



Chapter 12 Climate Change

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12 CLIMATE CHANGE

INTRODUCTION

This chapter summarizes climate change issues for Ventura County. This chapter is organized into two sections: Greenhouse Gas Emissions (Section 12.1) and Climate Change Effects and Impacts (Section 12.2).

SECTION 12.1 GREENHOUSE GAS EMISSIONS

Introduction

This section provides a discussion of climate change science and greenhouse gas (GHG) emissions sources in California and Ventura County. This section also provides a summary of applicable regulations with respect to local, regional, and statewide GHG emission sources. A discussion of the impacts caused by global climate change in Ventura County is included in Section 12.2 (Climate Change Effects).

Human-caused GHG emissions adversely affect the environment because, on a cumulative basis, they are the primary cause of global climate change. Global climate change is already causing rising sea levels, alterations of rain and snowfall, leading to changes in water supply, and impacts to habitat and other biological resources. Because GHG emissions come from many different sources, identification and reduction of GHG emissions is an important consideration for long-range planning efforts.

Major Findings

- Total countywide GHG emissions were approximately 7.2 million metric tons of carbon dioxide equivalent (MMT CO_2e) in 2012. The unincorporated area of Ventura County accounted for 1.3 MMT CO_2e in 2012, or 18 percent of countywide emissions.
- The primary source of countywide GHG emissions is on- and off-road transportation, comprising about 53 percent of all GHG emissions in the county in 2012. Electricity generation and natural gas combustion associated with buildings comprised nearly 37 percent of countywide emissions in 2012.
- The county set GHG emissions reduction goals in 2011 for GHG emissions sources from county operations. The goal includes achieving a 15 percent reduction in emissions by 2020, relative to GHG emissions levels in the established 2005 base year.
- The County has adopted several goals that address the reduction of GHG emissions and related efforts to improve sustainability in County operations. While the County has not formally adopted a local climate action plan (CAP) that addresses community-wide emissions, the County's Climate Adaptation Workgroup presented the Board of Supervisors with a Climate Protection Plan (CPP) that focused on GHG reduction opportunities in government operations and set out six major action areas with 15 goals.

Existing Conditions

Certain gases in the Earth's atmosphere, classified as GHGs, play a critical role in determining the Earth's surface temperature. Solar radiation enters the Earth's atmosphere from space. A portion of the radiation is absorbed by the Earth's surface, and a smaller portion of this radiation is reflected back toward space. This absorbed radiation is then emitted from the Earth as low-frequency infrared radiation. The frequencies at which bodies emit radiation are proportional to temperature. The Earth has a much lower temperature than the sun; therefore, the Earth emits lower frequency radiation. Most solar radiation passes through GHGs; however, infrared radiation is absorbed by these gases. As a result, radiation that otherwise would have escaped back into space is instead "trapped," resulting in a warming of the atmosphere. This phenomenon, known as the greenhouse effect, is responsible for maintaining a habitable climate on Earth. Without the greenhouse effect, Earth would not be able to support life as we know it.

Prominent GHGs contributing to the greenhouse effect are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and fluorinated gases (also known as "F-gases") that include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). Human-caused emissions of these GHGs in excess of natural ambient concentrations are responsible for intensifying the greenhouse effect and leading to a trend of unnatural warming of the Earth's climate, known as global climate change. According to the Intergovernmental Panel on Climate Change (IPCC), it is "extremely likely" that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic forcings-together (IPCC 2014:3, 5).

Climate change is a global problem. GHGs are global pollutants, unlike criteria air pollutants and toxic air contaminants, which are pollutants of regional and local concern. Whereas pollutants with localized air quality effects have relatively short atmospheric lifetimes (about one day), GHGs have long atmospheric lifetimes (one to several thousand years). GHGs persist in the atmosphere for long enough time periods to be dispersed around the globe. Although the exact lifetime of any particular GHG molecule is dependent on multiple variables and cannot be precisely identified, it is understood that more CO₂ is emitted into the atmosphere than is sequestered by ocean uptake, vegetation, and other forms of sequestration. CO₂ sinks, also known as reservoirs, include vegetation and the ocean, which sequester CO₂ through photosynthesis and dissolution, respectively, two of the most common processes of CO₂ sequestration. Of the total annual human-caused CO₂ emissions, approximately 55 percent is sequestered through ocean and land uptakes every year, averaged over the last 50 years. The remaining 45 percent of human-caused CO₂ emissions remains stored in the atmosphere (IPCC 2013:467).

Some GHG emissions are referred to as "short-lived climate pollutants" (SLCPs) due to their characteristically short atmospheric lifespan and high global warming potentials (GWPs) as compared to other GHGs with longer lifespans and lower GWPs. SLCPs include, but are not limited to, fluorinated gases (e.g., HFCs, PFCs), CH₄, and black carbon. Despite the short period in which they occupy the atmosphere, the GWPs of SLCPs can trap significantly more heat in the atmosphere and therefore these emissions constitute a significant contribution to global climate change (California Air Resources Board [CARB] 2017a).

The physical impacts of climate change are also influenced by land use changes, specifically those that result in the removal or addition of vegetation, forests, woodlands, and other photosynthesizing organisms. The planting or enhancement of photosynthesizing resources increases the Earth's carbon sequestration potential. Conversely, the removal of vegetation lowers the Earth's carbon sequestration potential. In combination with emissions of GHGs, global climate change has been exacerbated by deforestation fueled by agricultural and commercial practices. The practice of burning forests not only eliminates the carbon sequestering capabilities of a landscape, but releases considerable quantities of GHGs into the atmosphere in the process (IPCC 2005).

The quantity of GHGs in the atmosphere that ultimately results in climate change is not precisely known, but it is enormous; no single project alone would measurably contribute to an incremental change in the global average temperature, or to global, local, or micro climates.

Statewide GHG Emissions

Emissions of GHGs contributing to global climate change are attributable in large part to human activities associated with on-road and off-road transportation, industrial/manufacturing, electricity generation by utilities and consumption by end users, residential and commercial on-site fuel usage, high-GWP gases, the recycling and waste sectors, and agriculture. (CARB 2017b). The agriculture sector generates emissions of GHGs primarily from methane (CH₄) and nitrous oxide (N₂O) sources. Such sources include enteric fermentation and manure management of livestock, crop production (e.g., fertilizer use, soil preparation and disturbances, and crop burning), and fuel combustion associated with agricultural management activities (e.g., water pumping, cooling and heating of buildings and commodities) (CARB 2017).

The most recent California statewide GHG emissions inventory (2015) is summarized in Table 12-1. In California, the transportation sector is the largest emitter of GHGs, followed by electricity generation (CARB 2017b). Emissions of CO₂ are largely byproducts of fossil fuel combustion. CH₄, a highly potent GHG and SLCP, primarily results from off-gassing (the release of chemicals from nonmetallic substances under ambient or greater pressure conditions) and is largely associated with agricultural practices, leaks from petroleum and natural gas operations, and landfills. N₂O emissions are also largely attributable to agricultural practices and soil management. Additionally, high-GWP gases have atmospheric insulative properties that are hundreds to tens of thousands of times greater than that of CO₂, meaning that high-GWP gases can trap far more heat in the atmosphere than the same amount of CO₂. F-gases such as HFCs, PFCs, and SF₆, are some of the most common types of high-GWP gases and result from a variety of industrial processes. HFCs and PFCs are used as refrigerants and can be emitted through evaporation and leakage. SF₆ is a powerful electrical insulator used in power transmission and semiconductor manufacturing and is emitted through evaporation and leakage into the atmosphere. Due to their high GWP values and short atmospheric lifespan, F-gases are classified as SLCPs.

TABLE 12-1
CALIFORNIA STATEWIDE GREENHOUSE GAS EMISSIONS INVENTORY
1990-2015

Emissions Sector	MMTCO ₂ e				Percent of Total (2015) (%)	Percent Change (1990-2015) (%)
	1990 ¹	2000	2010	2015		
Transportation	151	176	170	163	37	8
Industrial	103	98	92	92	21	-12
Electricity Generation ²	111	105	90	84	19	-24
Commercial and Residential Fuel Use	44	43	45	40	9	-10
Agriculture	23	32	35	35	8	56
High GWP	-. ³	7	15	18	4	n/a
Recycling and Waste	-. ³	7	8	9	2	n/a
Total⁴	432	469	456	459	100	n/a

Notes: GWP = global warming potential; MMTCO₂e = million metric tons of carbon dioxide equivalent

¹California's first 1990 GHG emissions inventory was prepared in 2007 by CARB using GWP values from the IPCC Second Assessment Report. All other inventory years shown use GWP values from the IPCC Fourth Assessment Report.

²Includes both in-state electricity generation and out-of-state imported electricity

³High GWP and Recycling and Waste sectors were included in the Industrial sector for the 1990 inventory only.

⁴Totals may not sum exactly due to rounding.

Sources: CARB 2007, CARB 2017b; data compiled by Ascent Environmental 2017.

Countywide, Unincorporated, and Local Government GHG Emissions

Ventura County 2012 Greenhouse Gas Inventories

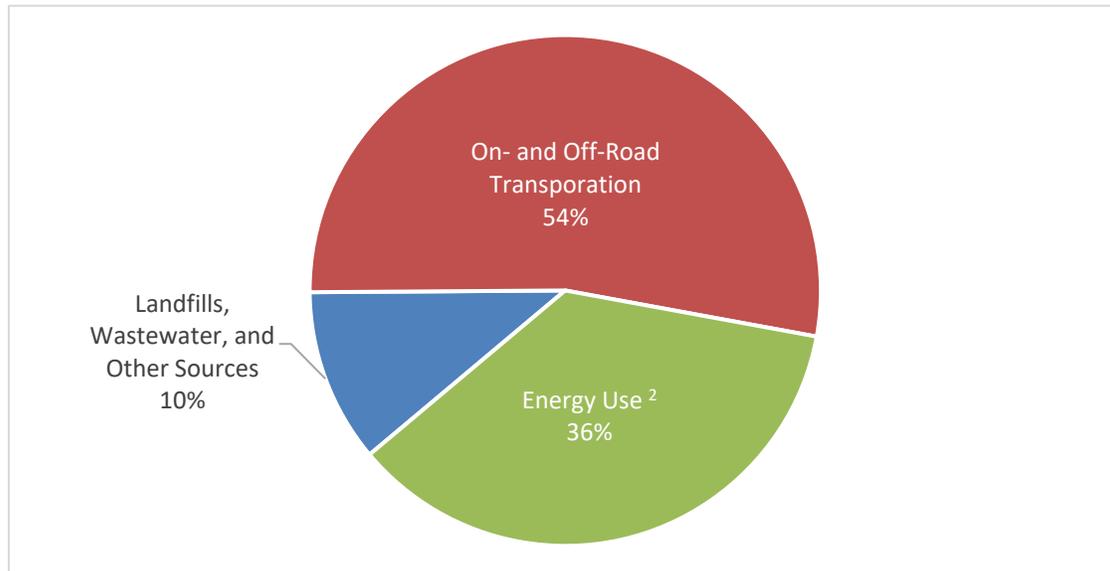
Countywide Community GHG Emissions in 2012

The Ventura County Regional Energy Alliance (VCREA) is a joint powers authority with representation from local governments, schools, and investor-owned utilities. In 2015, VCREA prepared an integrated community inventory of GHG emissions both regionally and for each of its local government member organizations using GWP values from the IPCC's fourth assessment report consistent with CARB's approach for evaluating GHG inventories (CARB 2017b). The most recent version of the community inventory was published by VCREA in December 2015 and reported emissions for calendar years 2010 – 2012. The summary below focuses on the latest available annual emissions for 2012.

