorporated Butte County*.

[38] Lusk, David, Butte County Air Quality Management District, personal communication with Margaret Williams, ICF Jones & Stokes, September 17, 2009.

adverse impacts on neighboring land uses by reducing noise, air quality, water quality, biological, agricultural, vibration and dust related impacts.

v. Waste – Landfill Emissions (Waste in Place)

Organic waste, when placed in a landfill, is initially decomposed by aerobic bacteria. After oxygen has been depleted, anaerobic bacteria continue to break down waste. The products of this process support CH_4-producing bacteria, which consume remaining waste byproducts to produce a mixture of roughly 50 percent CH_4 and 50 percent CO_2. CO_2 produced through the decomposition of solid waste is considered biogenic in origin[39] and is not included in the 2006 inventory or 2020/2030 projection. However, as described in Section B.2.b, above, CH_4 is a GHG and is the second largest contributor to anthropogenic GHG emissions. This section considers CH_4 emissions from landfills in Butte County.

GHG emissions from landfills are the result of the decay of waste produced over many years; the waste is not necessarily produced within the jurisdiction where the landfill is located. The Local Government Operating Protocol recommends that a landfill be included in a jurisdiction's inventory if it solely owns and operates the facility, even if the facility receives waste from many other jurisdictions.[40] The Neal Road Recycling and Waste Facility (Neal Road Facility) is included in this evaluation of the county's emissions because the facility is owned and operated by Butte County.

Development allowed by General Plan 2030 would result in increased generation of waste that would require disposal in landfills, resulting in an increase

[39] IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[40] ICLEI-Local Governments for Sustainability, August 2008, *Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories*.

in CH_4 emissions. Currently, 100 percent of waste generated in unincorporated Butte County remains in Butte County and is deposited at the Neal Road Facility.[41]

The Neal Road Facility opened in 1965, is scheduled to close in 2033, and contains two disposal pits, one of which was filled and closed in 2004. The second pit opened in 2005 and will have a gas to energy system installed and operational by 2011. The system is expected to produce 4.5 megawatts of electricity when completed. The Neal Road Facility currently has a gas flaring system installed[42] that reduces CH_4 emissions by roughly 75 percent from emissions in the absence of a gas capture system.[43]

Future emissions from waste in place were estimated according to current per capita waste generation and population growth rates for the region. For all emissions from landfilled waste, a 75 percent collection efficiency was applied. For the inventory year, 2006, GHG emissions from the Neal Road Facility are estimated to be 14,247 $MTCO_2e$ and comprise 2.4 percent of the total 2006 GHG budget. GHG emissions in 2020 are projected to be 21,295 $MTCO_2e$ and comprise 3.0 percent of the 2020 GHG budget. GHG emissions in 2030 are projected to be 27,232 $MTCO_2e$ and comprise 3.4 percent of the 2020 GHG budget.

Given the current and planned implementation of landfill gas capture and use of waste-to-energy technology in the future, future waste disposal may not contribute substantial amounts of CH_4. However, until full capture and re-

[41] California Integrated Waste Management Board, 2009, *California Waste Stream Profiles Homepage,* http://www.ciwmb.ca.gov/Profiles/, accessed September 15, 2009, and Mannel, Bill, Butte County Public Works Department, personal communication with Joanna Jansen, DC&E, February 23, 2010.

[42] Mannel, Bill, Butte County Public Works Department, personal communication with Margaret Williams, ICF Jones & Stokes, September 24, 2009.

[43] ICLEI-Local Governments for Sustainability, August 2008, *Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories*.

use of landfill gas is achieved, there will be increased emissions associated with additional waste disposal.

General Plan 2030 includes policies and actions that help to reduce GHG emissions from landfills. Action COS-A1.7 directs the County to upgrade methane capture systems at the Neal Road Facility to achieve a minimum 75 percent methane removal efficiency, with a goal to progress toward 90 percent methane removal efficiency when practicable. Public Facilities and Services Element Policy PUB-P9.1 encourages Butte County residents, businesses and industries to reduce the use of non-biodegradable and nonrecyclable materials. Policy PUB-P9.2 promotes technologies that benefit Butte County and that allow the use of solid waste as an alternative energy source, including biomass or biofuels. Policy PUB-P9.3 requires that innovative strategies be employed to ensure efficient and cost-effective solid waste and other discarded materials collection, disposal, transfer, and processing. Finally, Policy PUB-P11.4 directs the County to use post-consumer recycled paper and other recycled materials for County operations whenever possible. In addition, Action PUB-A9.2 directs the County to distribute public education materials on solid waste source reduction, recycling and composting, and the proper handling of household hazardous waste.

