City of Oroville Community Climate Action Plan

Final Draft

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with assistance from PlaceWorks and Fehr & Peers

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Acronyms and Abbreviations

2010 Inventory	Oroville 2010 community GHG emissions inventory
2020 BAU Forecast	Oroville 2020 BAU community GHG emissions forecast
AB	Assembly Bill
ARB	California Air Resources Board
BAU	business-as-usual
BCAG	Butte County Association of Governments
BCAQMD	Butte County Air Quality Management District
Bicycle Master Plan	*2010 City of Oroville Bicycle Transportation Plan*
CAA	federal Clean Air Act
Cal Water	California Water Service Company
CalFIRE	California Department of Forestry and Fire Protection
Caltrans	California Department of Transportation
CAP	Climate Action Plan
CCA	Community Choice Aggregator
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CH_4	methane
CIT	CAP implementation team
City	City of Oroville
CO_2	carbon dioxide
CTR	commute trip reduction
DP	Direct Purchase
EIR	environmental impact report
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EV	electric vehicle
F	Fahrenheit
GHG	greenhouse gas
GWP	global warming potential
HFCs	hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
ITS	Intelligent Transportation Systems
Local Hazard Mitigation Plan	*2014 Butte County Local Hazard Mitigation Plan*
$MTCO_2e$	metric tons of carbon dioxide equivalent
N_2O	nitrous oxide
NPV	Net Present Value
PACE	Property Assessed Clean Energy
PFCs	perfluorinated carbons
PG&E	Pacific Gas and Electric Company

PPA	Power Purchase Agreement
RPS	Renewables Portfolio Standard
SB	Senate Bill
SCOR	Sewage Commission-Oroville Region
SF_6	sulfur hexafluoride
SFWPA	South Feather Water and Power Agency
SWP	State Water Project
TWSD	Thermalito Water and Sewer District

Executive Summary

Introduction

The consensus among leading scientists is that without action to reduce greenhouse gas (GHG) emissions, climate change will pose a considerable threat to our way of life. Changes in the global climate have accelerated over the past 50 years. If current trends continue, the Oroville area is likely to experience future reductions in precipitation and snowmelt, as well as increases in temperatures, extreme heat events, and wildfire risk. These changes in the local climate could have significant and far-reaching public health, economic, and environmental consequences for the Oroville community.

The City of Oroville (City) has long-recognized the need to promote sustainability and address the growing challenge of climate change. Efforts such as the Solar Energy Ordinance, *2010 City of Oroville Bicycle Transportation Plan* (Bicycle Master Plan), and the *City of Oroville Design Guidelines* are already contributing to long-term GHG reductions throughout the community. The *Oroville 2030 General Plan* (2030 General Plan) also supports future carbon-reducing strategies and programs, including mixed-used development, increased transit, and alternative energy.

The City has set a target to reduce GHG emissions from community activities to 11% below 2010 levels by 2020—a goal referred to in this Climate Action Plan (CAP) as the *2020 emissions reduction target*. This target is consistent with larger statewide initiatives adopted through Assembly Bill 32, the California Global Warming Solutions Act. This CAP describes the City's plan for achieving its emissions reduction goal. The CAP also outlines a plan that will better prepare the City to address and adapt to potential economic, environmental, and social effects of climate change.

GHG Emissions in Oroville

Oroville is a diverse community with multiple emissions-generating sources and activities. The City inventoried GHGs generated by the community in 2010 (referred to as the *2010 Inventory*) to identify these existing emissions sources and the magnitude of their emissions. The inventory indicates that in 2010, Oroville residents and businesses generated approximately 163,000 metric tons of carbon dioxide equivalent ($MTCO_2e$)[1]. This accounted for about 0.04% of California's GHG emissions in the same year.

As shown in Figure ES-1, the transportation sector represents the largest source of community emissions (approximately 48% of the 2010 Inventory). The majority of onroad emissions in Oroville comes from personal and light-duty vehicles. Building energy consumption (primarily electricity and natural gas), which accounts for roughly 46% of total emissions, is the next most significant component of the 2010 Inventory. Roughly three-quarters of building energy emissions come from the commercial and industrial sector, with the remaining quarter generated by residential electricity and fuel consumption. Emissions generated by offroad equipment and through managing water, solid waste, and wastewater account for the remaining 6% of the 2010 Inventory.

[1] The standard metric for presenting GHG emissions, $MTCO_2e$, combines the different GHGs into a single total, accounting for the different global warming potentials of each gas.

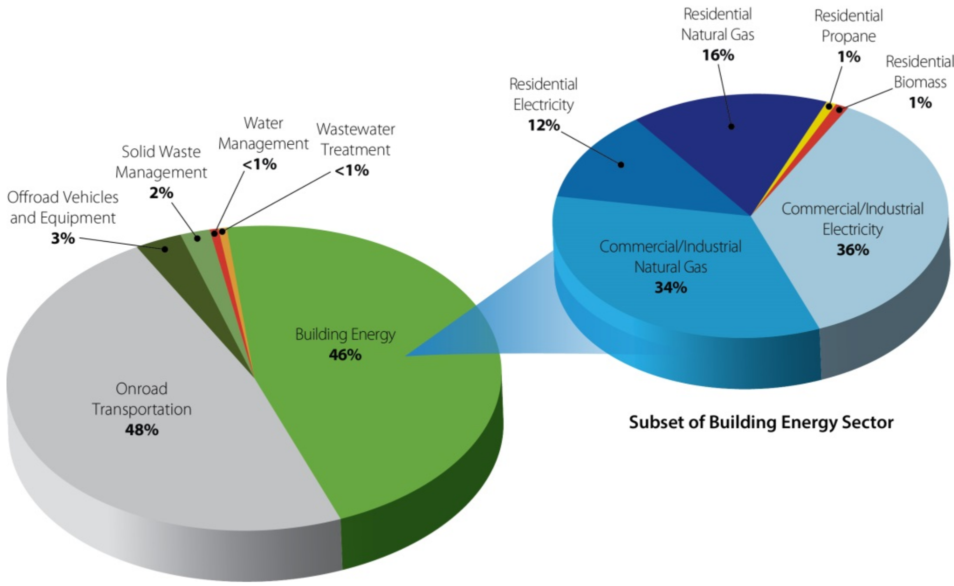

Figure ES-1. Oroville 2010 Community GHG Emissions Inventory by Sector

As Oroville grows, energy consumption, water usage, waste generation, and transportation activity will increase. The City developed a "business-as-usual" (BAU) forecast to evaluate the impact of this growth on future GHG emissions in 2020 (referred to as the *2020 BAU Forecast*). The 2020 BAU Forecast is based on changes in population, households, and employment and represents a scenario that does not consider the effects of future local, State, or federal actions to reduce GHG emissions. Table ES-1 compares the 2020 BAU Forecast to the 2010 Inventory and indicates that GHG emissions are expected to increase by approximately 32,500 $MTCO_2e$ (20%) between 2010 and 2020. Much of this growth is attributable to increases in building energy use, vehicle trips, and offroad equipment.

Table ES-1. Oroville 2010 Community GHG Emissions Inventory and 2020 BAU Community GHG Emissions Forecast ($MTCO_2e$)

Emission Sector	2010 Emissions	2020 BAU Emissions	Growth from 2010
Onroad Transportation	78,096	90,104	12,008
Building Energy	75,042	92,238	17,196
Offroad Vehicles and Equipment	4,221	6,133	1,911
Solid Waste Management	4,125	5,080	955
Wastewater Treatment	1,348	1,660	312
Water Management	456	571	115
Total	**163,288**	**195,786**	**32,498**

Note: BAU = business-as-usual.

Strategies to Reduce GHG Emissions

The CAP includes a variety of regulatory and incentive-based strategies that will reduce GHG emissions from both existing and new development in Oroville. State actions form the foundation of the CAP and will result in emissions reductions throughout the community. Local strategies adopted by Oroville will supplement State programs and achieve additional emissions reductions. The CAP includes 24 local strategies (Table ES-2), which are grouped into five action areas (Figure ES-2).

Figure ES-2. Action Areas to Reduce GHG Emissions

Table ES-2 summarizes the CAP strategies, including their estimated GHG reduction in 2020 and cost per $MTCO_2e$ reduced, as available. As shown in Table ES-2, many of the local strategies are cost effective, particularly those that target energy efficiency and renewable energy. In addition to reducing GHG emissions, all local strategies will result in community co-benefits, such as improved public health, resource conservation, and better air quality.