The VCREA inventory is divided into three broad areas: energy (electricity and natural gas combustion), mobile sources (on- and off-road burning of diesel and gasoline) and other emission sources (including landfill gas, emissions from wastewater treatment plants, and emissions of high GWP GHGs (i.e., HFCs, PFCs, SF₆)). In 2012, total county emissions were approximately 7.2 MMTCO₂e. Figure 12-1 illustrates countywide emissions by sector in 2012 (VCREA 2015). The existing countywide inventory does not currently account for agricultural emissions. However, a future inventory, expected in 2018, will account for applicable emission sectors consistent with the statewide inventory. This will include agricultural emissions.

**FIGURE 12-1
COUNTYWIDE GREENHOUSE GAS EMISSIONS¹**

**Ventura County
2012**



¹ Note: Totals may not sum exactly, due to rounding of figures.

² Energy Use includes electricity consumption and on-site combustion of natural gas.

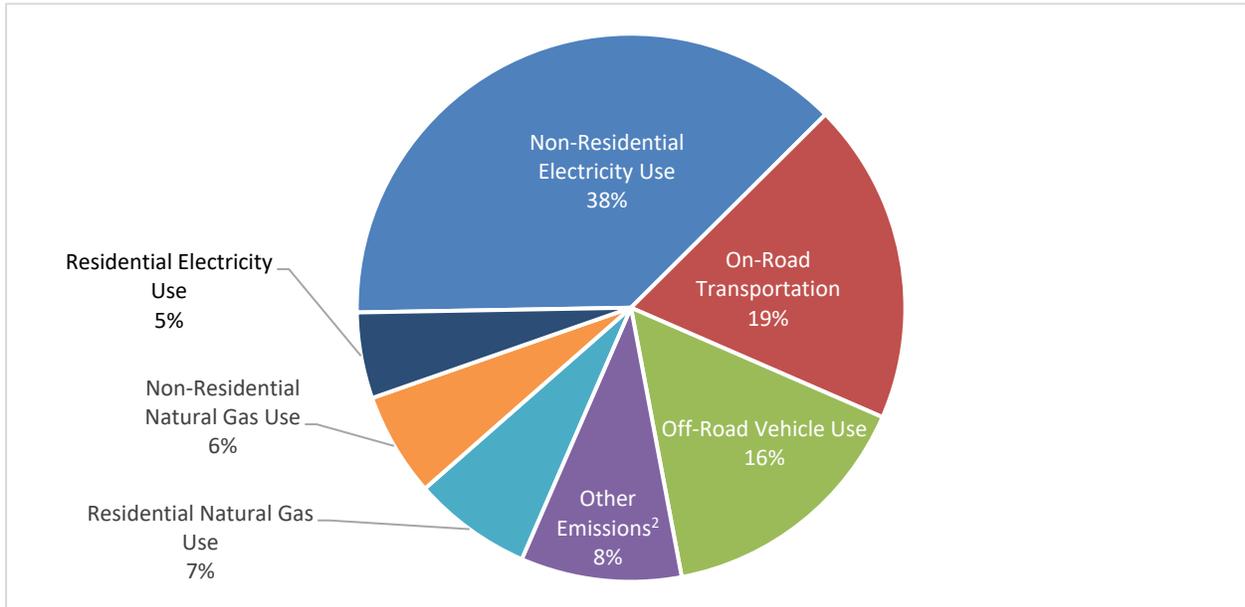
Source: Ventura County Regional Energy Alliance (VCREA). *Climate on the Move*. December 2015.

Unincorporated Ventura County Community GHG Emissions

The VCREA inventory also provided specific community emissions inventories by government jurisdictions in Ventura County. For the unincorporated area of Ventura County, GHG emissions were approximately 1.3 MMTCO₂e in 2012.

Figure 12-2 illustrates these emissions by sector (VCREA 2015).

**FIGURE 12-2
GREENHOUSE GAS EMISSIONS¹
UNINCORPORATED VENTURA COUNTY
2012**



¹ Notes: Totals may not sum exactly, due to rounding of figures.

² Other emissions include both direct (Scope 1) and indirect (Scope 2) emissions. Direct emissions are from sources that are owned or controlled by an organization (e.g., stationary combustion, mobile combustion, process emissions, fugitive emissions). Indirect emissions are from the consumption of purchased electricity, steam, or other sources of energy generated upstream from an organization.

Source: Ventura County Regional Energy Alliance (VCREA). *Climate on the Move*. December 2015.

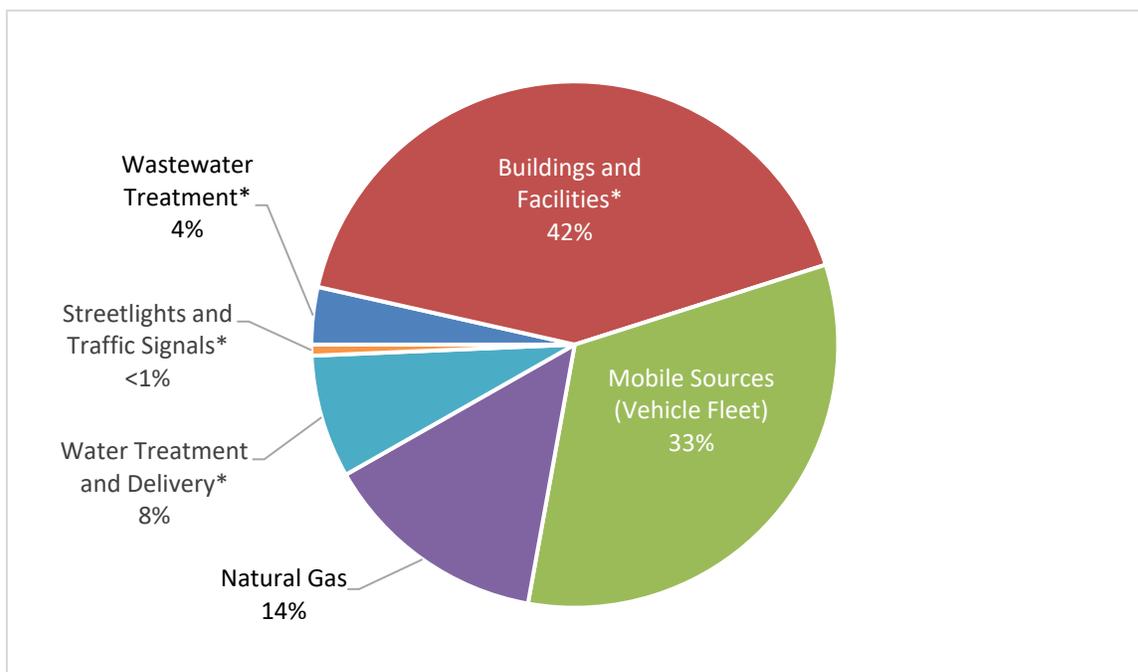
County of Ventura Government Operations

The VCREA inventory included estimates of operational emissions for County of Ventura operations. The inventory was prepared consistent with the Local Government Operations Protocol (LGOP) developed by CARB and The Climate Registry (TCR), which guides the reporting of GHG emissions by local governments. The LGOP defines the categories under which government operations are categorized, including facilities, lighting and traffic control, water pumping, and wastewater pumping. Because there were no significant changes between 2010 and 2012, the following chart shows the relative contribution of various sources to GHG emissions from County government operations. Total GHG emissions from government operations in Ventura County was approximately 38,787 metric tons of carbon dioxide equivalent (MTCO_{2e}) in 2012 (VCREA 2015).

Figure 12-3 illustrates these emissions by government operations sector. This estimate does not include emissions associated with commute activities of County employees.

**FIGURE 12-3
GREENHOUSE GAS EMISSIONS FROM COUNTY OF VENTURA GOVERNMENT
OPERATIONS¹**

**VENTURA COUNTY
2010-2012**



¹ Notes: * = emissions from use of electricity. Totals may not sum exactly, due to rounding of figures.

Source: Ventura County Regional Energy Alliance (VCREA). *Climate on the Move*. December 2015.

Regulatory Setting

This report has been prepared at a time when accepted practice and legislation regarding how government agencies should address climate change continue to evolve. This section summarizes the current federal, state, and local regulatory programs, plans, and policies that apply to GHG emissions and land use planning.

Federal

Supreme Court Ruling of Carbon Dioxide as a Pollutant

The U.S. Environmental Protection Agency (EPA) is the federal agency responsible for implementing the federal Clean Air Act (CAA) and its amendments. The Supreme Court of the United States ruled on April 2, 2007, that CO₂ is an air pollutant as defined under the CAA, and that EPA has the authority to regulate emissions of GHGs. The ruling in this case resulted in EPA taking steps to regulate GHG emissions and lent support for state and local agencies' efforts to reduce GHG emissions.

Endangerment and Cause or Contribute Findings

On December 7, 2009, EPA adopted its Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases under the CAA (Endangerment Finding). The EPA Administrator found that atmospheric concentrations of GHGs endanger the public health and welfare within the meaning of Section 202(a) of the CAA. The evidence supporting this finding consists of human activity resulting in “high atmospheric levels” of GHG emissions, which are very likely responsible for increases in average temperatures and other climatic changes. Furthermore, the observed and projected results of climate change (e.g., higher likelihood of heat waves, wild fires, droughts, sea-level rise, and higher-intensity storms) are a threat to the public health and welfare. Therefore, GHGs were found to endanger the public health and welfare of current and future generations. The Administrator also found that GHG emissions from new motor vehicles and motor vehicle engines are contributing to air pollution, which is endangering public health and welfare. EPA’s final findings respond to the 2007 U.S. Supreme Court decision that GHGs fit within the CAA definition of air pollutants.

National Program to Cut GHG Emissions and Improve Fuel Economy for Cars and Trucks

On August 28, 2012, EPA and the Department of Transportation’s National Highway Traffic Safety Administration (NHTSA) issued joint Final Rules for Corporate Average Fuel Economy (CAFE) standards for vehicle model years 2017 and beyond (NHTSA 2016). These first-ever national GHG emissions standards will increase fuel economy to the equivalent of 54.5 miles per gallon (mpg) for cars and light-duty trucks by model year 2025. EPA approved these standards under the CAA, and NHTSA approved them under the Energy Policy and Conservation Act.