In addition, as indicated in Section A.2.j and A.2.l, landfill emissions are regulated under AB 939, Titles 14 and 27, and CARB has proposed a rule requiring gas capture and collection for landfills having at least 450,000 tons of waste in place and establishing performance standards for systems already installed.

vi. Waste - Single Year (Future Waste Commitment)

Since waste deposited in a landfill will remain in the landfill for many years, GHG emissions from solid waste can also be represented in terms of the methane commitment of a single year's waste that is generated by a particular jurisdiction. These GHG emissions occur over the lifetime of the waste, regardless of where the waste is deposited, and are a direct reflection of current patterns and practices within a jurisdiction. As indicated in Section D.2.a.v,

emissions from waste in place at the Neal Road Facility were included in the inventory and projection, consistent with the Local Government Operating Protocol. Since inclusion of both a single year snapshot of a jurisdiction's waste and waste in place emissions would be "double-counting," emissions from a single year's waste are included in the inventory for informational purposes only. Although included in the inventory total, landfill emissions may not offer much mitigation potential, particularly for landfills with landfill gas to energy (LFGTE) systems already in place, as is the case at the Neal Road Facility. However, indirect, population-based emissions may reveal opportunities for cost-effective mitigation options aimed at reducing the waste generated in residences and businesses. The single year emissions estimate is included for this purpose.

In 2008,[44] data from the California Integrated Waste Management Board indicate that Butte County produced 66,468 tons of waste,[45] resulting in 17,873 $MTCO_2e$ over the lifetime of the waste. The projected 2030 buildout for the proposed project indicates that there would be an increase in the unincorporated county's population by 33,600 people, or roughly 40 percent, by 2030. Assuming per capita waste generation remains constant, the unincorporated portion of Butte County will produce 80,806 tons of solid waste in 2020 and 93,085 tons of solid waste in 2030. If all of this waste is placed in landfills with energy recovery systems, the resulting methane or GHG commitment of the waste is 21,729 $MTCO_2e$ for waste generated in 2020 and 25,030 $MTCO_2e$ for waste generated in 2030.

As discussed in Section D.2.a.v, the Conservation and Open Space and Public Facilities and Services Elements of General Plan 2030 contains policies and actions designed to provide safe, sanitary and environmentally acceptable solid waste management services, as well as to reduce non-biodegradable waste in general and convert waste to energy.

[44] 2006 data was not available for this source type.

[45] California Integrated Waste Management Board, 2009, *California Waste Stream Profiles Homepage,* http://www.ciwmb.ca.gov/Profiles/, accessed September 15, 2009.

vii. Agricultural Emissions

Agriculture is the dominant land use within unincorporated Butte County, accounting for approximately 599,040 acres, or 60 percent of the area of the unincorporated county. As described in Appendix F, GHG emissions from agricultural equipment and vehicles were estimated using the OFF-ROAD model. Agricultural vehicle and equipment emissions in 2006 were 77,019 $MTCO_2e$, or approximately 12.8 percent of emissions associated with on-road vehicles. In 2020, GHG emissions from agricultural equipment are estimated to be 76,025 $MTCO_2e$, and in 2030, 75,870 $MTCO_2e$. Accounting for reductions associated with implementation of the low carbon fuel standard reduces these emissions to 70,931 $MTCO_2e$ and 70,787 $MTCO_2e$ in 2020 and 2030, respectively.

This analysis only quantified agricultural emissions associated with agricultural vehicles and equipment. Agricultural GHG emissions are also related to enteric fermentation, livestock manure management, and other crop management practices, but are not quantified in this EIR. Quantitative estimates of emissions associated with rice cultivation, fertilizer usage, livestock and other agriculture practices were not included in this inventory due to analytical limitations, since such estimates must be based on detailed information regarding fertilizer type and usage and day-to-day practices that vary substantially from farm to farm depending on size, location and primary crops or livestock. Although these emissions are not included in the inventory, they should be considered in future inventories as methodology for assessing these emissions improves and site specific agricultural data availability increases. In the United States overall, agriculture represents 8.6 percent of the nation's total GHG emissions, including 80 percent of its nitrous oxide emissions and 31 percent of its methane emissions.[46]

Rice is one of the three most land-intensive crops in Butte County, which, along with walnuts and almonds, account for a third of the county's total agricultural acreage. According to a UC Davis study on rice cultivation in

[46] US Global Change Research Program, June 16, 2009, *Global Climate Change Impacts in the United States*.

California, Butte County had nearly 100,000 acres devoted to rice in 1996.[47] CH_4 is produced during flooded rice cultivation by the anaerobic (without oxygen) decomposition of organic matter in the soil. Flooded soils are ideal environments for CH_4 production because of their high levels of organic substrates, oxygen-depleted conditions, and moisture. Nationwide, rice cultivation resulted in the release of 6.2 $MMTCO_2e$ in 2007.[48] Emissions vary considerably depending on soil conditions, farming practices and climate. As noted above, emissions from this source were not quantified for this inventory.