Table ES-2. Emissions Reduction Strategies, Estimated Reductions, and Cost Effectiveness

State Strategy	2020 GHG Reduction	% Total of Reductions	Saving (Cost)/ MT Reduced
S-1. Renewables Portfolio Standard	15,661	26.0%	-[a]
S-2. Title 24 Standards for Commercial and Residential Buildings	2,673	4.4%	-
S-3. Lighting Efficiency and Toxics Reduction Act	2,380	4.0%	-
S-4. Residential Solar Water Heaters	54	0.1%	-
S-5. Pavley, Advanced Clean Cars, and Low Carbon Fuel Standard	30,300	50.3%	-
S-6. Assembly Bill 32 Vehicle Efficiency Measures	397	0.7%	-

Action Area	Local Strategy	2020 GHG Reduction	% Total of Reductions	Saving (Cost)/ MT Reduced
ENERGY EFFICIENCY AND RENEWABLE ENERGY	BE-1. Green Building Ordinance	323	0.5%	$10–$220
	BE-2. Residential Energy Efficiency Retrofits	624	1.0%	$60–$240
	BE-3. Nonresidential Energy Efficiency Retrofits	1,399	2.3%	$510–$540
	BE-4. Energy Efficient Lighting Standards	156	0.3%	$1,000–$1,400
	BE-5. Solar Installations for New Development	184	0.3%	($340)–$220
	BE-6. Solar Installations for Existing Development	1,000	1.7%	($320)–$220
	BE-7. Local Renewable Energy Development	69	0.1%	($770)–$210
LAND USE AND TRANSPORTATION	LUT-1. Residential and Commercial Density	Medium[b]	-	-
	LUT-2. Mixed-Use Development	227	0.4%	Not estimated
	LUT-3. Balanced Mode Circulation Plan	Low[b]	-	-
	LUT-4. Pedestrian Network Improvements	486	0.8%	Not estimated
	LUT-5. Traffic Calming	18	0.0%	Not estimated
	LUT-6. Electric Vehicle (EV) Charging Stations	24	0.0%	Not estimated
	LUT-7. Voluntary Commute Trip Reduction (CTR) Programs	265	0.4%	Not estimated
	LUT-8. Intelligent Transportation Systems (ITS)	Low[b]	-	-
	LUT-9. Idling Ordinance	37	0.1%	$430
	LUT-10. Electric-Powered Construction Equipment	317	0.5%	Not estimated
	LUT-11. Electric-Powered Landscaping Equipment	45	0.1%	Not estimated
WASTE REDUCTION	WR-1. Waste Diversion Goal	1,983	3.3%	($50–$180)
WATER CONSERVATION	WC-1. Per Capita Water Use Reduction	1,646	2.7%	Not estimated
	WC-2. Recycled Water Use	Low[b]	-	-
TREES AND AGRICULTURE	TR-1. Urban Forests	2	0.0%	($36,000)
	TR-2. Oak Tree Loss Mitigation Ordinance	Low[b]	-	-
	TR-3. Local Food Initiatives	Low[b]	-	-

Notes:

- = Refers to qualitative strategies that currently do not support a GHG reduction or cost and savings analysis; Not estimated = refers to strategies that do not currently support a quantitative cost and savings analysis, even though the strategy has been evaluated from an emissions reduction standpoint.

[a] Cost and savings were not estimated for State strategies.

[b] Emissions reduction strategies that do not currently support a quantitative assessment are qualitatively evaluated based on their likely GHG-reduction potential, as defined below.

Low = less than 500 $MTCO_2e$ reduction.

Medium = 501–1,000 $MTCO_2e$ reduction.

High = Greater than 1,000 $MTCO_2e$ reduction.

Combined, the State and local strategies included in the Oroville CAP are expected to reduce 2020 community-wide GHG emissions by approximately 60,000 $MTCO_2e$, which exceeds the 2020 emissions reduction target by over 9,000 $MTCO_2e$. This is equivalent to removing more than 12,500 passenger vehicles from the road each year (United States Environmental Protection Agency 2014). As shown in Table ES-3 and Figure ES-3, the majority (85%) of emissions reductions are achieved by State programs, such as the Pavley standards and Renewables Portfolio Standard (RPS)[2], which is typical of other CAPs throughout California. Local strategies implemented by Oroville supplement reductions achieved by the State programs to help meet and exceed the reduction target. Strategies not currently quantified, as well as local effects of the State's cap-and-trade program, will likely contribute additional reductions beyond those estimated by the CAP.

Table ES-3. Achieving Oroville's 2020 Emissions Reduction Target

Parameter	Emissions ($MTCO_2e$)
2020 BAU Community GHG Emissions Forecast	195,786
2020 Emissions Reduction Target (11% below 2010 levels)[a]	145,326
$Total_1$ Reductions Needed to Reach Target	***50,459***
2020 Emissions Reductions from State Strategies	51,465
2020 Emissions Reductions from Local Strategies	8,805
Energy Efficiency and Renewable Energy	3,756
Land Use and Transportation	1,418
Waste Reduction	1,983
Water Conservation[b]	1,646
Trees and Agriculture	2
$Total_2$ Emissions Reductions Achieved by the CAP	***60,270***
Emissions Reductions in Excess of Target ($Total_2$ minus $Total_1$)	9,811

Notes:

BAU = business as usual.

[a] Total GHG emissions in 2010 were 163,288 $MTCO_2e$; an 11% reduction equals 145,326 $MTCO_2e$.

[b] Water efficiency improvements will reduce water consumption, which will contribute to reductions in building energy use. For example, efficient faucets that use less water will require less energy for hot water heating. Most of the reductions achieved by WC-1 are associated with reduced hot water heating.

Community Choice Aggregation

The CAP includes an optional strategy—*Community Choice Aggregation*—through which the City would become a Community Choice Aggregator (CCA) and implement a voluntary program to achieve lower levels of GHG emissions for electricity than what Pacific Gas and Electric (PG&E) would provide. As a CCA, the City would supply electricity to customers within Oroville but would not own transmission and delivery systems. Developing and implementing a voluntary CCA that would achieve net reductions compared to PG&E's energy portfolio may not be feasible by 2020 due to programmatic and technical constraints. Accordingly, the strategy is considered optional and is not counted towards the City's 2020 emissions reduction target. Preliminary analysis indicates that if the City successfully implemented the strategy by 2020, an additional 2,500 $MTCO_2e$ (in addition to the State's RPS) could be reduced as a result of the CCA.

[2] Pavley will reduce GHG emissions from automobiles and light-duty trucks (2009 model years and newer) by 30% from 2002 levels by the year 2016. The RPS obligates certain utilities and electric-service providers to procure at least 33% of retail sales from renewable resources by 2020.