State

CARB is the agency responsible for coordination and oversight of state and local air pollution control programs in California and for implementing the California Clean Air Act (CCAA), which was adopted in 1988. CARB is also designated as the lead state agency for implementing the Global Warming Solutions Act of 2006 (Assembly Bill [AB] 32) and related efforts to reduce statewide GHG emissions in California. CARB coordinates closely with other state agencies and regional and local entities to implement AB 32 and related laws, rules and regulations.

Executive Order S-3-05

Executive Order (EO) S-3-05, which was signed by Governor Schwarzenegger in 2005, proclaims that California is vulnerable to the impacts of climate change. It declares that increased temperatures could reduce the Sierra Nevada snowpack, further exacerbate California’s air quality problems, and potentially cause a rise in sea level. To combat those concerns, the EO established total GHG emission targets. Specifically, emissions are to be reduced to the 2000 level by 2010, the 1990 level by 2020, and to 80 percent below the 1990 level by 2050. This EO is binding only on State agencies, and has no force of law for local governments; however, the signing of EO S-3-05 sent a clear signal to the California Legislature about the framework and content for legislation to reduce GHG emissions.

Executive Order B-30-15

On April 20, 2015, Governor Edmund G. Brown Jr. signed EO B-30-15 to establish a new California GHG reduction target of 40 percent below 1990 levels by 2030, as well as increase statewide efforts to address the need for increased climate change adaptation measures by state agencies. This EO aligns

California's GHG reduction targets with those of leading international governments such as the 28-nation European Union which adopted the same target as part of the 2030 Climate and Energy Framework in October 2014. California is on track to meet or exceed its legislated target of reducing GHG emissions to 1990 levels by 2020, as established in AB 32 (summarized below). California's new emission reduction target of 40 percent below 1990 levels by 2030 will make it possible to reach the ultimate goal of reducing emissions 80 percent below 1990 levels by 2050. This is in line with the scientifically established levels needed in the U.S. to limit global warming below 2 °C, the warming threshold at which there will likely be major climate disruptions such as super droughts and rising sea levels. The targets stated in EO B-30-15 have not been adopted by the State legislature.

Assembly Bill 32, The California Global Warming Solutions Action of 2006

In September 2006, Governor Arnold Schwarzenegger signed Assembly Bill (AB) 32, the California Global Warming Solutions Act of 2006. AB 32 establishes regulatory, reporting, and market mechanisms to achieve quantifiable reductions in GHG emissions and a cap on statewide GHG emissions. AB 32 requires that statewide GHG emissions be reduced to 1990 levels by 2020. This reduction will be accomplished through an enforceable statewide cap on GHG emissions and are being implemented through the California Cap-and-Trade regulation starting in 2012, along with other regulations and programs to achieve GHG emissions reductions in sectors that are included under the statewide cap.

Assembly Bill 32, Climate Change Scoping Plan

In December 2008, CARB adopted its Climate Change Scoping Plan, which contains the main strategies California will implement to achieve reduction of approximately 118 MMTCO₂e, or approximately 22 percent, from the State's projected 2020 emission level of 545 MMTCO₂e under a business-as-usual (BAU) scenario. This is a reduction of 47 MMTCO₂e, or almost 10 percent, from 2008 emissions. CARB's original 2020 projection was 596 MMTCO₂e, but this revised 2020 projection takes into account the economic downturn that occurred in 2008 (CARB 2011a). The Scoping Plan reapproved by CARB in August 2011 includes the Final Supplement to the Scoping Plan Functional Equivalent Document (FED), which further examined various alternatives to Scoping Plan measures. The Scoping Plan also includes CARB-recommended GHG reductions for each emissions sector of the state's GHG inventory. CARB estimates the largest reductions in GHG emissions to be achieved by implementing the following measures and standards (CARB 2011a):

- improved emissions standards for light-duty vehicles (26.1 MMTCO₂e),
- the Low-Carbon Fuel Standard (LCFS) (15.0 MMTCO₂e),
- energy efficiency measures in buildings and appliances (11.9 MMTCO₂e), and
- renewable portfolio and electricity standards for electricity production (23.4 MMTCO₂e).

Senate Bill (SB) 32 and AB 197, Statutes of 2016

In August 2016, Governor Brown signed SB 32 and AB 197, which serve to extend California's GHG reduction programs beyond 2020. SB 32 amended the Health and Safety Code to include Section 38566, which contains language to authorize CARB to achieve a statewide GHG emission reduction of at least 40 percent below the AB 32 goal of 1990 levels by 2020 by no later than December 31, 2030. SB 32 codified the targets established by EO B-30-15 for 2030, which set the next interim step in the State's continuing efforts to pursue the long-term target expressed in EOs S-3-05 and B-30-15 of 80 percent below 1990 emissions levels by 2050.

SB 32 is contingent upon AB 197, which grants the State Legislature stronger oversight over CARB's implementation of its GHG reduction programs. AB 197 amended the existing Health and Safety Code sections and establish new statutory directions, including the following provisions. Section 9147.10 establishes a six-member Joint Legislative Committee on Climate Change Policies to ascertain facts and make recommendations to the Legislature. CARB is required to appear before this committee annually to present information on GHG emissions, criteria pollutants, and toxic air contaminants from sectors covered by the Scoping Plan. Section 38562.5 requires that CARB consider social cost when adopting rules and regulations to achieve emissions reductions and prioritize reductions at large stationary sources and from mobile sources. Section 38562.7 requires that each Scoping Plan update identify the range of projected GHG and air pollution reductions and the cost-effectiveness of each emissions reduction measure.

Senate Bill 375

The Sustainable Communities and Climate Protection Act of 2008 (SB 375) aligns regional transportation planning efforts, regional GHG emission reduction targets for cars and light trucks, land use planning, and housing allocation. SB 375 requires Metropolitan Planning Organizations (MPOs) to adopt a Sustainable Communities Strategy (SCS) or Alternative Planning Strategy (APS), which integrates regional land use and transportation planning within an MPO's Regional Transportation Plan (RTP).

SB 375 requires CARB, in consultation with MPOs, to provide each region with reduction targets for GHGs emitted by passenger cars and light trucks in the region for the years 2020 and 2035. These reduction targets will be updated every eight years, but can be updated every four years, if advancements in emissions technologies affect the reduction strategies to achieve the targets.

Ventura County is under the jurisdiction of the Southern California Association of Governments (SCAG), which includes Ventura, Los Angeles, Orange, San Bernardino, Riverside, and Imperial Counties. In April 2016, SCAG adopted its 2016-2040 Regional Transportation Plan / Sustainable Communities Strategy (RTP/SCS), which is the region's transportation and sustainability investment strategy for protecting and enhancing the region's quality of life and economic prosperity through this period. Plan implementation is expected to result in regional benefits to mobility, economy, health and sustainability. SCAG's plan is also expected to help California reach its greenhouse gas reduction goals, with an 8 percent reduction in GHG emissions per capita by 2020, an 18 percent reduction by 2035, and a 21 percent reduction by 2040—compared with 2005 levels (SCAG 2016).

Senate Bill 97

SB 97 directed the California Natural Resources Agency (CNRA) to adopt amendments to the California Environmental Quality Act (CEQA) Guidelines related to analysis of GHG emissions on December 30, 2009. On February 16, 2010, the Office of Administrative Law approved the amendments, and filed them with the Secretary of State for inclusion in the California Code of Regulations. The Amendments became effective on March 18, 2010.

CEQA allows lead agencies to analyze and mitigate the significant effects of GHG emissions at a programmatic level, such as in a general plan, or as part of a separate plan (e.g., a climate action plan) to reduce GHG emissions (CEQA 15183.5).

Renewable Electricity (or Renewable Portfolio) Standard

SB 1078 (Chapter 516, Statutes of 2002) requires retail sellers of electricity, including investor owned utilities and community choice aggregators, to provide at least 20 percent of their power supply from renewable sources by 2017. SB 107 (Chapter 464, Statutes of 2006) changed the target date to 2010. On November 17, 2008, Governor Schwarzenegger signed EO S-14-08 requiring all retail sellers of electricity to serve 33 percent of their load with renewable energy by 2020. The following year, EO S-21-09 directed CARB, under its AB 32 authority, to enact regulations to achieve the goal of 33 percent renewables by 2020. In 2011, Governor Brown signed SB X1-2, which codified the 33 percent by 2020 standard into law.

The California Public Utilities Commission (CPUC) and the California Energy Commission (CEC) jointly implement the statewide Renewable Portfolio Standard (RPS) program through rulemakings and monitoring the activities of electric energy utilities in the state (CPUC 2016).

Senate Bill 350, the Clean Energy and Pollution Reduction Act of 2015

In consideration of the approaching expiration of Senate Bill X1-2 goals in 2020, SB 350 of 2015 calls for 1) a new objective to procure 50 percent of the state's electricity from renewables by 2030 and 2) a doubling of statewide energy efficiency savings in electricity and natural gas final end uses of retail customers by January 1, 2030 with annual targets established by the CEC.

California Building Efficiency Standards (Title 24, Part 6)

Buildings in California are required to comply with California's Energy Efficiency Standards for Residential and Nonresidential Buildings established by the CEC regarding energy conservation standards and found in Title 24, Part 6 of the California Code of Regulations. California's Energy Efficiency Standards for Residential and Nonresidential Buildings was first adopted in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated on a three-year cycle to allow consideration and possible incorporation of new energy efficient technologies and methods. CEC adopted the 2016 Building Energy Efficiency Standards in 2015. The 2016 Title 24 standards went into effect on January 1, 2017. For single-family residences, the 2016 Title 24 standards will result in about 28 percent less energy use for lighting, heating, cooling, ventilation and water heating than the 2013 Title 24 standards (CEC 2015a). For non-residential land uses, the 2016 standards would result in 5 percent less energy use than those built to 2013 standards (CEC 2015b).

California Building Efficiency Standards (Title 24, Part 11): CALGreen

The 2016 Energy Provisions of CALGreen employ a range of voluntary energy efficiency measures to reduce wasteful, uneconomical, and unnecessary uses of energy, thereby reducing the rate of growth of energy consumption, prudently conserve energy resources, and assure statewide environmental, public safety, and land use goals are met. The 2016 Energy Provisions of CALGreen provide example building energy efficiency provisions that will lead to additional energy and water savings than would be achieved by complying with the Energy Code. Interested persons may choose to follow these voluntary measures, or local jurisdictions may elect to make the measures mandatory to realize the potential energy and cost savings and other benefits. These provisions help address three problems: (1) achieving the State's goals, including reducing energy consumption and greenhouse gas emissions associated with energy production; (2) having zero net energy buildings (i.e., buildings whose energy consumption is balanced by on-site generation), and; (3) testing energy efficiency-related measures for future inclusion in the Energy Code, so that the Energy Code will better achieve the aforementioned goals.