As noted above, GHG emissions associated with agricultural water use were not quantified in this analysis. However, energy is consumed in the transport, storage and treatment of water, which results in GHG emissions. The County updated its water resource inventory in 2008 as part of the Integrated Water Resources Plan (IWRP). The IWRP indicates that the majority of the water demand in Butte County occurs in the valley areas due to the concentration of urban populations and farming. Agricultural water needs constitute 71 percent of the total demand in all of Butte County, including the incorporated municipalities.[49]

Historically, the County has not experienced water shortages in normal years, but has occasionally had shortages in specific areas, such as the southwest portion of the county, in dry years. Several statewide climate change

[47] Hill, J.E., S.R. Roberts, D.M. Brandon, S.C. Scardaci, J.F. Williams, and R.G. Mutters, September 23 1998, *Rice Production in California*, http://www.plantsciences.ucdavis.edu/uccerice/PRODUCT/rpic01.htm, accessed September 30, 2009.

[48] US Environmental Protection Agency, April 2009, *U. S. Greenhouse Gas Inventory – Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2007*.

[49] Butte County Integrated Water Resources Plan, http://www.buttecounty.net/Water%20and%20Resource%20Conservation/Butte%20IWRP/IWRP.aspx accessed on July 30, 2009.

impact studies[50,51] indicate that California will experience reduced water resources as a consequence of climate change. However, the specific change in water supplies in Butte County has not been assessed and will depend on the balance of hydrologic changes, such as precipitation levels and types and evapotranspiration, as well as storage conditions. Due to the large portion of State resources devoted to agriculture, future GHG inventories should address the impact of agricultural water use on regional GHG emissions, as well as the impact of climate change on water resources in the region.

The proposed General Plan 2030 includes agricultural policies that can act to reduce GHG emissions; these are generally focused around water and resource conservation, conservation of agriculture lands from transformation to urban uses, and promotion of sustainable agriculture.

Policies under Goal AG-2 aim to protect agricultural land from conversion to non-agricultural uses. In particular, Policy AG-P2.1 directs the County to work with the Local Agency Formation Commission (LAFCO) to create and maintain a consistent approach to the conservation of agricultural land through the designation of reasonable and logical SOI boundaries. Policy AG-P2.6 directs the County to retain and protect agricultural lands through the use of proactive land use techniques, such as clustered development and density bonuses.

In addition, Policy AG-P3.1 directs the County to use the existing local working group process to cooperate with the Natural Resource Conservation Service to provide support to farmers regarding conserving water, planting drought-tolerant crops, and protecting natural resources. Policy AG-P3.2 supports existing efforts to educate and encourage farmers to use agricultural

[50] California Natural Resources Agency, 2009, *2009 Climate Adaptation Strategy Discussion Draft – A Report Prepared for the Governor of the State of California in Response to Executive Order S-13-2008*.

[51] California Energy Commission, May 2009, *The Future Is Now – An Update on Climate Change Science Impacts and Response Options for California*, CEC-500-2008-071, prepared by the California Climate Change Center.

methods that reduce or minimize use of pesticides, herbicides, and manufactured fertilizer.

Furthermore, Policy COS-P1.6 directs the County to recognize and promote the emerging market for agricultural producers to provide carbon sequestration services.

viii. Emissions Associated with Land Use Changes

Development allowed by General Plan 2030 would result in the conversion of natural vegetation and agricultural lands to other land uses such as residential and commercial. Since natural vegetation and agricultural lands can act as carbon sinks, this land conversion could result in a loss of carbon sinks. However, given the uncertainties associated with estimating GHG fluxes from natural vegetation and agricultural lands, the potential loss of carbon sinks associated with land conversion was not quantified. Furthermore, the impact of increasing or decreasing the extent of timberlands in the region was not quantified because the County does not exert discretionary land use authority over the permitting of timber operations. Such authority is under State jurisdiction for private lands and under federal jurisdiction for federal lands.

A number of General Plan 2030 policies seek to limit the amount of natural land conversion due to urban growth. Land use policies in General Plan 2030 that would result in reduced GHG emissions generally support higher density development in the urban areas and placing jobs close to transit. Specific land use-related policies are discussed below.

Policy LU-P1.1 directs the County to protect and conserve land that is used for agricultural purposes. Policy LU-P15.1 directs the County to prevent scattered development patterns and focus development in existing urbanized areas and within unincorporated communities, and in particular areas that have access to public services and infrastructure. Policy LU-P1.5 directs the County to conserve timber resources.

In addition, Policy LU-P15.2 requires new urban development to be primarily located in or immediately adjoining already urbanized areas. Policy LU-P4.3 requires higher density housing to generally be located along collector and arterial streets and within easy walking distance of public facilities. Policy LU-P8.1 requires industry to be located near major transportation facilities. Policy LU-P15.3 encourages efficient urban infill development within municipal limits, municipal SOIs, and existing unincorporated communities where development can readily be served by public infrastructure facilities.