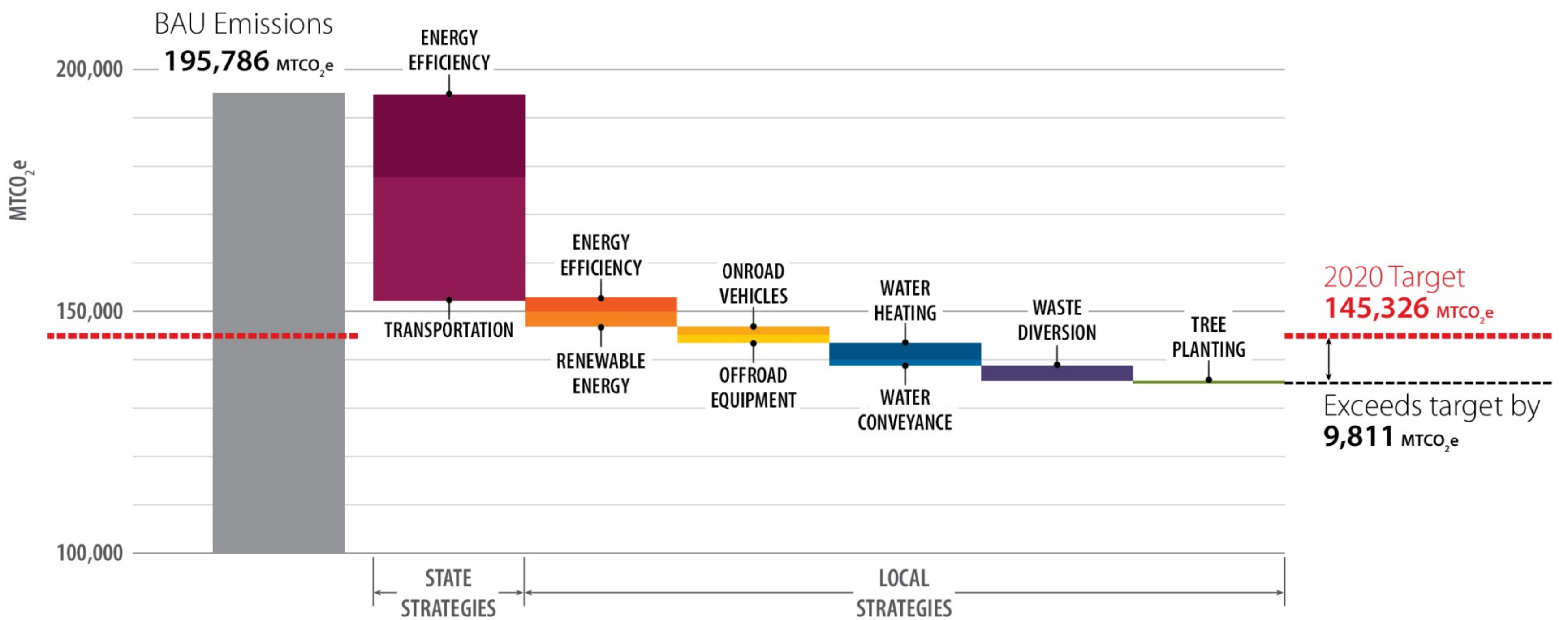

Figure ES-3. Achieving Oroville's 2020 Emissions Reduction Target

Emissions Reduction Strategy Implementation Program

The City faces many challenges—and correspondingly many opportunities—as it moves to reduce GHG emissions. Establishing a robust management program is necessary to ensure the CAP meets its GHG reduction objectives and is implemented in a timely and efficient manner. The City has designated a CAP implementation team (CIT) to lead and coordinate the City's efforts on implementing, monitoring, and managing the emissions reduction strategies. Composed of City staff, the CIT will be responsible for updating and adaptively managing the CAP.

Involvement from residents and businesses in Oroville is integral to the success of the CAP, particularly because several strategies depend on voluntary commitment. Community members will incur some costs of implementing the emissions reduction strategies, although the City will help identify funding opportunities and resources to reduce monetary burdens on the private sector. A detailed community outreach and education plan also will be developed to leverage community involvement, interests, and perspectives.

Following adoption of the CAP, the emissions reduction strategies will be swiftly implemented to ensure that the City's 2020 emissions reduction target is achieved. Beginning in 2016, strategies will be implemented in three groups, and strategy prioritization will be based on several factors including cost effectiveness, emissions reduction efficacy, and general benefits to the community. Specific timelines and milestones for each strategy will be developed by the CIT early in the implementation process.

During each year of implementation, the City will monitor emissions reductions achieved by the State and local strategies. Data collected by routine monitoring will document the City's progress in reducing emissions and enable the City to make informed decisions on future priorities, funding, and scheduling. The City will also prepare two inventory updates, one in 2017 and another in 2019, to measure overall emissions trends in the community. The updated inventories will be submitted to the City Council and distributed to the public for review. As the year 2020 approaches, the City will develop reduction targets for years beyond 2020 to continue the City's commitment to reducing GHG emissions.

Adaptation Plan

The climate in northern California is already changing as a result of existing GHG concentrations. Recent studies indicate that if GHG emissions continue to increase globally based on current trends, climate change could impact the City in the following ways.

 Increased Ambient Temperatures and Extreme Heat Events

 Increased Flooding

 Increased Wildfire Risk

 Decreased Snowfall and Winter Snowpack

 Increased Frequency and Intensity of Storms

 Changes in Growing Season and Species Distribution

Preparing for these inevitable changes is a fundamental component of the City's overall strategy to address climate change. The CAP includes a preliminary vulnerability assessment (Chapter 5) to identify community elements that may be exposed to future climate change. The analysis indicates that water supply, public health, and transportation infrastructure are three valuable community assets with high potential to suffer consequences as a result of changes in the existing climate. Several emissions reduction strategies outlined in the CAP will increase the ability of these assets to respond to climate change effects. Additional adaptation strategies to further decrease local climate change effects to water supply, public health, and transportation infrastructure are summarized in Table ES-4.

Table ES-4. Adaptation Strategies for Water Supply, Public Health, and Transportation Infrastructure

Strategy	Description
WATER SUPPLY	
Adapt-1: Xeriscaping	Promote water conservation and xeriscaping (i.e., climate appropriate landscaping) through City demonstrations and rebate programs
Adapt-2: Rain Barrels	Encourage the use of rain barrels to decrease runoff and lower the demand for potable water
Adapt-3: Low-Impact Development	Manage rainfall onsite through low-impact development and green infrastructure
Adapt-4: Open Space	Utilize open space in the floodplain with "safe-to-fail" infrastructure that can withstand periodic inundation that does not cause runoff that contaminates the water supply
Adapt-5: Slope Stability	Assess and reinforce the stability of slopes in forested areas that are likely to be deforested during wildfires
Adapt-6: Mapping Revisions	Complete timely revisions of floodplain maps
Adapt-7: Channel Restoration	Identify areas with channel erosion (such as the tributaries of Dry Creek) and develop restoration projects
Adapt-8: Infrastructure Planning	Assess drainage concerns in Oroville and update infrastructure plans to accommodate increased development and periods of increased runoff caused by extreme weather
Adapt-9: Regional Planning	Incorporate climate change projections into regional plans including, but not limited to, the *Oroville 2030 General Plan*, *2014 Butte County Local Hazard Mitigation Plan*, *Butte County Flood Mitigation Plan*, *City of Oroville Design Guidelines*, and the *City of Oroville's Fire Hazard Objectives and Implementing Policies.*
Adapt-10: Agricultural Practices	Research and promote water-saving agricultural practices that will be successful under projected climatic conditions
PUBLIC HEALTH	
Adapt-11: Disease Tracking	Increase research and tracking for water-borne, air-borne, and vector-borne diseases that may not have posed a threat in the region in the past. Shifts in the growing season, poor air quality, and contaminated water may introduce new diseases for which the public health system is unprepared
Adapt-12: Warning Alert Systems	Improve warning alert systems and public service announcements. Oroville should evaluate its emergency announcement systems to make sure that vulnerable populations receive early warning for heat advisories, wildfires, and storms
Adapt-13: Public Shelters	Identify public buildings that can be used as shelters and cooling centers
Adapt-14: Education and Outreach	Provide information about health concerns—information about emerging diseases, prevention, care, and how to cope with extreme heat
Adapt-15: Sustainable Building Materials	Use cool roofs, green roofs, and cool pavement to decrease the ambient temperatures and need for air conditioning during hot weather
TRANSPORTATION INFRASTRUCTURE	
Adapt-16: Tracking Metrics	Develop tracking metrics to understand the impacts of weather events on the transportation system and to inform future strategies; metrics may include the frequency, causes, and costs of weather-related disruptions as well as the response to those disruptions

Strategy	Description
Adapt-17: Drainage Capacity	Increase drainage capacity by improving retention basins and storm runoff system to protect transportation infrastructure from flooding
Adapt-18: Emergency Service Access	Construct roads and bridges for increased water service access to help combat wildfire
Adapt-19: Weed Abatement	Expand weed abatement to reduce the impact of wildfire to transportation infrastructure
Adapt-20: Evacuation Programs	Improve public notification and evacuation programs during extreme events
Adapt-21: Construction Materials	Use flexible, expandable materials in railway systems and improved asphalt/ concrete mixtures for roads and runways to reduce the impact of extreme heat events
Adapt-22: Maintenance Activities	Shorten maintenance periods to accommodate changes in temperature and precipitation
Adapt-23: Redundancy	Develop redundant services to accommodate disruptions, taking into consideration the costs of building redundancy into the system versus the benefits of reducing impacts from extreme weather events
Adapt-24: Siting Risk	Consider flooding, wildfire, and landslide risks when siting new transportation structures; incorporate climate change information into the design of new transportation assets

Climate change adaptation continues to evolve as researchers develop methods to better predict local climate change effects and assess the effectiveness of various adaptation options. The strategies identified in Table ES-4 are a starting point for the City's climate change adaptation plan. The City will collaborate with regional and community partners to build on Table ES-4 and develop additional adaptation strategies for other affected community elements. Selected strategies will be implemented through a climate change adaptation plan, which will be managed by the CIT and integrated into the City's long-term planning efforts.