Low-Carbon Fuel Standard

EO S-1-07, signed by Governor Schwarzenegger in 2007, proclaims that the transportation sector is the main source of GHG emissions in California, at over 40 percent of statewide emissions. It establishes a goal that the carbon intensity of transportation fuels sold in California should be reduced by a minimum of 10 percent by 2020. This order also directed CARB to determine if this Low Carbon Fuel Standard (LCFS) could be adopted as a discrete early action measure after meeting the mandates in AB 32. CARB adopted the LCFS regulation in 2009, and subsequently re-adopted the regulation with modifications in 2015, in response to an order of the California Appellate Court.

Advanced Clean Cars Program

In January 2012, CARB approved the Advanced Clean Cars program which combines the control of GHG emissions and criteria air pollutants, as well as requirements for greater numbers of zero-emission vehicles, into a single package of standards for vehicle model years 2017 through 2025. The new rules strengthen the GHG standard for 2017 models and beyond. This will be achieved through existing technologies, the use of stronger and lighter materials, and more efficient drivetrains and engines. The program's zero-emission vehicle regulation requires battery, fuel cell, and/or plug-in hybrid electric vehicles to account for up to 15 percent of California's new vehicle sales by 2025. The program also includes a clean fuels outlet regulation designed to support the commercialization of zero-emission hydrogen fuel cell vehicles planned by vehicle manufacturers by 2015 by requiring increased numbers of hydrogen fueling stations throughout the state. The number of stations will grow as vehicle manufacturers sell more fuel cell vehicles. By 2025, when the rules will be fully implemented, the statewide fleet of new cars and light trucks will emit 34 percent fewer global warming gases and 75 percent fewer smog-forming emissions than the statewide fleet in 2016 (CARB 2011b).

SLCP Reduction Strategy

CARB adopted the SLCP Reduction Strategy on March 24, 2017, pursuant to SB 605, SB 1383, and other legislative mandates. The SLCP Reduction Strategy identifies CH₄, F-gases, and black carbon as the three most prominent and potent SLCPs in the state and lays out a range of options to accelerate SLCP emission reduction activities in the state including regulations, incentives, and other market-supporting activities. The SLCP Reduction Strategy establishes reductions targets for SLCPs of 40 percent reduction CH₄ emissions, 40 percent reduction in F-gases, and 50 percent reduction in black carbon emissions by 2030. The SLCP Reduction Strategy is integrated into the 2017 Climate Change Scoping Plan Update as a contribution to state strategies to meet the 2030 GHG reduction target pursuant to SB 32.

Emissions of F-gases are curtailed through CARB's Refrigerant Management Program which requires facilities with refrigeration systems with 50 or more pounds of high-GWP refrigerants (i.e., HFCs or PFCs) to conduct inspections, repair leaks, and keep records. The SLCP Reduction Strategy also identifies measures and regulations to reduce emissions of CH₄ from the agricultural sector, landfills, and wastewater treatment. Mobile sources (primarily from diesel exhaust) and wildfire constitute the primary statewide sources of black carbon. The SLCP Reduction Strategy includes a statewide inventory for black carbon and notes that black carbon emissions from mobile sources have been reduced dramatically in recent decades and will continue to be reduced by recent actions contained in the State's Mobile Source Strategy, Sustainable Freight Strategy, and other regulations and actions related to mobile source emissions. Notably, as identified in Appendix C to the Reduction Strategy, accurate statewide black carbon estimates are difficult to estimate due to the various factors that influence black carbon emissions such as fuel type, engine operating conditions, age, maintenance, emission control technology, load, and drive cycle. Further, wildfires, which are now the largest statewide source of black carbon, occur in

varying degrees of frequency and magnitude on a year-to-year basis. Due to these variables, there is inherent uncertainty regarding the state's total emissions of black carbon.

Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities

On March 23, 2017, CARB adopted the Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities (“Methane Regulation”) to reduce GHG emissions (fugitive methane) from onshore and offshore crude oil and/or natural gas production; crude oil, condensate, and produced water separation and storage; natural gas underground storage; natural gas gathering and boosting stations; natural gas processing plants; and natural gas transmission compressor stations. The Methane Regulation imposes emissions standards for the oil and gas industry to comply with the emissions standards set forth by AB 32 as well as meet the standards set forth in the National Ambient Air Quality Standards and California Ambient Air Quality Standards. As such, the Methane Regulation established uniform control requirements for methane sources and expands upon some existing local air district volatile organic compound regulations by including additional infrastructure components such as valves, flanges, and seals for oil and gas extracting activities. Further, the Methane Regulation requires that vapors from separator and tank systems be collected and conveyed into existing sales lines, existing fuels lines, or existing injection wells first, with the use of existing vapor control devices to reduce emissions of nitrogen oxides (CARB 2017c).

California Solar Initiative

The California Solar Initiative (CSI) was authorized in 2006 under SB 1 and allows CPUC to provide incentives to install solar technology on existing residential, commercial, nonprofit, and governmental buildings if they are customers of the State's investor owned utilities (IOUs), including Southern California Edison (SCE). The CSI program had a budget of nearly \$2.2 billion to be expended between 2007 and 2016, with a goal to reach 1,940 megawatts (MW) of installed solar power throughout the state by that time (CPUC 2015). The CSI program has several components, including Research and Development, Single-family Affordable Solar Housing (SASH), Multi-family Affordable Solar Housing (MASH), and Solar Water Heating Pilot Program, each of which provides incentives to further the installation of solar technology on California's buildings.

Assembly Bill 939, the California Integrated Waste Management Act

AB 939 (Sher, Statutes of 1989) established the California Integrated Waste Management Act of 1989. Among the bill's provisions is a requirement that each city and county develop and adopt a plan to divert 25 percent of all solid waste from landfill or transformation facilities by January 1, 1995, through source reduction, recycling, and composting activities; and, diversion of 50 percent of all solid waste by January 1, 2000, through source reduction, recycling, and composting activities (CalRecycle 2016).

Assembly Bill 341

AB 341 (Chesbro, Chapter 476, Statutes of 2011) established a policy goal for the state that not less than 75 percent of solid waste generated be source reduced, recycled, or composted by the year 2020. The California Department of Resources Recycling and Recovery's (CalRecycle) identified five priority strategies for achieving the 75 percent statewide waste diversion target, which include:

- Moving organics out of the landfill;
- Expanding recycling/manufacturing infrastructure;

- Exploring new approaches for state and local funding of sustainable waste management programs;
- Promoting state procurement of post-consumer recycled content products; and,
- Promoting extended producer responsibility (CalRecycle 2015).

Model Policies for Greenhouse Gases in General Plans

In June 2009, the California Air Pollution Control Officers Association (CAPCOA) prepared a white paper that presented model policies for addressing GHG emissions in general plans. CAPCOA intends this paper to be a resource rather than a guidance document intended to dictate how local communities should address GHG emission in their general plans. Model language is provided in nine major categories: GHG reduction planning (overall); land use and urban design; transportation; energy efficiency; alternative energy; municipal operations; waste reduction and diversion; conservation and open space; and education (CAPCOA 2009).

Quantifying Greenhouse Gas Mitigation Measures

In August 2010, the CAPCOA prepared a report on quantifying greenhouse gas emissions from select mitigation strategies to provide a common platform of information and tools to support local governments. CAPCOA intends this paper as a resource rather than a guidance document that dictates how cities or counties address greenhouse gas emissions in the context of projects they review or in the preparation of a General Plan. The report includes information related to the purpose of quantifying mitigation measures, quantification concepts, quantification approaches and methods, discussion of select quantified measures, understanding and using fact sheets, and quantification fact sheets for individual measures (CAPCOA 2010).

Regional

Ventura County Regional Energy Alliance – Regional Emissions Forecasts and Reduction Targets

In coordination with preparation of the integrated countywide GHG emissions inventory described earlier, VCREA prepared regional GHG emissions forecasts and identified potential GHG emissions reduction targets for 2020 for all cities in the county (VCREA 2015).

Forecasted GHG emissions countywide were developed for the major sectors in the inventory (energy use and on-road mobile source emissions) for the year 2020, assuming two business-as-usual (BAU) scenarios: (1) no additional state or local actions would be taken other than those taken by the state previously under AB 32; and, (2) an adjusted BAU condition that includes some state actions that would be taken through 2020 (e.g., statewide achievement of the Renewable Portfolio Standard [RPS] and clean vehicle regulations by 2020). Countywide, emissions are expected to decrease by 8.2 percent by 2020 compared to 2010 levels under the adjusted BAU scenario (VCREA 2015).

Based on the adjusted BAU forecasts, VCREA developed three scenarios for setting potential regional emissions reduction targets: 5 percent, 10 percent and 15 percent below adjusted BAU levels in 2020. Additional local or regional measures would need to be implemented in order to achieve these reductions. (VCREA 2015). While the potential targets developed by VCREA are not binding on any local jurisdiction, they could be adopted and applied by each jurisdiction within the county as part of local climate action plans or other plans for the reduction of GHG emissions.

Local

2015 Saticoy Area Plan

The Saticoy Area Plan addresses reduction of GHGs as a key feature of its Guiding Principle to promote sustainable development and a healthy community and as important underpinnings of its Mobility and Resources elements. It also includes a technical appendix on Air Quality and Greenhouse Gas Emissions Analysis (Appendix E).

2011 Initial Study Assessment Guidelines

The Initial Study Assessment Guidelines include criteria for evaluating environmental impacts for greenhouse gas emissions. These can be found in Section 24. Greenhouse Gases.

County of Ventura Climate Protection Plan for Internal Operations

In January 2011, the Board of Supervisors set an emissions reduction target of 15 percent by 2020, using a 2005 baseline inventory, focused on County of Ventura government operations and in April 2011, the county's draft Climate Protection Plan was presented to the Board of Supervisors. The 2005 baseline inventory was estimated using reporting protocols adopted by The Climate Registry (TCR) and CARB. Additional inventories for County of Ventura government operations have been completed for calendar years 2006 through 2015 (Ventura 2012; VCREA 2015).

Key Terms

Carbon dioxide (CO₂). An odorless and colorless GHG emitted from natural sources, such as the decomposition of dead organic matter; respiration of bacteria, plants, animals, and fungus; evaporation from oceans; and volcanic out-gassing. Anthropogenic (man-made) sources include the burning of fossil and other fuels (e.g., coal, oil, natural gas, wood).

Carbon dioxide equivalent (CO₂e). A unit for describing how much global warming a given type and amount of GHG may cause, normalized to a functionally equivalent amount or concentration of CO₂ as the reference. See Global Warming Potential.

Carbon Sequestration. Atmospheric CO₂ taken up through leaves and becomes carbon in the woody biomass of trees and other vegetation where it is stored.

Climate Action Plan (CAP). A planning document that lays out a set of strategies and policy recommendations intended to reduce GHG emissions associated with a given entity, agency, or jurisdiction.

Climate Change. Long-term changes in temperature, precipitation, and other elements of the Earth's climate system. An ever-increasing body of scientific research attributes these climatological changes to GHGs, particularly those generated from the human production and use of fossil fuels.

Fluorinated gases (F-gases). Refers to a group of man-made GHGs with short atmospheric lifespans and high GWPs. F-gases include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF₆), and nitrogen trifluoride (NF₃).