Finally, policies under Goal LU-13 maintain the Chico Area Greenline, which limits urban development in the Chico area. In particular, Policy LU-P13.1 maintains the Chico Area Greenline, and Policy LU-P13.5 requires that all land use on the Agricultural Side of the Chico Area Greenline consist solely of agricultural land uses, except for Rural Residential uses provided for on the land use map.

ix. GHG Emissions from Additional Sources not Quantified

In addition to the sources described above, GHG emissions can result from embodied emissions associated with water usage and conveyance, material manufacture and transport outside of the county, timberland management, and fertilizer consumption. Emissions associated with land use change are discussed in Section D.2.a.viii. Emissions and/or carbon sinks were not quantified from these sources due to a lack of appropriate standard methodologies at this time. As scientific understanding of carbon cycling through these sources improves, methodologies for quantifying these sources and carbon sinks in local-scale inventories will become available. They are discussed herein qualitatively.

Policies in General Plan 2030 that aim to reduce GHG emissions from sectors not specifically quantified in this inventory, but that may address the inventory categories listed above, are discussed below.

a) Water Resources Element

General Plan 2030's water resources-related policies related to GHG emissions reductions support water conservation and increased recycling of water. Specifically, Policy W-P4.1 promotes agricultural and urban water use efficiency. Policy W-P4.3 directs the County to work with municipal and industrial water purveyors to implement water conservation policies and measures. Policies W-P4.4 and W-P4.5 promote opportunities to recover and utilize wastewater for beneficial purposes. Policy W-P4.6 requires new development to adopt best management practices for water use efficiency and demonstrate specific water conservation measures. Policy W-P4.7 requires County facilities to adopt water conservation measures and when appropriate retrofit existing facilities.

b) Conservation and Open Space Element

General Plan 2030's conservation and open space-related policies related to GHG emissions reductions support decreased GHG emissions, increased open space, tree conservation, alternative energy, and energy efficiency. Conservation and open space-related General Plan 2030 policies and actions are discussed below.

Policies and actions under Goal COS-1 aim to reduce GHG emissions. Policy COS-P1.1 requires GHG emission impacts from proposed projects to be evaluated as required by CEQA, and Policy COS-P1.2 requires new development projects to mitigate GHG emissions on-site or as close to the site as possible. In addition, Action COS-A1.1 directs the County to, within one year of adoption of General Plan 2030, coordinate with regional agencies to develop a Climate Action Plan, which, in combination with other existing policies and regulations by other agencies and business sectors of the economy, would reduce GHG emissions in the county to a level that would comply with State guidelines. The action also lists specific components that shall be included in the Climate Action Plan.

In addition, Policy COS-P7.2 encourages clustered development patterns to conserve natural areas, and Policy COS-P11.1 supports State and federal legis-

lation designed to protect timber resources and promote sustainable timber production.

c) Public Facilities and Services Element

As discussed in Section D.2.a.v, the General Plan 2030 Public Facilities and Services Element includes polices that promote water conservation and efficiency, which saves pumping energy, and waste reduction and recycling, which reduces landfill-related GHG emissions and emissions associated with goods fabrication. In addition, Policy PUB-P1.2 requires County facilities to be designed, constructed, and operated to be environmentally sustainable and beneficial to the community and the region.

x. Area Plan Policies

The following area, neighborhood and specific plans have already been adopted, and will remain as separate, stand-alone documents with the adoption of General Plan 2030. These plans include policies that would further address GHG emissions, in addition to those proposed in General Plan 2030 discussed above.

- **Durham-Dayton-Nelson Area Plan.** This Area Plan was adopted in 1992 and covers the unincorporated communities of Durham, Dayton and Nelson in west-central Butte County. Goal 4, Policy 4 of the Area Plan directs the County to foster a compact rather than a scattered development pattern. Goal 8, Policy 1 directs the County to concentrate future residential uses within or near the existing developed communities. Goal 8, Policy 3 directs the County to establish appropriate growth guidelines that will achieve a balance and relationship between urban expansion and the natural environment.
- **Chapman/Mulberry Neighborhood Plan.** This Neighborhood Plan was adopted in 1999 for the Chapman/Mulberry area, which includes two unincorporated "islands" located within the Chico urban area. The Plan's Neighborhood Design and Buffer Policy 3 requires that the urban forest of the neighborhood be preserved and expanded. Circulation Policy 5 requires that a pedestrian and bicycle circulation plan be implemented, and that it be developed within the community park and pro-

vide for both internal and external linkages. Circulation Policy 6 directs County Transit and Chico Area Transit to cooperate to ensure that public transit routes and stops are available to and within the Chapman/Mulberry Neighborhood, and that where possible, stops are designed with turn-outs that minimize disruption of traffic flow.