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Chapter 1
Introduction

1.1 Purpose of the CAP

The City of Oroville (City) aims to reduce and avoid greenhouse gas (GHG) emissions associated with community activities, which include everyday activities of local residents and businesses like driving and cooking. The ultimate goal of this Climate Action Plan (CAP) is to reduce GHG emissions to 11% below 2010 levels—a goal referred to as the *2020 emissions reduction target*. Emissions that result from the City's municipal operations are distinct from community-wide activities and are only included in the CAP if they occur within the City's political boundary. While some emissions from municipal activities are included in the CAP, the focus of the plan is to reduce GHG emissions generated by the larger community.

The CAP ties together many of City's existing climate change initiatives and provides a blueprint for a more sustainable future. The strategies and actions outlined in the CAP have other benefits beyond reducing GHG emissions, mainly to make Oroville a more environmentally attractive place to live through better air quality, reduced traffic congestion, and increased opportunities for walking and biking. The City's 2020 emissions reduction target is consistent with larger statewide efforts established by Assembly Bill (AB) 32, the California Global Warming Solutions Act. New development proposed within the city can use the CAP to address GHG impacts and streamline project-level environmental review under the California Environmental Quality Act (CEQA). The CAP therefore serves as a mechanism to facilitate sustainable development as well as a tool to support community-wide reductions in GHG emissions.

The CAP also outlines a forthcoming climate change adaptation plan that will better prepare the City to address potential economic, environmental, and social effects of climate change. GHG concentrations in the atmosphere are believed to be already high enough that some degree of climate change will happen despite emissions reduction efforts. Preparing for these changes—or *adaptation*—is therefore a necessary component of the City's strategy to address climate change. The CAP identifies key areas of potential vulnerability and establishes a framework for responding to potential climate change threats in an effective and coordinated manner that promotes long-term community resiliency.

1.2 Scope and Content of the CAP

The CAP consists of the following six chapters. Several appendices that provide additional detail and background information are included at the end of the document.

- Chapter 1, *Introduction*, describes the purpose of the CAP, provides recommendations for using the CAP, and summarizes information about climate change projections and GHG regulations.
- Chapter 2, *Emissions Inventory, Forecast, and Target*, includes the 2010 baseline inventory of GHG emissions in Oroville, as well as the City's 2020 business-as-usual (BAU) forecast. The emissions reduction target for the CAP is also identified.
- Chapter 3, *Emissions Reduction Strategies*, describes the strategies the City will pursue to reduce GHG emissions. The chapter describes each strategy and estimates potential GHG reductions, costs, savings, and associated "co-benefits."
- Chapter 4, *Emissions Reduction Implementation Program*, provides recommendations for implementing the emissions reduction strategies, including funding approaches, City actions,

and mechanisms for monitoring and updating the analysis.

- Chapter 5, *Climate Change Adaptation*, discusses the effects and implications of climate change within the city and outlines an adaptation strategy.
- Chapter 6, *References*, includes citations for the documents used to prepare the CAP.

1.3 How to Use the CAP

The CAP is a resource for the City and the community. Residents, businesses, and the public are encouraged to review the emissions reduction strategies outlined in Chapter 3 and participate in community engagement activities for the CAP. Many of the strategies outlined in the CAP are designed to encourage residents to adopt more sustainable practices, rather than solely offer enforceable regulation. City staff will work closely with the community to provide education and outreach to support effective implementation of the emissions reduction programs.

Public agencies and private developers can also use the CAP as a tool to comply with project-level review requirements under CEQA. The State CEQA Guidelines allow project applicants to "tier off" a programmatic analysis of GHG emissions, like this CAP, provided that the programmatic analysis does the following (CEQA Guidelines Section 15183.5):

- Quantify GHG emissions, both existing and projected over a specified time period, resulting from activities within a defined geographic area.
- Establish a level, based on substantial evidence, below which the contribution to GHG emissions from activities covered by the plan would not be cumulatively considerable.
- Identify and analyze the GHG emissions resulting from specific actions or categories of actions anticipated within the geographic area.
- Specify measures, including performance standards, which substantial evidence demonstrates would collectively achieve the specified emissions level, if implemented on a project-by-project basis.
- Monitor the plan's progress.
- Adopt the GHG emissions reduction strategy in a public process following environmental review.

The CAP is consistent with the criteria listed above from CEQA Guidelines Section 15183.5 and therefore comprises a qualified GHG emissions reduction strategy for the purposes of CEQA. Accordingly, projects that incorporate applicable CAP strategies can tier off the environmental impact report (EIR) prepared and certified for the CAP to meet project-level CEQA evaluation requirements for GHG emissions. Tiering potentially eliminates the need to prepare a quantitative assessment of project-level GHG emissions. Rather, project-specific environmental documents that rely on the CAP can qualitatively evaluate GHG impacts by identifying all applicable CAP actions and describing how those actions have been incorporated into the project design and/or identified as mitigation. This type of tiered analysis can reduce project costs and streamline the City permit process. Projects that demonstrate consistency with applicable CAP strategies can be determined to have a less-than-significant cumulative impact on GHG emissions and climate change (notwithstanding substantial evidence that warrants a more detailed review of project-level GHG emissions).

Figure 1-1 displays how the CAP streamlines the environmental review process by eliminating the need for a project-level GHG analysis.

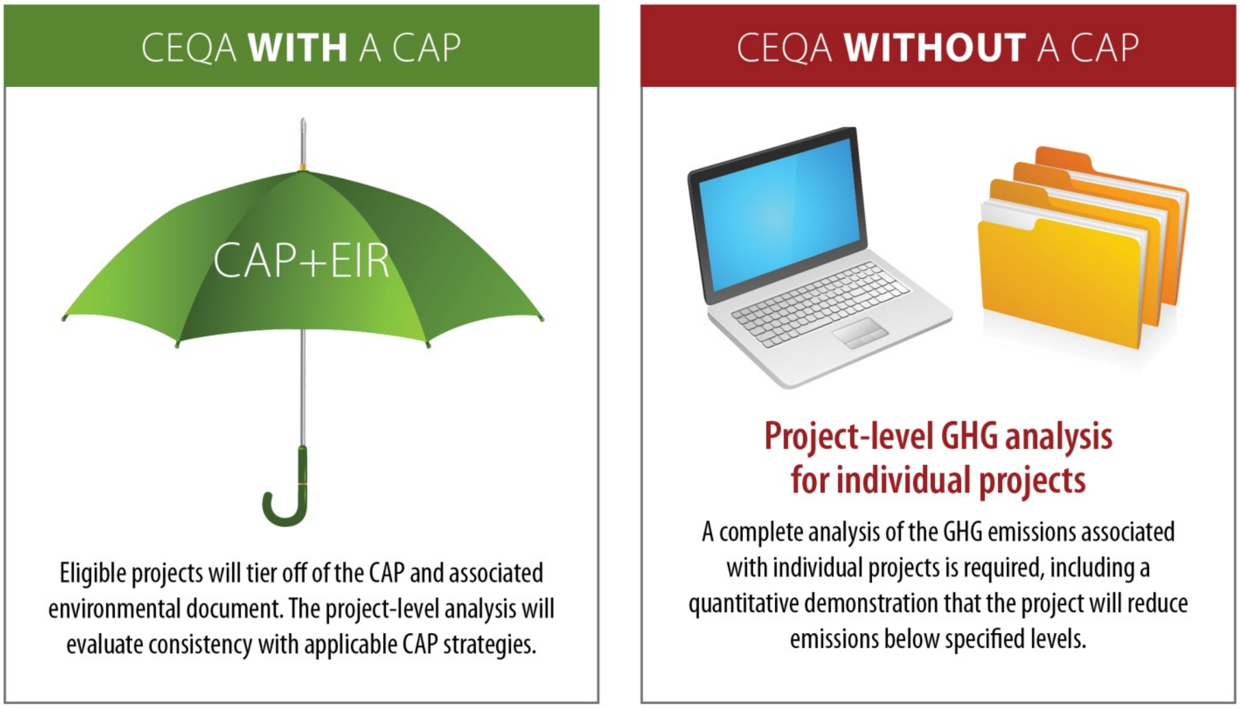

Figure 1-1. California Environmental Quality Act and the CAP: Project Streamlining Benefits

1.4 Background on Climate Change and GHG Emissions

Earth's atmosphere contains naturally occurring GHGs that help regulate the planet's temperature. This phenomenon, known as the *greenhouse effect*, is responsible for maintaining a climate suitable for human life by trapping heat emitted from the Earth's surface that otherwise would escape into space (Figure 1-2). Human activities that generate GHGs increase the amount of GHGs in the atmosphere, thus enhancing the natural greenhouse effect and amplifying global warming (Center for Climate and Energy Solutions 2011).