Global Warming Potential (GWP). One type of simplified index based upon properties of the GHG that can be used to estimate the effect on the climate system with reference to CO₂. For example, one ton of methane is as potent a GHG as 25 tons of CO₂. Methane has GWP of 25 CO₂e. See also Carbon dioxide equivalent.

Greenhouse Effect. The Earth's natural warming process. Certain atmospheric gases that trap heat in the atmosphere, causing the greenhouse effect, are referred to as GHGs.

Greenhouse Gases (GHGs). Gases that contribute to the greenhouse effect. Some GHGs such as carbon dioxide (CO₂) occur naturally, and are emitted to the atmosphere through natural processes and human activities. Other GHGs (e.g., fluorinated gases) are created and emitted solely through human activities. The principal GHGs that enter the atmosphere because of human activities include: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), chlorofluorocarbons (CFCs), and fluorinated gases (hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆).

Greenhouse Gas (GHG) Inventory. An accounting of the amount of GHGs emitted to or removed from the atmosphere over a specific period of time (e.g., one year) for a specified area.

Methane (CH₄). A GHG with GWP of 25. Anthropogenic (human-caused) sources of methane emissions include agricultural activities, natural gas consumption, landfills, wastewater treatment plants, and mobile sources.

Nitrous oxide (N₂O). A GHG with GWP of 298. Nitrous oxide sources include wastewater treatment plants, fertilizer application and soil management in agricultural activities, and mobile sources.

Short-Lived Climate Pollutants (SLCPs). A classification of GHGs that have characteristically short atmospheric lifespans and high GWPs. Black carbon, methane, and F-gases are considered SLCPs.

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SECTION 12.2 CLIMATE CHANGE EFFECTS

Introduction

This section presents a summary of the current state of climate change science; the effects of climate change and associated impacts in California and Ventura County; and, a summary of applicable federal, State, and local regulations, policies, programs, and plans that address the effects of climate change.

Greenhouse gas (GHG) emissions associated with human activities are the primary cause of global climate change, and while the topic of GHG emissions is related to global warming and associated climate change effects, GHG emissions are addressed in detail in Section 12.1 of the chapter.

Major Findings

- Annual average temperatures in Ventura County are projected to rise by three to six degrees Fahrenheit (°F) by 2090, with the range based on low and high global GHG emissions scenarios (Cal-Adapt 2016).
- Climate change impacts due to sea-level rise and storm events in Ventura County include:
 - more frequent flooding events due to rising sea levels;
 - more extensive and longer duration of flooding;
 - permanent inundation in coastal areas due to higher ocean levels and shifts in the tidal range;
 - increased shoreline erosion; and
 - elevated groundwater levels and salinity intrusion.
- Ventura County could experience coastal erosion of up to 1.36 meters per year by 2100 as a result of sea-level rise and related coastal flooding. (The Nature Conservancy, 2013)
- Currently 7,300 people, or one percent of Ventura County's population, live in areas at risk of being inundated in a 100-year flood event. A 1.4-meter rise in sea level will put an additional 16,000 people at risk of exposure to a 100-year flood event, for a total of 23,300 people. While the racial composition of populations vulnerable to a 100-year flood event generally reflects the county as a whole, a disproportionate number of affected persons (located largely in southeastern Oxnard) are low-income and are especially vulnerable. (California Energy Commissions [CEC] 2009).
- Critical infrastructure in Ventura County, including 170 miles of roads and railways, hospitals, schools, emergency facilities, wastewater treatment plants, three power plants, and a naval base will be at increased risk of inundation, as will areas of wetlands and other natural ecosystems due to sea-level rise. In addition, the cost of replacing property at risk of coastal flooding with a 1.4-meter rise in sea levels is projected at \$2.2 billion (in year 2000 dollars) (CEC 2009).
- Biological resources in Ventura County will be affected by multiple climate change-related factors. Increased temperatures will induce movement of terrestrial species to higher elevations resulting in habitat fragmentation. Changes in precipitation will lead to prolonged periods of

drought and/or more intense rain events, which could adversely affect river flow and riparian habitat. Rising sea levels will inundate existing coastal biotic communities.

- Areas south of U.S. 101 in the City of Ventura, including the Ventura County Fairgrounds, the City of Ventura Marina, and some residential uses along North Harbor Boulevard, as well as some commercial and residential uses southeast of State Route (SR) 1 in Oxnard and around Naval Base Ventura County - Point Mugu are currently vulnerable to flooding. Taking varying levels of sea-level rise into consideration (up to 1.4 meters) along with existing flood risks, additional inundation areas in Ventura County will be exposed to flooding further upland and closer to SR 1.
- According to Cal-Adapt, the countywide average extreme heat day for Ventura County is 88°F and the county has a historical average of four extreme heat days a year. Under a low-emissions scenario, the number of extreme heat days is projected to increase to an average of 20 days per year between 2040 and 2045 and an average of 31 days per year from 2095 to 2099. Further, under a high-emissions scenario, an average of 20 extreme heat days are projected to occur between 2040 and 2045 with an average of 79 from 2095 to 2099.
- Ventura County is projected to experience a 15 percent increase in the potential amount of area burned by wildfire between 2020 and 2085 (Cal-Adapt 2016).

Existing Conditions

Effects of Climate Change on the Environment

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the World Meteorological Organization and the United Nations Environment Programme to provide the world with a scientific view on climate change and its potential effects. Global climate change is already responsible for a number of adverse effects on natural resources and the human population that will continue to worsen in the coming decades. These include:

- rising sea levels around the world due to melting of polar ice caps and sea ice, which can inundate low-lying areas and increase the severity of flooding risk;
- changes in the timing or amounts of rainfall and snowfall, leading to changes in water supply;
- increased stress to vegetation and habitat, leading to adverse effects on biological resources and sensitive species;
- increased frequency and duration of heat waves and droughts, which can affect human populations and the infrastructure on which they depend; and,
- increases in wildfire hazards and related effects on forest health.

Based on the work of IPCC and research conducted by the State of California and partner agencies and organizations, it has been shown that climate change is already affecting, and will continue to affect, the physical environment throughout California and Ventura County. To identify local impacts, the climate change scenario planning tool Cal-Adapt may be used. Cal-Adapt was developed by CEC and the University of California Berkeley Geospatial Innovation Facility. Cal-Adapt downscales global climate simulation model data to local and regional resolution under two emissions scenarios: the A-2 scenario represents a higher, future global GHG emissions scenario, and the B-1 scenario represents a lower future GHG emissions scenario. Which scenario occurs in the future depends on the efficacy of programs

implemented to reduce GHG emissions. Because the degree of efficacy is not yet known, results from both emissions scenarios are considered in this background report and distinguished, where possible.

Not all climate change effects within Cal-Adapt have data aggregated specifically for countywide description. Cal-Adapt downscales most of its data to grid cells 12 kilometers (km) by 12 km (approximately 60 square miles) in size. Thirty-nine grid cells are located entirely or partially within Ventura County boundaries. For the purposes of this background report, where countywide data are not available, a composite score of the total county was developed and will be used for consistency in comparisons.

Cal-Adapt data describing future climate conditions for Ventura County are summarized in the sections below.

Increased Temperatures

According to IPCC, global average temperature is expected to increase relative to the 1986-2005 period by 0.3–4.8 degrees Celsius (°C) (0.5-8.6 °F) by the end of the 21st century (2081-2100), depending on future GHG emission scenarios (IPCC 2014:SPM-8). According to the California Natural Resources Agency (CNRA), downscaling of global climate simulation model data suggests that average temperatures in California are projected to increase 2.7 °F above 2000 averages by 2050 and, depending on emission levels, 4.1–8.6 °F by 2100 (CNRA 2012a:2).

According to Cal-Adapt, annual average temperatures in Ventura County will rise by 3.6 to 6.0 °F by 2090, based on the low- and high-emission scenarios (Cal-Adapt 2016). With a total area of 2,208 square miles, temperature increases within the county would be expected to be more severe farther inland.

Ventura County supports a prosperous agricultural industry. According to the Farm Bureau of Ventura County, the county is considered the tenth most productive county in the country with a gross value of approximately \$2.1 billion in 2014 (County of Ventura 2014). Increased temperatures associated with climate change pose potential challenges and opportunities to the county's production of crops. Recently, the county's most lucrative crop has been berries. Berries are a perennial crop, and are considered temperature-sensitive. Statistical modeling projections based on historic crop yield and temperature data suggest a 2°F warming will have a differential impact on yield across crops. As temperature-sensitive crops, it would be expected that berry production could be adversely affected from projected increases in temperature; however, a warming of the Ventura County climate could create an opportunity to grow heat-tolerant crops that historically have been unavailable (California Department of Food and Agriculture [CDFA] 2013).

Increased temperatures will also result in adverse impacts to biological species within the county. Ventura County is characterized as a Mediterranean climate and experiences warm, wet winters and calm, hot, dry summers. This environment fosters an abundance of biodiversity; while only covering two percent of the world's land area, Mediterranean habitats contain 16 percent of the world's plant species. The warming of the climate in the county could lead to the movement of terrestrial species to areas of higher elevation to track suitable habitat conditions. This movement could lead to loss of habitat within linkages between core habitats. Timing and success of species reproduction could likely be affected. Further, longer-lived species with limited reproductive output or dispersal capacities (e.g., oaks) may be less able to adapt to the shifting climatic conditions (The Nature Conservancy 2008). Additionally, increased temperatures have the potential to result in more invasive species introductions through expanded habitat range (CDFA 2013).

Changes to Precipitation Patterns

Global climate change will affect physical conditions beyond average temperatures. For example, changes in weather patterns resulting from increases in global average temperature will result in a decreased volume of precipitation falling as snow in California and an overall reduction in snowpack in the Sierra Nevada and other mountain ranges in the state. Snowpack and rainfall in the mountain ranges within Los Padres National Forest (e.g., Sierra Madre), which supplies watersheds in Ventura and Santa Barbara counties, is projected to decrease by 17 percent, which could affect water supply to the Ventura River and Santa Clara River Watersheds (County of Ventura 2015a).

According to Cal-Adapt, Ventura County has historically received an average of approximately 17 inches of precipitation annually, with the majority of rain events occurring in the winter months. Under the low-emission scenario, Cal-Adapt projects an overall decrease in countywide precipitation of about 1 to 2 inches for the years 2040 and 2100, respectively. Under the high-emission scenario, Cal-Adapt projects a 2-inch decrease in countywide precipitation by 2040 and a 4-inch decrease by 2100 (Cal-Adapt 2016).