- **North Chico Specific Plan.** This Specific Plan was adopted in January 1995, and encompasses 3,590 acres bounded by Sycamore Creek to the south, Highway 99 to the west, Rock Creek to the north and the Chico Municipal Airport to the east. The Plan's Circulation Policy 5 requires that the arterial street design provide for bus turnouts and for the location of bus shelters. Circulation Policy 7 encourages non-vehicular access throughout the Plan area and to the commercial and industrial areas by requiring the construction of sidewalks, pedestrian and bicycle paths, and bicycle parking facilities.

- **Stringtown Mountain Specific Plan.** This Specific Plan, adopted in September 1994, addresses design criteria and development standards for the future development of a health resort and residential community in the foothills east of Oroville, at Highway 162 and Forbestown Road. The Plan's Pedestrian Circulation Policy 1 requires that all sub-areas within the Plan be designed to facilitate pedestrian cross-connections to adjacent uses and access to the area-wide trail system. Pedestrian Circulation Policy 2 requires bicycle racks within the commercial areas that are visible from the entry. Energy Conservation Policy 1 encourages tree planting and maintenance in all parking areas to ensure that, within 15 years of planting, at least 50 percent of the parking area is shaded at midday during the summer season. Energy Conservation Policy 2 requires deciduous trees, which aid summer cooling and allow solar gain for winter heating, to be used around buildings and parking areas. Energy Conservation Policy 3 and Utilities Policy 5 require all cost-effective energy conservation and peak usage reduction measures required by Title 24 to be incorporated in building and development design. Energy Conservation Policy 4 requires that subdivisions and other new development be designed to facilitate solar use where feasible and given physical constraints of the area.

xi. Impact Significance Determination

Many of the policies identified in the proposed General Plan 2030 related to land use, agriculture, water resources, circulation, open space and conservation, and public services could reduce GHG emissions from the baseline emissions that would occur in the absence of these policies; reductions associated with these policies have not been quantified or accounted for in the BAU projection.

As shown above in Table 4.15-5, GHG emissions in Butte County under BAU conditions would result in 2020 emissions that are 18.8 percent higher than current 2006 GHG emissions, without consideration of currently adopted programs, including AB 1493 and SB 1078/SB 107. With consideration of currently adopted programs at the State level, and with no further action on the part of the County, GHG emissions would be 1.8 percent more than current 2006 emissions in 2020 and 14.3 percent less than the 2020 BAU projection. This amount exceeds the significance threshold of 15 percent below current GHG emissions and demonstrates that further action is required for the County to meet its fair share of the statewide AB 32 reduction goal.

In addition, GHG emissions in Butte County under BAU conditions would result in 2030 emissions that are 33.6 percent higher than current 2006 GHG emissions, without consideration of currently adopted programs. With consideration of currently adopted programs at the State level and no further action on the part of the County, GHG emissions would be 14.6 percent more than current 2006 emissions in 2030.

Proposed General Plan 2030 policies and actions provide a comprehensive framework for reducing GHG emissions in the county. In particular, the Climate Action Plan requirements under Action COS-A1.1 would assist California in meeting the reduction goals for 2020 that are embodied in AB 32, and would ensure that GHG emissions in Butte County would not contribute considerably to cumulative GHG emissions and associated climate change effects. However, until the Climate Action Plan is fully developed, it cannot be assured that all measures to achieve the needed GHG reduction are feasi-

ble. Furthermore, although Action COS-A1.1 requires that the County update the Climate Action Plan by 2020 to include reduction measures to achieve the adopted 2030 reduction goal, State action beyond 2020 is uncertain as there are no adopted State plans to achieve reductions beyond 2020. Thus, even if the County were to achieve its stated 2030 reduction goals, given the limitations on County authority (e.g. lack of authority over vehicle emissions), GHG emissions in the county would still contribute considerably to 2030 cumulative emissions. Therefore, the proposed project would have a significant GHG emission impact.

b. Subject property and persons to additional risk of physical harm related to flooding, public health, wildfire risk and other impacts resulting from climate change.

The assessment of climate change in this section is based on a spatial analysis of impacts resulting from implementation of General Plan 2030. Existing and new development and the natural environment in Butte County will be subject to climate change impacts resulting from past, present, and future GHG emissions, regardless of the success of local, State, national, or international efforts in reducing future GHG emissions. Due to the existing concentrations of GHG emissions in the atmosphere and the inevitable additional emissions before GHG reductions plans provide reductions, a known amount of warming in the lower atmosphere and consequent changes in historical climate patterns will inevitably occur.[52]

Changes to Butte County agriculture, water supplies, flooding, wildfire potential, environmental health, air quality and other areas are reasonably foreseeable, although not quantifiable in some aspects at present. New development allowed by General Plan 2030 could place persons and property at higher levels of risk to climate change effects if it does not anticipate reasona-

[52] IPCC, 2007, *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt,M. Tignor and H.L. Miller (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

bly foreseeable changes in environmental conditions. Without further planning, current requirements may provide inadequate protection against adverse physical impacts and may not anticipate changed conditions resulting from climate change.