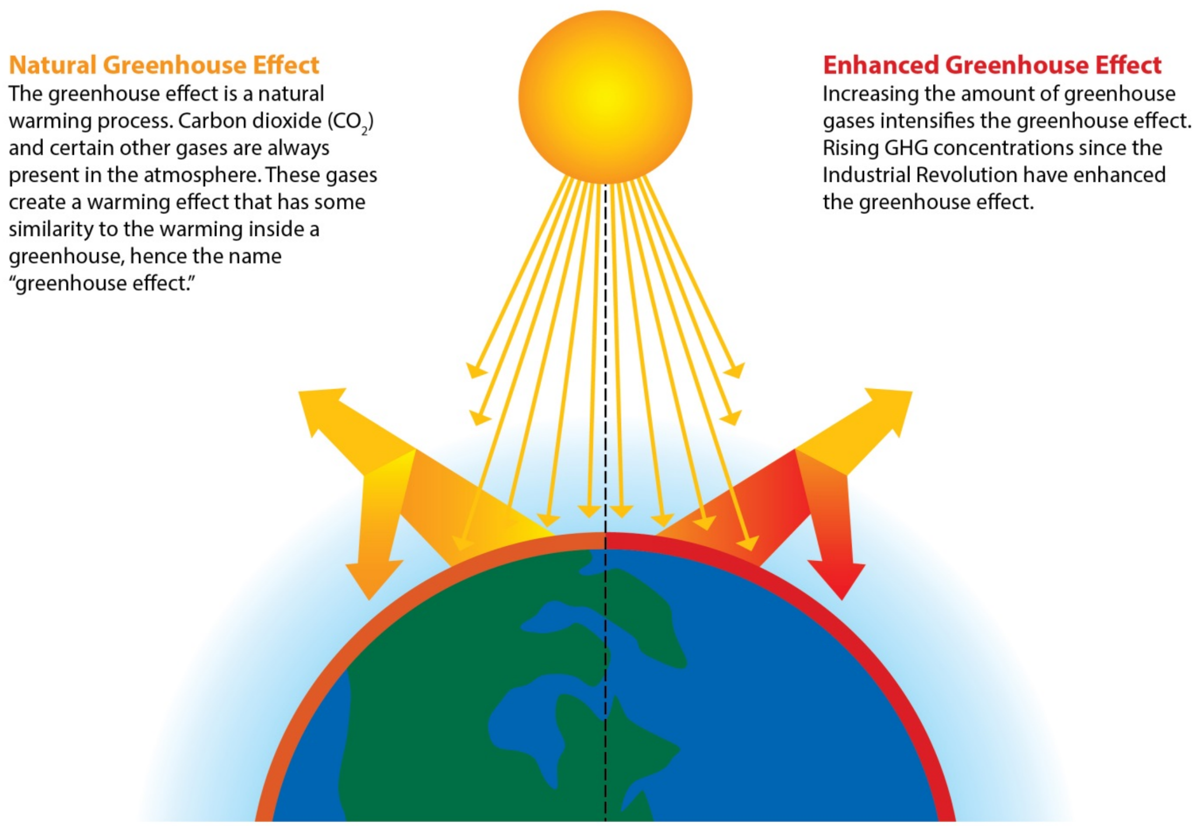

Figure 1-2. The Greenhouse Effect

Increases in fossil fuel combustion and deforestation have substantially increased concentrations of GHGs in the atmosphere since the Industrial Revolution. Rising atmospheric concentrations of GHGs in excess of natural levels result in increasing global surface temperatures—a phenomenon commonly referred to as *global warming*. Higher global surface temperatures in turn result in changes to Earth's climate system, including increased ocean temperature and acidity, reduced sea ice cover, different rainfall and snowfall patterns, and increased frequency and intensity of weather events (Intergovernmental Panel on Climate Change 2007a, 2007b). These large-scale changes are collectively referred to as *climate change*.

While changes in global climate have been recorded throughout history, there is strong consensus among the scientific community that recent changes are primarily the result of human-caused GHG emissions. A recent study published in *Environmental Research Letters* indicates that 97% of climate scientists agree that human activity is "very likely" causing current global warming trends (Cook et al. 2013). Every national academy of science in the world likewise concurs that human-caused GHG emissions are accelerating the magnitude and pace of climate change.

AB 32 identifies the following compounds as the major GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorinated carbons (PFCs), sulfur hexafluoride (SF_6), and hydrofluorocarbons

(HFCs). These gases are quantified in terms of metric tons of carbon dioxide equivalent ($MTCO_2e$)[3] emitted per year, which accounts for their global warming potential (GWP). The GWP is the ability of a GHG to trap heat in the planet's atmosphere when compared to an equal amount of CO_2, which assumes a GWP of 1. Presenting GHGs in $MTCO_2e$ allows one to characterize the complex mixture of GHGs as a single unit, taking into account that each gas has a different GWP.

Table 1-1 describes the key characteristics and sources of the six major GHGs.

Table 1-1. Principal GHG Emissions

Greenhouse Gas	Chemical Formula(s)	Primary Emissions Sources	Global Warming Potential	Atmospheric Lifetime (years)
Carbon Dioxide	CO_2	• Burning of fossil fuels • Gas flaring • Cement production • Land use changes • Deforestation	1	50–200
Methane	CH_4	• Agricultural practices • Natural gas combustion • Landfill outgassing	25	9–15
Nitrous Oxide	N_2O	• Agricultural practices • Nylon production • Gas-fired power plants • Nitric acid production • Vehicle emissions	298	120
Perfluorinated Carbons	CF_4 C_2F_6	• Aluminum production • Semiconductor manufacturing	7,398–12,200	10,000–50,000
Sulfur Hexafluoride	SF_6	• Power distribution • Semiconductor manufacturing • Magnesium processing	22,800	3,200
Hydrofluorocarbons	HFC-23 HFC-134a HFC-152a	• Consumer products • Automobile air conditioners • Refrigerants	124–4,470	1.5–264

Source: Intergovernmental Panel on Climate Change 2007a.

The majority of GHG emissions generated in the United States and California are in the form of CO_2. In 2011, for example, CO_2 accounted for 84% of the United States GHG emissions inventory, with most of these emissions generated through the combustion of fossil fuels. Fossil fuels are burned to create electricity and heat for homes, commercial buildings, and vehicles. In the United States, energy used to power buildings is the primary source of GHG emissions, representing 33% of the 2011 inventory. The transportation sector is the next largest source GHG emissions (28%) (United States Environmental Protection Agency 2013). In California, the emissions profile is reversed, with the transportation sector representing the largest source of emissions (38%), following by electricity generation (23%) (California Air Resources Board 2013). Other sources of GHG emissions generated in the United States and California include industrial processes, commercial and residential buildings, and agricultural activities.

[3] The standard metric for presenting GHG emissions, $MTCO_2e$, combines the different GHGs into a single total, accounting for the different global warming potentials of each gas.