As discussed above, decreases in precipitation associated with climate change may affect delivery of water for agricultural and other uses. While changes in precipitation at the local level are difficult to predict, it is expected that California's water resources will deplete over the course of the century due to a decrease in snowpack in the Sierra Nevada Range. Of the 20,000 acre-feet of State Water Project (SWP) contracted to Ventura County Water Protection District (WPD), a 10,000 acre-feet entitlement is held by the City of Ventura and 5,000 acre-feet entitlement is held by Casitas Municipal Water District. The remaining 5,000 acre-feet entitlement is held by United Water Conservation District which is located in the Santa Clara River Watershed. As of 2016, these entities currently are not fully exercising their entitlements from the SWP due to a lack of facilities. It would be reasonable to assume that if water supply in the county became constrained, Ventura County could invest in facilities to receive the allocation (Ventura Water 2014). It should be noted, however, that changes in precipitation patterns and rates may affect the availability of SWP resources.

Additionally, drought conditions combined with warming temperatures have affected insect populations. For example, in Ventura County, strawberry yields in 2013 were greatly affected by a burst in population of spider mites due to lack of rain, which caused major damage to strawberry fields throughout the county (Ventura County 2013). Increases in the frequency and persistence of future drought conditions in the state and county could result in similar impacts to crop yields.

Changes in precipitation patterns will also affect the endemic ecosystems of Ventura County. Increased frequency and periods of drought and/or more severe rain events could affect the flow regime of the Calleguas Creek, Santa Clara River, and Ventura River watersheds. Alterations in precipitation patterns producing drought conditions may result in increased salinity in estuaries and near-shore aquifers (Watersheds Coalition of Ventura County [WCVC] 2014). A study of the Santa Clara River found that climate change could result in more extreme fluctuations in water flow, leading to the scouring of the riparian zone and loss in habitat for aquatic vertebrates (The Nature Conservancy 2008).

Sea-Level Rise

Another outcome of global climate change is sea-level rise. The average global sea level rose approximately seven inches during the last century. According to the CEC's 2009 report, *The Impacts of Sea-Level Rise on the California Coast*, currently 7,300 people, or approximately one percent of the county's population, live in areas currently at risk of being inundated in a 100-year flood event. Based on a set of climate scenarios prepared by the CEC's Public Interest Energy Research Climate Change

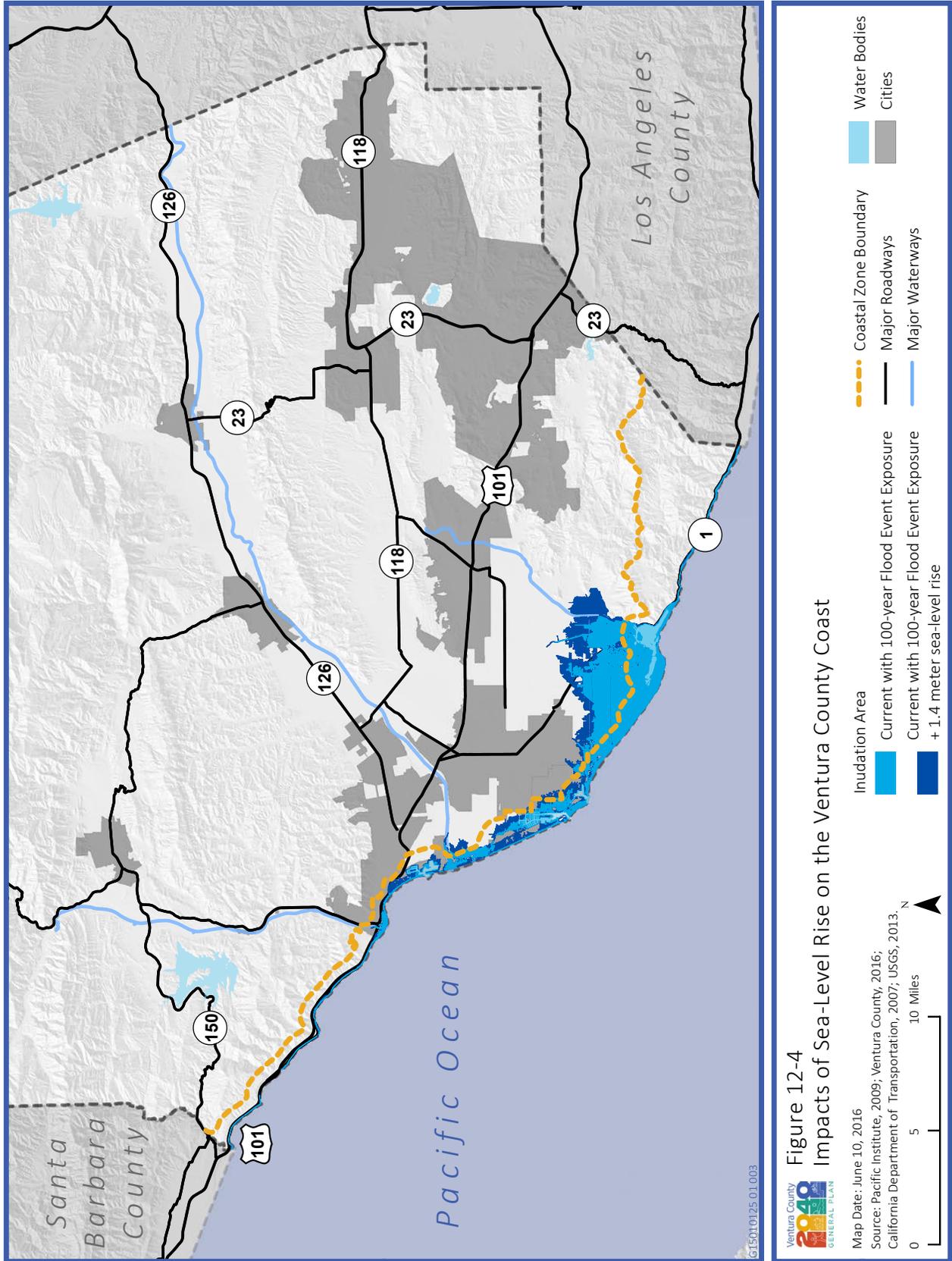
Research Program, under medium- to high-emissions scenarios, mean sea level along the California coast will rise from 1.0 to 1.4 m by the year 2100.

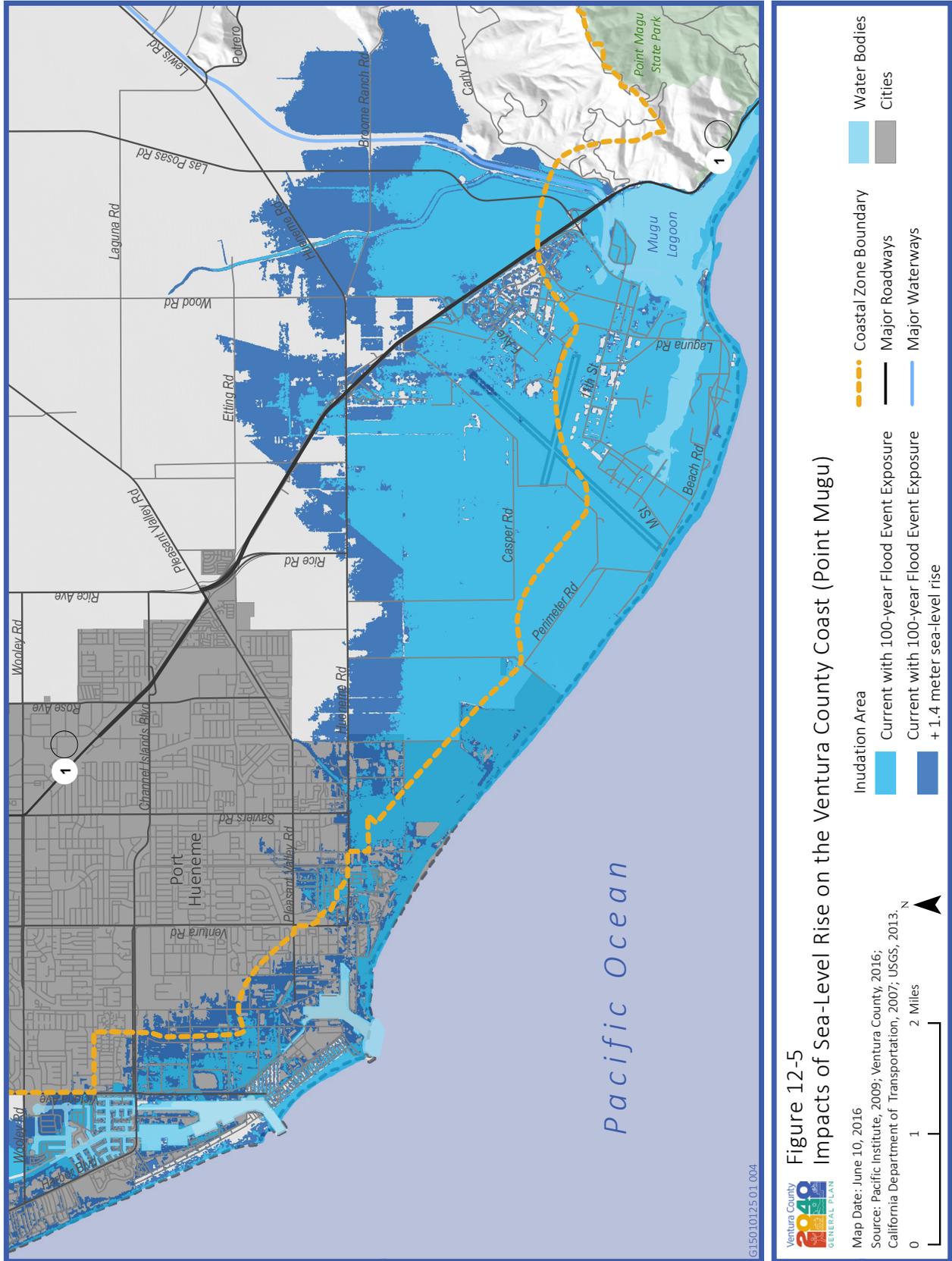
Under a high-emissions scenario, a 1.4-meter rise in sea level will put an additional 16,000 people at risk, raising the total number of people at risk to 23,300. While the racial composition of populations vulnerable to a 100-year flood event generally reflects the county as a whole, a disproportionate number of affected persons (located largely in southeastern Oxnard) are low-income and are especially vulnerable. Critical infrastructure in Ventura County, including 170 miles of roads and railways, hospitals, schools, emergency facilities, agricultural lands, wastewater treatment plants, three power plants, and a major military facility will be at increased risk of inundation due to coastal flooding as a result of sea-level rise and a 100-year flood event, as will vast areas of wetlands and other natural ecosystems. In addition, the cost of replacing property in the county at risk of coastal flooding with a 1.4-meter rise in sea level is \$2.2 billion (in year 2000 dollars), a 120 percent increase as compared to current risk. Continued development in vulnerable areas would put additional Ventura County areas at risk and raise flood protection costs (CEC 2009).