A recent report from the CEC uses a range of emissions scenarios developed by the IPCC to project a series of potential warming ranges with temperature increases from 3.0 to 10.5 degrees Fahrenheit.[53] The report also analyzes impacts associated with a specific warming scenario of 2.2 degrees Fahrenheit, the level of warming that would result if industrialized nations reduced their emissions by 30 percent below 1990 levels before 2020, and the level of warming that guides numerous adopted and proposed policies. The report presents analysis of future climate in California under each warming range.

Based on this report, substantial temperature increases would result in a variety of impacts to the people, economy, and environment of California, including impacts related to public health, water resources, flooding, agriculture, forests and ecosystems, sea-level rise, growing energy demands, and vulnerability to the Sacramento-San Joaquin Delta. Sea level rise does not pose an immediate threat to Butte County due to its inland location and is not discussed further in this EIR, nor are specific impacts associated with the Delta. Anticipated impacts that will result from a warming of the lower atmosphere are described by sector below.

i. Public Health

Public health impacts associated with a changing climate depend not only on climatic conditions, but also on the specific populations in question and the community's ability to deal with new stress. The most recent CEC-sponsored impacts report defines the measure of a community's ability to

[53] California Energy Commission, May 2009, *The Future Is Now – An Update on Climate Change Science Impacts and Response Options For California*, CEC-500-2008-071, prepared by the California Climate Change Center.

respond to stresses and shocks as "social vulnerability."[54] Social vulnerability is projected to increase in California in coming decades regardless of climatic changes due to demographic changes in the state that will further stress the public health system.

Climate change could affect the health of county residents by increasing the frequency, duration, and intensity of conditions conducive to air pollution formation; increased frequency and intensity of heat-waves; and wildfires. Extreme heat events are particularly challenging for the elderly, infants, the infirm, and others exposed to relentless heat, such as agricultural laborers or people without access to cooling spaces and air conditioning. The primary concern is not the change in average climate, but rather the projected increase in extreme conditions or natural hazards that are responsible for the most serious health consequences, such as heat waves, drought and extremely poor air quality.

In general, urban areas and the southern portion of the state are projected to be most vulnerable to the increased frequency and duration of heat waves. However, climate model projections indicate that for the Butte County region, the duration of extreme heat events will increase at a rate of approximately 1 day per decade. Additionally, the frequency of heat waves is expected to increase in the region. From 1950 to 2000, a heat wave was experienced in approximately 40 percent of the years. The frequency is expected to increase to 80 percent before 2100.[55] Residents in regions experiencing increased frequency and duration of extreme events may find it increasingly difficult to cope with climate-related stresses. In coming years, communities

[54] English, et al., 2007, as cited in California Energy Commission, May 2009, *The Future Is Now – An Update on Climate Change Science Impacts and Response Options For California*, CEC-500-2008-071, prepared by the California Climate Change Center.

[55] California Energy Commission, March 2009, *Current and Future Impacts of Extreme events in California,* CEC-500-2009-026-D, prepared for the California Climate Change Center by M.D. Mastrandrea, C. Tebaldi, C.P. Snyder and S. H. Schneider.

may require additional public resources or actions to address this need and to avoid potential harm.

ii. Water Resources

Butte County's water resources could be altered due to climate change. It is unknown at present whether climate change may lead to significant changes in precipitation within the county boundaries, which would affect the likelihood that water supplies would change. From a statewide perspective, water resource management in the face of climate change is among the largest challenge facing California. The combination of a growing population and increasingly unreliable surface water storage will tax delivery of water to residential, commercial, energy, environmental and agricultural sources. Currently, about 50 percent of water used in California for human consumption comes from groundwater, and intense scientific study is now focused on understanding the interplay of groundwater supplies, precipitation patterns, groundwater recharge, snowpack, and usage in California. The connectedness of the California water system renders Butte County potentially vulnerable to water scarcity in the future.

iii. Hydrology and Flooding

At present, it is uncertain whether areas like Butte County will experience increases, decreases, or no change in precipitation due to climate change. Atmospheric modeling at scales that can provide meaningful precipitation projections at the county level is an active area of research, and in coming decades, a better scientific foundation for forecasting this impact at the county level will likely be available. However, regional climate change modeling for northern California shows a decrease in precipitation falling as snow and an increase in rainfall during the winter, as well as an increase in the frequency of intense rainfall events.[56] These conditions will heighten local flood risk. Furthermore, as reliability of the snowpack declines and snowmelt oc-

[56] Knowles, et al., 2006, as cited in California Energy Commission, May 2009, *The Future Is Now – An Update on Climate Change Science Impacts and Response Options For California*, CEC-500-2008-071, prepared by the California Climate Change Center.

curs earlier in the year, water managers must adapt infrastructure and procedures to capture and bank winter rainfall to avoid summer shortages.