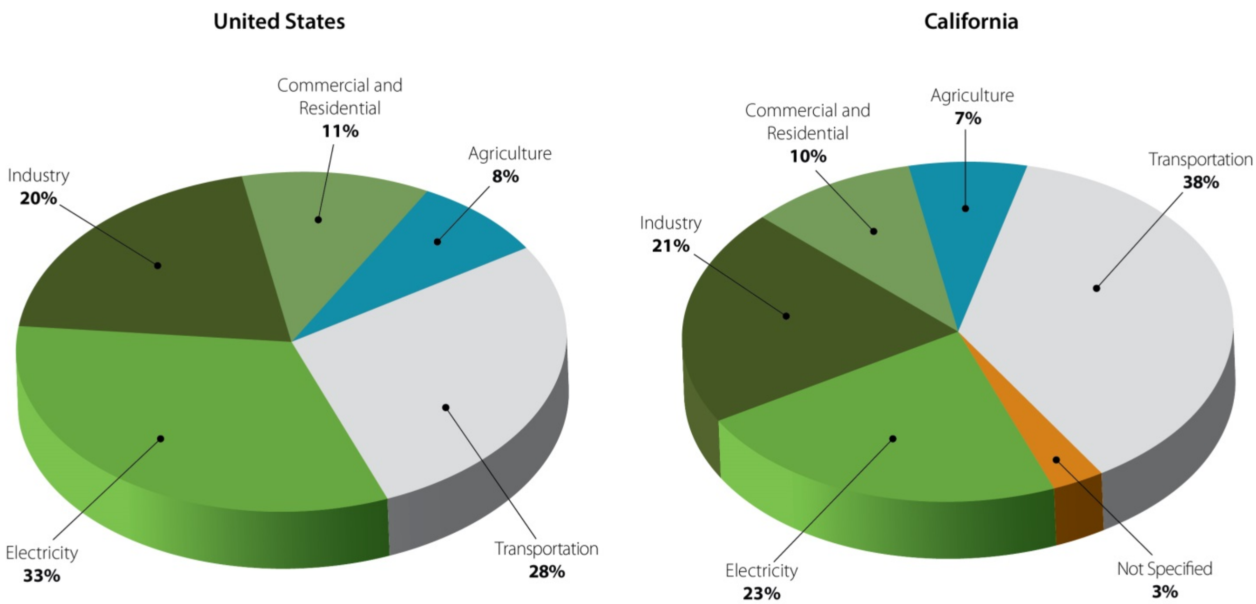

Figure 1-3. United States and California GHG Inventories

1.5 Climate Change Regulations

1.5.1 Federal, State, and Regional Initiatives

Climate change is widely recognized as an imminent threat to the global climate, economy, and population. The U.S. Environmental Protection Agency (EPA) has acknowledged this threat, finding that the GHG emissions from new motor vehicles contribute to pollution that threatens public health and welfare. Based on this finding, the EPA has adopted new vehicle emissions standards that reduce GHG emissions. Federal climate change regulation under the federal Clean Air Act (CAA) for stationary sources is also currently under development. Standards for CO_2 emissions from new fossil fuel–fired electricity power plants have also been proposed by EPA and outlined in *The President's Climate Action Plan*, issued in 2013. If approved, these standards would be the first to establish national GHG limits for the electric power industry.

California has adopted statewide legislation to address various aspects of climate change and reduce GHG emissions. AB 32, the California Global Warming Solutions Act, codified an emissions reduction target for the State to reduce statewide GHG emissions to 1990 levels by the year 2020. AB 32 requires the California Air Resources Board (ARB) to adopt and update a Scoping Plan that identifies specific measures to achieve this goal and requires that ARB and other State agencies develop and enforce regulations and other programs for reducing GHGs. Many of the State regulations under AB 32 are aimed at large sources of emissions such as stationary sources and transportation fuels. The AB 32 Scoping Plan also articulates an important role for local governments in achieving the statewide target, recommending that they establish GHG reduction goals, such as the target outlined in this CAP, that are consistent with those of the State.

The Butte County Association of Governments (BCAG) is the metropolitan transportation organization in the region. Pursuant to Senate Bill (SB) 375, BCAG has adopted a sustainable communities strategy that promotes reductions in onroad transportation GHG emissions through regional land use policies and increased transit and other alternatives to vehicular travel. The Butte County Air Quality Management District (BCAQMD) oversees regional regulation of stationary sources of air pollution and often coordinates with local governments on reducing air pollution from new projects, both of which can also help reduce GHG emissions.

Two jurisdictions within Butte County have adopted CAPs to address local GHG emissions. Butte County adopted the *Butte Climate Action Plan* in February 2014 with a goal of reducing communitywide GHG emissions generated within the unincorporated County by 15% below 2006 levels by 2020. The CAP also outlines a long-term goal of 42% below 2006 levels by 2030. The City of Chico adopted the *2020 Climate Action Plan* in September 2012. The City's CAP identifies a communitywide reduction target of 25% below 2005 levels by 2020. Although not a local government, California State University, Chico, has also published a CAP to address GHG emissions generated by campus activities. The CAP, which was adopted in May 2011, outlines strategies to achieve an interim target of 1990 emissions levels by the year 2020 and an ultimate goal of carbon neutrality by 2030.

Please refer to Appendix A for additional information on climate change legislation at the federal, State, and regional levels relevant to the City's climate action planning efforts.

1.5.2 Local Government Actions

Oroville has a long history of implementing and promoting initiatives to protect the environment and conserve natural resources. The City's commitment to environmental stewardship is born from an understanding that the community and its residents depend on the health of the environment. The following community-based sustainability programs and policies have been adopted by the City and will contribute to long-term GHG reductions. The CAP builds on these existing programs and proposes additional strategies the City and community can take to help reduce GHG emissions within Oroville.

- **Solar Energy Ordinance and Priority Solar Facilities**. The City adopted a Solar Energy Ordinance in 2012 to facilitate alternative energy production. The ordinance includes provisions to streamline permitting of solar facilities. The ordinance also outlines priority infrastructure improvements for solar energy facilities, which has helped to develop over 34 acres of solar installations.
- **Environmental Design Guidelines**. The *City of Oroville Design Guidelines* is a policy document and an implementation tool developed to protect public health and safety and to improve the overall functional quality of the community. Incorporation of the natural environment into community design is one of the foundational goals of document. The guidelines outline basic principles to improve energy efficiency, encourage alternative modes of transportation, support green building, and promote low-impact development and resource efficiency.
- **Renewable Energy Projects**. The City and other local agencies have a long history of promoting and implementing renewable energy projects. Solar panels on Oroville's City Hall, police station, and fire safety center currently provide the City with clean, carbon-free electricity. The Sewerage Commission—Oroville Region (SCOR) also installed a solar array at the 5th Street wastewater treatment plant in 2002. At this time, the array was the largest solar system in the nation that was operated by a public enterprise. The array currently provides over 80% of the treatment facility's electricity.
- **Property Assessed Clean Energy (PACE) Program**. The City has approved residential and commercial PACE programs, which help finance energy and water improvements through land-secured loans.

- **Infill and Mixed-Use General Plan Policies**. The 2030 General Plan includes numerous policies that promote infill development and revitalization of underutilized areas in the city, which are supported by specific incentives in the Zoning Ordinance. The General Plan also provides measures to promote sustainable growth, multi-modal transportation, and mixed-use and compact development.
- **Bicycle Master Plan**. The bicycle master plan identifies proposed bikeways and bike-friendly policies and programs to promote bicycle ridership throughout Oroville.
- **Recycling Programs, Education, and Outreach**. There are currently 40 active recycling programs in Oroville. The City also has a dedicated recycling coordinator and outreach program that provides recycling tips and other educational resources to the community. The recycling and waste management programs collectively diverted over 59% of waste generated in the city to recycling centers and other end uses.

As discussed above, the focus of the CAP is to reduce GHG emissions generated by community activities. Emissions that result from the City's municipal operations are largely addressed through internal strategies that target energy and resource consumption at City facilities. For example, the City recently replaced six police cars with hybrid vehicles, which consume significantly less fuel than their standard gasoline counterparts. Recycling services are also available at City offices. Several of the strategies outlined in the CAP may also be applicable to municipal operations. For example, the City can undertake energy audits of internal facilities and make energy efficiency improvements based on the results. The City is committed to reducing GHG emissions both within the community and at City facilities, and will continue to model energy efficiency and sustainability through its own internal actions.

Chapter 2

Emissions Inventory, Forecast, and Target

2.1 Introduction

Oroville's 2010 community GHG emissions inventory (2010 Inventory) serves as a starting point for emissions projections and forms the foundation for climate action planning efforts in Oroville. The purpose of the 2010 Inventory is to provide a snapshot of community emissions in 2010. Specifically, the inventory identifies existing emissions sources and the magnitude of their emissions, which enables the City to tailor specific reduction strategies based on the community's unique emissions profile. The inventory also supports development of the Oroville 2020 BAU community GHG emissions forecast (2020 BAU Forecast), which is a prediction of how community emissions may change in the future, in absence of State and local actions to reduce GHG emissions.