Although California does not typically experience hurricane events, the state is routinely affected by the El Niño Southern Oscillation (ENSO), which is characterized by a warming of wind and sea surface temperatures over the Pacific Ocean. ENSO events typically result in an increase in precipitation over southern California as compared to normal conditions. Combined with a projected rise in sea temperature, low lying coastal areas of Ventura County such as Ventura Harbor and the Oxnard Shores are particularly vulnerable to flooding associated with ENSO storm surges, which can be 0.5 to 1 foot above normal conditions. According to the Federal Emergency Management Agency (FEMA), an ENSO-related storm during the winter of 1997 to 1998 caused storm damage totaling approximately \$50,000,000. During that event, swells overtopped revetments and flooded several roads, a bike path, and a parking lot causing considerable destruction (FEMA 2011).

Using data developed by the United States Geological Survey (USGS) and the Pacific Institute, the Cal-Adapt tool depicts sea-level rise projections and existing storm-related flooding events using a “bathtub model,” which shows the consequences of a 100-year flood event combined with up to 1.4-meter sea-level rise (without taking into account protective structures, such as levees or wave run-up). As shown in Figure 12-4, several areas in Ventura County (10,530 acres) are currently vulnerable to flooding in 100-year storm events (Cal-Adapt 2016; Ventura County 2015a). These include areas south of U.S. 101 in the City of Ventura, including the Ventura County Fairgrounds, the City of Ventura Marina, and some residential uses along North Harbor Boulevard, as well as some commercial and residential uses southeast of SR 1 in Oxnard, as well as around Naval Base Ventura County - Point Mugu. Taking varying levels of sea-level rise into consideration (up to 1.4 meters) along with existing flood risks, the tool projects additional inundation areas in Ventura County further upland past SR 1, with a 36 percent increase in total acreage of land vulnerable to a 100-year flood event. As shown in Figure 12-5, south-eastern Oxnard is especially vulnerable (Cal-Adapt 2016).

As previously discussed, several areas of Ventura County are at high risk of inundation from the combined effects of sea-level rise and a 100-year flood event; however, coastal areas of the county will also experience permanent inundation due to rising sea levels alone. Through close coordination with private and public entities, the Nature Conservancy’s Coastal Resilience Project has collected sufficient data to map the areas of Ventura County vulnerable to inundation from rising tides for the years 2030, 2060, and 2100 under low, medium, and high sea-level rise scenarios (The Nature Conservancy 2015).





Rising sea levels will also result in the inundation of coastal and riparian habitats in Ventura County. Vulnerable ecological communities include those endemic to McGrath Beach, the Santa Clara River estuary, Ormond Beach, and Point Mugu. As sea levels rise, species will be forced into land farther from the existing coast, and the movements of these species could be impeded by urban infrastructure (The Nature Conservancy 2008).

As a coastal community, Ventura County is at high risk of erosion associated with sea-level rise. Coastal erosion occurs as a function of artificial elements (e.g., jetties, rock revetments) with natural stressors such as wave action, tidal and wave currents, drainage features, and sediment composition. Currently, Ventura County contains several sites that have experienced a cumulative adverse effect related to urbanization over the past century (i.e., Oil Piers beaches, Hobson County Park, North Rincon Parkway, South Rincon Parkway, Emma Wood State Beach, Surfers Point Park, San Buenaventura State Beach, Pierpont Beach, Oxnard Shores, and Hueneme Beach). Damming of streams and rivers upstream from the shoreline, coastal urbanization, and other development impacts have impacted the balance of sand movement and the process of natural beach replenishment (Coastal Sediment Management Workgroup 2010).

A study performed in 2013 modeled the impacts to coastal erosion employing three scenarios of differing sea-level rise at Mandalay Beach Road. The model applied three components: historic rates of erosion, additional erosion due to sea-level rise, and the potential erosion impact caused by a large storm wave event (i.e., 100-year or 500-year). Using a combination of the three components, under the low sea-level rise scenario (0.44 meters by 2100), by the year 2100, the area was expected to experience erosion at a rate 0.52 meters per year. Under the medium sea-level rise scenario (0.93 meters by 2100), erosions rates would occur at 0.88 meters per year by 2100. Under the high sea-level rise scenario (1.48 meter by 2100), the area was modeled to experience erosion at a rate of 1.36 meters per year (The Nature Conservancy 2013).

Further, as sea levels rise, saltwater intrusion to groundwater supply occurs. Due to the contentious and highly politicized nature of groundwater extraction, groundwater resources are especially vulnerable to the effects of rising sea levels. In cases where groundwater extraction exceeds recharge in coastal communities, a vacuum-like phenomenon pulls saltwater into aquifers. Saltwater intrusion has already been documented in the deep aquifer system of the South Oxnard Plain (The Nature Conservancy 2016). Rising sea levels combined with the potential for future overdraft associated with changes in precipitation patterns could exacerbate this effect.

Increased Frequency of Extreme Heat Events and Wildfire Risk

Changes in precipitation patterns and increased temperatures associated with climate change will alter the distribution and character of natural vegetation and associated moisture content of plants and soils. An increase in frequency of extreme heat events and drought are also expected. These changes will lead to increased frequency and intensity of large wildfires (CNRA 2012a:11).

Cal-Adapt defines the extreme heat day as any day between April and October where the maximum temperature exceeds the 98th historical percentile of maximum temperatures based on daily temperature maximum data between 1961 and 1990. Using data provided by Scripps Institution of Oceanography, the countywide average extreme heat day for Ventura County is 88°F according to Cal-Adapt. Cal-Adapt data show that Ventura County has a historical average of four extreme heat days a year and show a range of projected increases in the number of extreme heat days until the year 2099. Under a low-emissions scenario, the number of extreme heat days is projected to increase to an average of 20 days per year between 2040 and 2045 and an average of 31 days per year from 2095 to 2099. Further, under a high-

emissions scenario, an average of 20 extreme heat days are projected to occur between 2040 and 2045 with an average of 79 from 2095 to 2099. Notably, Cal-Adapt's extreme heat day tool accounts for historic annual variability as well as general uncertainty regarding modeling future conditions, which results in peaks and dips on a year-to-year basis. For this reason, five-year averages have been taken to demonstrate a more comprehensive trend of increases in future temperatures and extreme heat days.

It should be noted that due to its geographical location, portions of Ventura County will experience a range of temperature-related effects depending on their proximity to the Pacific Ocean. Coastal communities may not experience the same increase in extreme heat days due to the Pacific Ocean's coastal influence. Water has a high specific heat, meaning it requires a high amount of energy to alter its temperature; therefore, climatic forces which may otherwise result in more extreme fluctuation in temperature are regulated in coastal areas. Further, wind direction in Ventura County is regulated by the behavior of Ferrel Cells which move wind west to east pulling cooler, oceanic air onto the coast. Conversely, communities in Ventura County that are located farther inland (e.g., Piru) will experience greater variation in temperature due to their distance from the Pacific Ocean, and will be more susceptible to impacts related to extreme heat.

The Ventura County Multi-Hazard Mitigation Plan (MHMP) identifies 23 fires that consumed greater than 10,000 acres over the past 50 years. Most recently, the 2013 Springs Fire constitutes the most recent fire in the county burning over 24,251 acres over the course of a week destroying 10 structures, damaging 12, and resulted in 10 injuries (Ventura County 2015a). Within Ventura County, zones at risk of high, very high, or extreme wildfire threat are located in mountainous or hillside areas (west of Lake Casitas, northeast of Ojai, north of Fillmore, and surrounding Thousand Oaks and Simi Valley) (County of Ventura 2015a). According to Cal-Adapt, a majority of Ventura County will experience an increase of 15 percent in the potential amount of area burned by wildfire between 2020 and 2085. Ventura County will experience a similarly minor projected increase in wildfire risk for both the low and high emissions scenarios (Cal-Adapt 2016).

Regulatory Setting

A variety of federal, state, and local laws, policies, and guidance address the adverse impacts of global climate change. Climate change effects and adaptation may be considered within the existing policy and regulatory framework for natural resources and hazards; however, a number of specific regulatory considerations and related climate change and adaptation planning studies and initiatives are applicable to Ventura County and are discussed below.

Federal

Executive Order 13653

Executive Order (EO) 13653, signed by President Barack Obama on November 1, 2013, directs Federal agencies to take a series of steps to make it easier for American communities to strengthen their resilience to climate change. The EO requires agencies to modernize Federal programs to support climate resilient investments; manage lands and waters for climate preparedness and resilience; provide information, data, and tools for climate preparedness and resilience; and plan for climate change related risks. Among other steps, the EO established a State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience (Task Force) to advise the Administration on how the federal government can respond to the needs of communities nationwide that are dealing with the impacts of climate change. To implement these actions, the EO also established a Council on Climate Preparedness and Resilience (Council).

Executive Order 13690

EO 13690, signed by President Barack Obama on January 30, 2015, aims to reduce the risk and cost of future flood disasters by requiring all Federal investments in and affecting floodplains to meet higher flood risk management standards. The EO requires federally funded buildings, roads, and other infrastructure be constructed to better withstand the impacts of flooding. The EO provides agencies with flexibility to use data and methods informed by best-available science or to build to a set height above the 100- or 500-year flood elevation.

President's State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience: Recommendations to the President

The President charged the Task Force, established by EO 13653, with providing recommendations on how the Federal Government can respond to the needs of communities nationwide that are dealing with the impacts of climate change. The President's Task Force released its Recommendations to the President report in November 2014. Recommendations in the report include building resilient communities, improving resilience in the Nation's infrastructure, ensuring resilience of natural resources; preserving human health and supporting resilient populations; supporting climate-smart hazard mitigation and disaster preparedness and recovery; understanding and acting on the economics of resilience; and building capacity for resilience (Task Force 2014).

Progress Report: Highlighting Federal Actions Addressing the Recommendations of the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience

The Obama Administration in July 2015 released the Progress Report: Highlighting Federal Actions Addressing the Recommendations of the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience (Progress Report). The Progress Report focuses on key actions taken by the Federal Government and describes more than one hundred completed and ongoing initiatives that Federal agencies have taken to support efforts, at all levels of government, to prepare for changing climate conditions. The Administration issued the report in response to a list of Task Force recommendations received in 2014 (Task Force 2015).

Priority Agenda: Enhancing the Climate Resilience of America's Natural Resources

The Priority Agenda: Enhancing the Climate Resilience of America's Natural Resources, was prepared by the Council and Natural Resources Working Group in October 2014. The Agenda builds upon the robust climate change adaptation work already accomplished by Federal agencies and identifies significant actions moving forward. It identifies the following four priority strategies to make the Nation's natural resources more resilient to climate change, including:

- foster climate-resilient lands and waters;
- manage and enhance U.S. carbon sinks;
- enhance community preparedness and resilience by utilizing and sustaining natural resources; and
- modernize federal programs, investments, and delivery of services to build resilience and enhance sequestration of biological carbon.

The Agenda also provides an implementation strategy and priority actions to focus on (Council 2014).

Open Pacific Coast Study. FEMA is performing detailed coastal engineering analysis and mapping of the Pacific coast of California pursuant to FEMA’s February 2005 Pacific guidelines for new coastal studies. The Open Pacific Coast Study will include mapping of coastal flood risk and wave hazards along the California coast including Ventura County. Following the completion of flood plain mapping, FEMA will present coastal counties with Flood Insurance Rate Maps and coordinate with local stakeholders in developing risk awareness strategies to communicate risks to impacted residents and businesses. Completion of the process will differ county-to-county, but it is expected that mapping for the Ventura County coast will be available between 2016 and early 2018 (FEMA 2015).