Localized studies of potential changes in storm intensity have not been conducted for Butte County. On a broad level for California, there is a potential increase in the severity of winter storms due to climate change.[57] If this were to occur, peak stream flows may increase, which would increase the risk of flooding beyond the existing risk levels in the county.

iv. Agriculture

Agriculture, along with forestry, is the sector of the California economy that may be most affected by a change in climate. In 2004, income from California agriculture accounted for 13 percent of the US total income. Currently, agricultural land uses account for 60 percent of the area of unincorporated Butte County. Agricultural lands in Butte County currently include field and row crops, orchards, rice, grazing, dry farming, and timber.

Crops vary in their vulnerability to various climate-related impacts, such as increasing temperature, declining water availability and reduced air quality. In general, agricultural impacts associated with a warming climate may include the following:

- Crop yield changes.
- Changes in crop types and cultivars.
- New weed invasions and expanded ranges of existing weeds.
- New pest invasions and expanded ranges of existing pests.
- Flooding and crop pollination changes.
- Heat waves and heat stress resulting in low crop quality and/or low crop yields, increased vulnerability to pests, increased animal vulnerability to disease, increased animal mortality, and decreased animal production.

[57] California Natural Resources Agency, 2009, *2009 Climate Adaptation Strategy Discussion Draft – A Report Prepared for the Governor of the State of California in Response to Executive Order S-13-2008*.

The CEC recently released a report detailing specific climate change impacts to the agricultural sector.[58] The CEC report focuses on impacts associated with increased temperatures by county and crop type, including decreased chill hours and lengthened growing season, and did not address water availability fluctuations associated with a changing climate, vulnerability to flooding, or changes in weed and pest ranges. The report also does not address embodied impacts associated with changes in California's water supply or decreased air quality. In general, the report concluded that statewide profits from agriculture would not be negatively impacted by climate change, assuming water resources and farm prices remained constant. Both assumptions represent significant uncertainty in the study. Specifically, the study found that individual crops vary in their response to warmer temperatures. Of the 15 largest grossing crops in California, tomatoes, rice, oranges, lemons, food grapes, avocados and almonds are expected to show a decrease in annual crop value of production of between 2 and 50 percent. Walnuts, strawberries and wine grapes show no change in production value, while pistachios, lettuce, hay, cotton and broccoli show an increase in value of production of between 2 and 50 percent.

Regional analyses of climate trends over agricultural regions of California suggest that climate change is already in motion. The number of chill hours in California's fruit growing region has been decreasing steadily since 1950, with the most significant decreases observed in the mid-Sacramento valley. Fruit quality and overall economic value is reduced when the minimum number of chill hours are not met. Conversely, the production of certain wine grapes is expected to benefit from a reduction in the number of chill hours, at least within certain ranges of warming. Statewide, degree-days, which is a measure of the growing season, are estimated to increase between 6 and 10 percent, depending on the season,[59] but vulnerability to extreme heat

[58] California Energy Commission, August 2009, *Economic Impacts of Climate Change on California Agriculture*, CEC-500-2009-043-F.

[59] California Energy Commission, August 2009, *Economic Impacts of Climate Change on California Agriculture*, CEC-500-2009-043-F.

events is also expected to rise.[60] Elevated temperature may also impact livestock through increased mortality and decreased productivity.

v. Wildfire Risk

With climate change, the potential for wildfires may increase due to changes in fuel conditions, such as forests transitioning to chaparral and grasslands; precipitation, including longer dry seasons and higher extreme temperatures; wind, which affects the spread of wildfire; and other variables. Wildfire intensity and frequency have increased in recent years across the western United States, with the total area burned increasing nearly seven times for the period between 1987 and 2003 as compared to the period between 1970 and 1986.[61] The wildfire season in the western United States has increased by 78 days since 1979.

In 2007, almost 66 million board feet of timber was produced in Butte County, with a value of over $16 million. Timber producing areas located predominantly in the eastern portion of the county will be increasingly at risk to wildfire damage in coming decades.

Recent research indicates that statewide occurrence of fire could increase by between 37 and 94 percent before 2085 depending on the level of global warming assumed.[62] Additionally, as fires grow in size, they can result in stand-replacing burns that are too large for natural regeneration. Butte County relies on the timber industry as an economic generator. For both

[60] California Natural Resources Agency, 2009, *2009 Climate Adaptation Strategy Discussion Draft – A Report Prepared for the Governor of the State of California in Response to Executive Order S-13-2008*.

[61] Westerling, et all, 2006, as cited in California Energy Commission, May 2009, *The Future Is Now – An Update on Climate Change Science Impacts and Response Options For California*, CEC-500-2008-071, prepared by the California Climate Change Center.