This chapter describes the community-wide 2010 Inventory and 2020 BAU Forecast for Oroville. The City's 2020 emissions reduction target is also presented. This target is consistent with statewide reductions required under AB 32 and recommendations for local governments outlined in the ARB's 2008 AB 32 Scoping Plan and subsequent AB 32 Scoping Plan Updates (California Air Resources Board 2014).

2.2 Overview of Analysis Methods

Oroville's 2010 Inventory and 2020 BAU Forecast include GHG emissions generated by activities within the city limits. The inventory also includes emissions that occur outside the city, but only to the extent that such emissions are the result of community activities. For example, GHG emissions generated by regional power plants to provide electricity to local homes and businesses in Oroville are considered even though the power plants themselves may not be located within the city.

The 2010 Inventory and 2020 BAU Forecast are divided into six major sectors. Each sector represents a subset of community emissions, and some are comprised of multiple emissions-generating activities. For example, natural gas and electricity consumption are both included in the building energy sector. The six sectors analyzed represent the major emissions categories within the city and are defined as follows.

- **Building Energy**—emissions from electricity generation and natural gas, wood, and propane combustion by residential, commercial, and industrial buildings.
- **Onroad Transportation**—consumption emissions from vehicle trips made by Oroville residents, employees, and visitors.
- **Offroad Vehicles and Equipment**—fuel consumption emissions from use of onsite, heavy-duty equipment (e.g., cranes, bulldozers).
- **Solid Waste Management**—transport and methane emissions from community waste disposed in the Ostrom, Hay, and Neal Road Landfills.
- **Wastewater Treatment**—emissions from community wastewater treatment.
- **Water Management**—emissions from electricity required to convey, distribute, supply, and treat water for Oroville residents and businesses.

Emissions generated by community activities were analyzed using widely accepted methodologies and procedures that are recommended by federal, State, and local air quality management agencies. The

2010 Inventory was developed using actual activity data, like kilowatt-hours of electricity consumed, reported by local utilities and other entities. The 2020 BAU Forecast is based on expected growth in the population, employment, and households. All emissions were quantified in terms of $MTCO_2e$. Please refer to Appendices B and C for detailed information on methods and assumptions used to prepare the 2010 Inventory and 2020 BAU Forecast.

2.3 Oroville 2010 Community GHG Emissions Inventory

Community activities in Oroville generated approximately 163,000 $MTCO_2e$ in 2010, which is less than 1% of California's GHG emissions in the same year. As shown in Table 2-1 and Figure 2-1, the transportation sector represents the largest source of emissions (approximately 48% of the 2010 Inventory). In general, emissions from onroad transportation typically constitute between 30% and 70% of community emissions, depending upon other sources and local conditions. The majority of onroad emissions in Oroville come from personal and light-duty vehicles. Heavy-duty trucks used for hauling and material movement represent about 30% of total onroad emissions.

The building energy sector, which accounts for roughly 46% of total emissions, is the next most significant component of the 2010 Inventory. Building energy is often one of the largest sources of GHG emissions in community inventories and includes energy consumed for heating, cooling, lighting, and cooking. Roughly three-quarters of building energy emissions come from the commercial and industrial sector, with the remaining quarter generated by residential electricity and fuel consumption.

The offroad, waste, water, and wastewater sectors account for the remaining 6% of the 2010 Inventory.

Table 2-1. Oroville 2010 Community GHG Emissions Inventory ($MTCO_2e$)

Emission Sector	Emissions ($MTCO_2e$)	Percentage of Inventory
Onroad Transportation	78,096	47.8%
Building Energy	75,042	46.0%
Offroad Vehicles and Equipment	4,221	2.6%
Solid Waste Management	4,125	2.5%
Wastewater Treatment	1,348	0.8%
Water Management	456	0.3%
Total 2010 Inventory	**163,288**	**100.0%**

Note:
Please refer to Appendix B for additional inventory details.

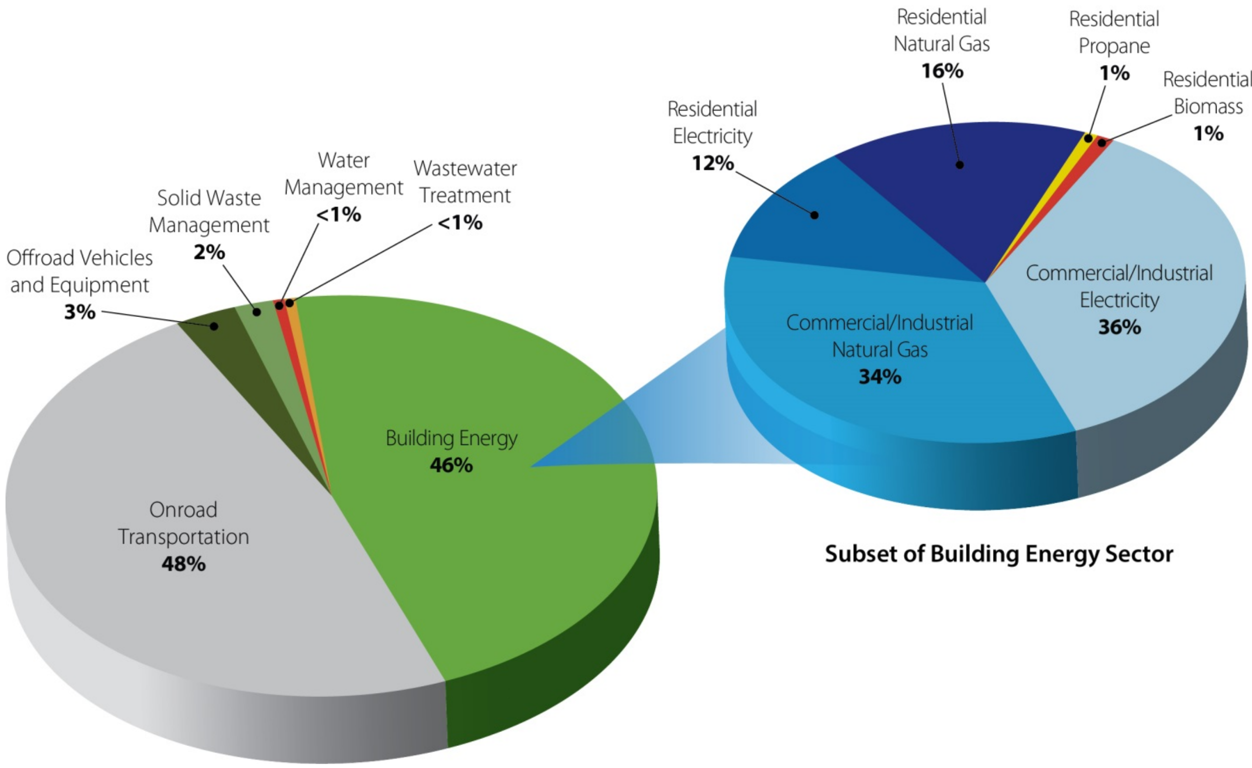

Figure 2-1. Oroville 2010 Community GHG Emissions Inventory by Sector

2.4 Oroville 2020 BAU Community GHG Emissions Forecast

The 2020 BAU Forecast is a prediction of community emissions that would occur in 2020 without accounting for future federal, State, and local actions designed to reduce GHG emissions. Emissions are estimated based on future changes in population, households, and employment from the 2030 General Plan. Since the forecast does not account for GHG reductions achieved by the CAP or other State actions, it represents a starting point for the City's 2020 emissions reduction target.

As shown in Table 2-2 and Figure 2-2, community GHG emissions are expected to increase by approximately 32,500 $MTCO_2e$ (20%) from 2010 to 2020. Much of this growth is attributable to increases in building energy use, vehicle trips, and offroad equipment. As the city grows, energy consumption and transportation activity will increase. Likewise, offroad equipment emissions will increase as a result of new development and increased construction activity. The overall emissions profile for the 2020 BAU Forecast is similar to the 2010 Inventory, although building energy is anticipated to become the largest source of emissions within the community (47%). Combined, building energy and transportation will still represent the majority of emissions (93%).