State

Executive Order S-13-08

EO S-13-08, signed by Governor Arnold Schwarzenegger on November 14, 2008, required CNRA to develop California’s first Climate Adaptation Strategy in coordination with local, regional, State, and federal public and private entities. Under the EO, the National Academy of Sciences was instructed to issue a report on sea-level rise to advise California planning efforts, which was released in June 2012. It also directed the Governor’s Office of Planning and Research (OPR) to provide State land-use planning guidance related to sea-level rise and other climate change impacts. The Interim Guidance Document was released in November 2008, with an update released in 2013.

Executive Order B-30-15

On April 20, 2015, Governor Edmund G. Brown Jr. signed EO B-30-15 to establish a new California GHG reduction target of 40 percent below 1990 levels by 2030, as well as increase statewide efforts to address the need for increased climate change adaptation measures by State agencies. These measures include:

- incorporating climate change impacts into the State’s Five-Year Infrastructure Plan;
- updating the Safeguarding California Plan to identify how climate change will affect California infrastructure and industry, and what actions the State can take to reduce the risks posed by climate change;
- factoring climate change into State agencies’ planning and investment decisions;
- requiring OPR to establish a technical advisory group to help state agencies incorporate climate change impacts into planning and investment decisions; and,
- implementing measures under existing agency and departmental authority to reduce greenhouse gas emissions.

Senate Bill 379, Climate Change Adaptation in General Plan Safety Elements

Senate Bill (SB) 379 (Jackson, Chapter 608, Statutes of 2015), requires all cities and counties to include climate adaptation and resiliency strategies in the safety elements of their general plans. The update must include the following:

- a climate change vulnerability assessment;
- adaptation and resilience goals, policies, and objectives;

- feasible implementation measures; and,
- reference to or attachment of a separate adaptation plan, if it fulfills these requirements.

The general plan safety element update is due at the time of a jurisdiction's first FEMA Local Hazard Mitigation Plan adopted after January 1, 2017, or if no such FEMA plan has been adopted, after January 1, 2022. The bill also references specific sources of useful climate information to consult, such as Cal-Adapt.

Senate Bill 246, Integrated Climate Adaptation and Resiliency Program

SB 246 (Wieckowski, Chapter 606, Statutes of 2015), establishes the Integrated Climate Adaptation and Resiliency Program, which is to be administered by OPR. The Program will coordinate regional and local adaptation planning efforts with statewide climate adaptation strategies. The bill also requires, within one year of an update to the Safeguarding California Plan, Cal OES to review and update, as necessary, the Adaptation Planning Guide, in coordination with CNRA, OPR, and relevant public and private entities. The bill establishes an advisory council to support the goals of OPR and requires OPR to establish a clearinghouse for climate adaptation information.

2009 California Climate Adaptation Strategy

In compliance with EO S-13-08, CNRA, in coordination with local, regional, State, and federal public and private entities, prepared the 2009 California Climate Adaptation Strategy. The 2009 California Climate Adaptation Strategy summarizes climate change impacts and recommends adaptation strategies across seven sectors: Public Health, Biodiversity and Habitat, Oceans and Coastal Resources, Water, Agriculture, Forestry, and Transportation and Energy. The report was the first of its kind to use downscaled climate models to assess statewide climate impacts with more accuracy as a basis for providing guidance for establishing actions that prepare, prevent, and respond to the effects of climate change (CNRA 2009).

Safeguarding California: Reducing Climate Risk

Safeguarding California is California's overall plan for climate adaptation (CNRA 2014). The plan provides policy guidance for state decision-makers, and is part of continuing efforts to reduce impacts and prepare for climate risks. This plan, which updates the 2009 California Climate Adaptation Strategy, highlights climate risks in nine sectors in California, discusses progress to date, and makes realistic sector-specific recommendations (CNRA 2014).

In March 2016, CNRA released the final Safeguarding California Implementation Action Plans, which provide more specific guidance and actions to implement Safeguarding California's statewide strategies (CNRA 2016).

Sea-Level Rise Policy Guidance

In August 2015, the California Coastal Commission (CCC) adopted a Sea-Level Rise Policy Guidance document that provides an overview of the best available science on sea-level rise for California and recommended methodology for addressing sea-level rise in CCC planning and regulatory actions. It is intended to serve as a multi-purpose resource for a variety of audiences and includes a high level of detail on many subjects. Because the document is not specific to a particular geographic location or

development density, the content serves as a menu of options for use if relevant, rather than a checklist of required actions (CCC 2015).

State of California Sea-Level Rise Interim Guidance Document and Update

In October 2010, the Coastal and Ocean Working Group of the California Climate Action Team (CO-CAT), in response to EO S-13-08, developed the State of California Sea-Level Rise Interim Guidance Document. This document provided guidance for incorporating sea-level rise projections into planning and decision making for projects in California (CO-CAT 2010). In March 2011, the Ocean Protection Council adopted a Resolution stating that state agencies should follow the Interim Guidance Document, as well as future guidance documents developed by the CO-CAT. In March 2013, an update to the State of California Sea-Level Rise Guidance Document was released. The purpose of the Guidance remains the same: to help State agencies incorporate future sea-level rise impacts into planning decisions; however, it has been updated to include the best available science, as summarized in the National Academy of Sciences Sea-Level Rise for the Coasts of California, Oregon, and Washington (CO-CAT 2013).

Adapting to Sea Level Rise: A Guide for California's Coastal Communities

In 2012, CEC released *Adapting to Sea Level Rise: A Guidance for California's Coastal Communities* as a document intended to guide and assist managers and planners in California in developing sea-level rise adaptation plans for their communities. The document provides a framework for performing sea-level rise vulnerability assessments and risk analyses for the development of adaptation plans that can be tailored specifically to their individual communities (CEC 2012).

California Adaptation Planning Guide

The California Governor's Office of Emergency Services (Cal OES) and CNRA prepared and adopted the California Adaptation Planning Guide in July 2012. The purpose of the Guide is to assist local and regional jurisdictions with proactively addressing unavoidable consequences of climate change. It provides a step-by-step process for conducting a local and regional climate vulnerability assessment, as well as developing and implementing adaptation strategies and other responses to the effects of climate change. The Guide allows for flexibility in the commitment of time, money, and effort when conducting adaptation planning efforts to suit the needs of a particular community (CNRA 2012b).

Water Quality Control Policy for the Enclosed Bay and Estuaries of California

Initially adopted in 1974 and amended in 1995 by the State Water Resources Control Board, the Water Quality Control Policy for the Enclosed Bay and Estuaries of California provides water quality principles and guidelines to prevent water quality degradation and to protect the beneficial uses of waters of enclosed bays and estuaries. The policy directs the phase out of discharge of municipal wastewaters and industrial process waters to enclosed bays and estuaries, excepting the San Francisco Bay-Delta System. Exceptions to this policy may be granted by the applicable Regional Water Quality Control Board.

Local

2005 Ventura County General Plan

The General Plan Resources and Hazards Elements contain goals and policies that may relate to climate change effects and adaptation.

Ventura County Multi-Hazard Mitigation Plan

In September 2015, unincorporated Ventura County, nine of the county's ten cities, and seven county-based agencies developed the Ventura County Multi-Hazard Mitigation Plan (MHMP) for Ventura County. The MHMP addresses the local planning requirements of the Federal Disaster Mitigation Act for unincorporated Ventura County and other local participants.

The MHMP identifies natural hazards with the greatest impact to Ventura County including climate change, flooding, landslides, wildfires, invasive species, and drought. The Plan discusses the role that climate change plays in increasing the frequency and intensity of these hazards. The MHMP establishes a countywide mitigation strategy designed to minimize the physical and financial risks associated with the identified hazards. The mitigation strategy contains updates to previous mitigation goals, identifies new mitigation actions, prioritizes mitigation actions, and implements mitigation action plans.

County of Ventura Climate Protection Plan

In April 2011, a Climate Protection Plan and its first annual report was presented to the County Board of Supervisors. The Plan identified six major action areas and included 15 climate protection goals to achieve a 15 percent reduction in GHG emissions as compared to the 2005 baseline inventory. More information regarding the Climate Protection Plan can be found in the "Regulatory Setting" of Chapter 12.1, "Greenhouse Gases."

Conservation Plan for the Lower Santa Clara River Watershed and Surrounding Areas

In 2008, the Nature Conservancy released the Conservation Plan for the Lower Santa Clara River Watershed and Surrounding Areas (Plan). Though not strictly a regulatory document, the Conservation Plan has the support of several public stakeholders, including the California Department of Fish and Wildlife, EPA, and the County of Ventura. The Plan provides an overview of the biodiversity found within the Lower Santa Clara River Watershed, which is located within Ventura County. The Plan identifies conservation targets, which are elements of biodiversity that serve as the focus of planning efforts. Within the county, coastal communities, riparian forest and scrub communities, grasslands, coastal sage scrub communities, oak woodlands, chaparral communities, aquatic vertebrates, and wide-ranging terrestrial vertebrates were identified as the conservation targets in the Plan. The Plan also categorizes six critical threats to conservation targets: incompatible urban development, altered fire regime, bank stabilization and channelization, invasive plants, aquatic barriers, and climate change.

The Plan identifies long-term conservation strategies to combat the stressors to conservation targets. The strategies include land-use planning, public planning, land-use policy, public advocacy and education, scientific investigation, and land management (The Nature Conservancy 2008).

Watershed Coalition of Ventura County 2014 Integrated Regional Water Management Plan

The Integrated Regional Water Management (IRWM) Plan was established with the passage of Proposition 50 in 2002 and Proposition 84 in 2006. The IRWM Plan addresses water resources management such as water supply, water quality, flood management, ecosystem health, and recreation through enhanced collaboration across geographic and political boundaries with diverse stakeholder groups. As an outcome of Proposition 50, IRWM Plans are required to include climate change adaptation strategies with respect to water resources. Strategies to adapt to climate change that are being implemented throughout the county include increased water use efficiency, water recycling, integrated flood management, and ecosystem management.

Key Terms

The following key terms used in this chapter are defined as follows:

Climate Adaptation. Adjustment or preparation of natural or human systems to a new or changing environment which moderates harm or exploits beneficial opportunities (CNRA 2014).

Climate Change. Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among others, that occur over several decades or longer (EPA 2016).

Greenhouse Gas (GHG). Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆) (CNRA 2014).

Hazard Mitigation. Hazard Mitigation is sustained action taken to reduce or eliminate long-term risk to people and their property from hazards and their effects (CNRA 2014).

Resilience. The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change (CNRA 2014).

Vulnerability. The extent to which a natural or social system is susceptible to sustaining damage from climate change, and is a function of the magnitude of climate change, the sensitivity of the system to changes in climate and the ability to adapt the system to changes in climate (CNRA 2014).

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