[62] Westerling, et al., 2009, as cited in California Natural Resources Agency, 2009, *2009 Climate Adaptation Strategy Discussion Draft – A Report Prepared for the Governor of the State of California in Response to Executive Order S-13-2008.*

safety and economic reasons, the County will need to address the need for increased fire fighting resources, as well as augmented fire management strategies in the future.

vi. Natural Ecosystems

Climate changes and increased CO_2 concentrations are expected to alter the extent and character of natural ecosystems: the distribution of species is expected to shift; the risk of climate-related disturbance such as wildfires, disease, and drought is expected to rise; and forest productivity is projected to increase or decrease, depending on species and region. In Butte County, these ecological changes could have significant implications for fire suppression, managed ecosystems, public health, and the sustainability of the county's natural ecosystems.

A number of ecological changes have already occurred in the United States in response to changes in temperature and precipitation patterns, earlier spring arrival and later onset of fall.[63] Ecosystem impacts in California can generally be described as the following: impacts on species that rely on temperature to dictate migration and reproduction; shifting of ranges of Sierra Nevada flora and fauna; increases in dry season and consequent increases in wildfire; and warming of the waters of Lake Tahoe.

Additionally, managed landscapes such as rangelands, timberlands and agricultural lands are especially vulnerable to changes in temperature and water availability.[64] Changes in temperature and soil moisture can shift the suitable range for crops and timber species north or up-slope from current areas of cultivation. A recent study on Ponderosa pine in California examined historical data to show that between 1934 and 1996 on the western edge of the

[63] California Energy Commission, May 2009, *The Future Is Now – An Update on Climate Change Science Impacts and Response Options For California*, CEC-500-2008-071, prepared by the California Climate Change Center.

[64] California Energy Commission, May 2009, *The Future Is Now – An Update on Climate Change Science Impacts and Response Options For California*, CEC-500-2008-071, prepared by the California Climate Change Center.

Sierra Nevada range, the western front of the forest had moved 4.4 miles east and shifted up roughly 637 feet in altitude.[65] The study attributes the shift largely to climate change.

vii. Impact Significance Determination

As discussed in Sections D.2.b.i through D.2.b.vi, development allowed by General Plan 2030 could subject property and persons to additional risk of physical harm from climate change related to agriculture, public health and safety, wildfire risk, hydrology and flooding, water supplies, and natural ecosystems. However, Action COS-A1.1 directs the County to prepare a Climate Action Plan within one year of adoption of General Plan 2030, and requires that the Climate Action Plan include a Climate Change Preparedness Plan that will prepare for the impacts of climate change on the county's economic and natural ecosystems and promote a climate-resilient community. In addition, General Plan 2030 includes numerous policies that protect agriculture, promote public health and safety, reduce wildfire risk, reduce risks from flooding, promote a sustainable water supply, and protect natural ecosystems. Therefore, General Plan 2030 would have a *less-than-significant* impact regarding exposure to risks of impacts resulting from climate change.

3. Cumulative Impacts

As discussed in Section C, climate change is the result of cumulative global emissions. There is no single project, when taken in isolation, that can "cause" global warming, as a single project's emissions are insufficient to change the radiative balance of the atmosphere. Because global warming is the result of GHG emissions, and GHGs are emitted by innumerable sources worldwide, global climate change is a significant cumulative impact of human development and activity. The global increase in GHG emissions that has occurred and will occur in the future is the result of the actions and choices of individuals, businesses, local governments, states, and nations. Therefore, the analysis in Section D.2 addresses cumulative impacts.

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[65] Thorne, J.H., 2008, as cited in California Energy Commission, May 2009, *The Future Is Now – An Update on Climate Change Science Impacts and Response Options For California*, CEC-500-2008-071, prepared by the California Climate Change Center.

E. Maximum Theoretical Buildout

Under the maximum theoretical buildout of General Plan 2030, there would be significantly more development than under the projected 2030 buildout analyzed in Section D, in terms of both the amount and the extent of development. As a result, GHG emission-related impacts would be more significant than described in Section D. However, as discussed in Chapter 3, it is unlikely that maximum theoretical buildout would ever occur under General Plan 2030, and an analysis of maximum theoretical buildout is not required by CEQA.

F. Impacts and Mitigation Measures

Impact CC-1: Implementation of General Plan 2030 would result in GHG emissions that would contribute to cumulative GHG emissions and global climate change. The 2020 GHG forecast for the county indicates that emissions would be greater than 85 percent of current (2006) conditions, creating a significant contribution to GHG emissions and associated climate change impacts. Policies and actions would provide a comprehensive framework for reducing GHG emissions in the county, but they would not ensure that the County can meet the reduction goal.

As part of the General Plan 2030 process, the County considered a wide range of policies and actions to reduce GHG emissions, and all feasible measures are included. However, they do not ensure that the County will meet its reduction goal, so the impact is considered *cumulatively significant and unavoidable*.