Table 2-2. Comparison of the Oroville 2020 BAU Community GHG Emissions Forecast and Oroville 2010 Community GHG Emissions Inventory

Emission Sector	2020 BAU Emissions ($MTCO_2e$)	Percentage of 2020 Forecast	Growth from 2010 ($MTCO_2e$)
Building Energy	92,238	47.1%	17,196
Onroad Transportation	90,104	46.0%	12,008
Offroad Vehicles and Equipment	6,133	3.1%	1,911
Solid Waste Management	5,080	2.6%	955
Wastewater Treatment	1,660	0.8%	312
Water Management	571	0.3%	115
Total	**195,786**	**100%**	**32,498**

Notes:
BAU = business-as-usual.
Please refer to Appendix C for additional forecast details.

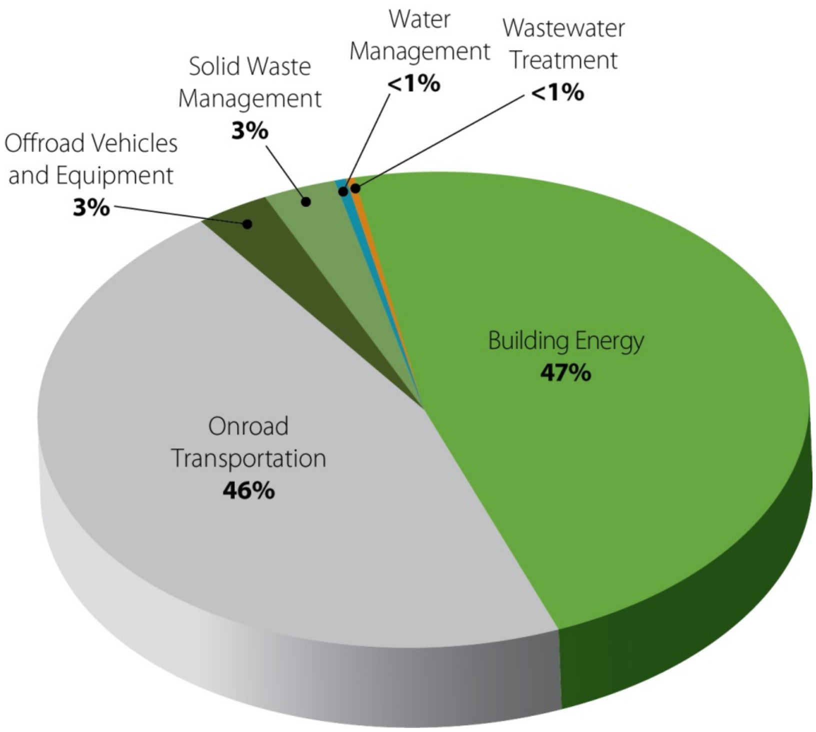

Figure 2-2. Oroville 2020 BAU Community GHG Emissions Forecast Inventory by Sector

2.5 Oroville 2020 Emissions Reduction Target

Establishing a reduction target that is both practical and ambitious is important for guiding future actions that not only contribute to GHG reductions, but also strengthen the community as a whole. The City has adopted an emissions reduction target of 11% below 2010 levels by 2020. This target reflects Oroville's commitment to implement achievable emissions reductions on a timescale that is consistent with major statewide climate change legislation. Meeting the target will depend on a combination of State and local policies, as well as the participation of local residents and businesses.

The City's 2020 emissions reduction target aligns with statewide goals established by AB 32, which commits to reducing statewide GHG emissions to 1990 levels by 2020. The AB 32 Scoping Plan provides a roadmap for achieving these reductions and recommends a complementary reduction goal for local governments of 15% below current emissions levels. However, subsequent to the development of the AB 32 Scoping Plan, ARB released updated statewide emissions data that reflect the effect of the recent economic recession (California Air Resources Board 2013). The updated inventories indicate that a 10–11% reduction below current levels by 2020 is now needed to achieve the AB 32 target as opposed to the previous estimate of a 15% reduction.

Based on the updated inventory data developed by the ARB, Oroville's target of 11% below 2010 levels is consistent with the most recent statewide trends and goals for reducing GHG emissions.[4] Achieving this goal would avoid the generation of approximately 50,000 $MTCO_2e$ and reduce 2020 GHG emissions to approximately 145,000 $MTCO_2e$. The strategies outlined in Chapter 3 represent a combination of local and State initiatives that will collectively lower future GHG emissions in Oroville consistent with the City's reduction target (see Figure 2-3).

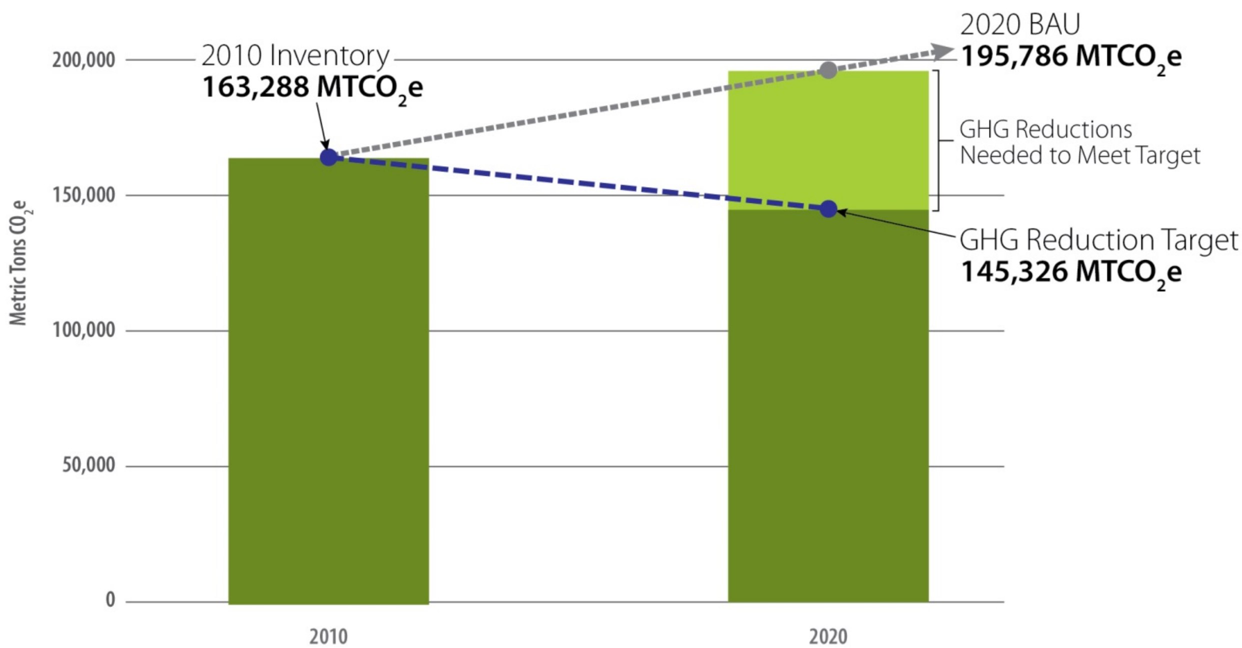

Figure 2-3. Oroville 2020 Emissions Reduction Target

[4] The target likely exceeds the local effort needed to meet AB 32. Statewide analysis by the ARB defines *current* as the period between 2005 and 2008. Accordingly, Oroville's 2010 Inventory is approximately 2–5 years later than the current year (2005–2008) inventories used to establish ARB's recommended reduction target. Fewer reductions from 2010 levels would therefore be required to meet AB 32 because cumulative emissions generated between 2010 and 2020 will be lower than cumulative emissions generated between 2005 and 2020. While the City could have adopted a slightly lower reduction target to match the effort required from the 2010 base year, it has selected 11% because the target is 1) consistent with the percent reduction needed at the State level from 2005 to 2008 and accounts for any potential uncertainty in directly applying State inventory data to the City, and 2) provides the City with flexibility to adaptively manage the CAP.

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Chapter 3
Emissions Reduction Strategies

3.1 Introduction

The CAP includes a variety of regulatory and incentive-based strategies that will reduce emissions from both existing and new development in Oroville. Several of the CAP strategies build on existing City programs, whereas others provide new opportunities to address climate change. Statewide sustainability efforts, which will have a substantial impact on future GHG emissions, serve as the foundation of the CAP. Local strategies adopted by Oroville will supplement these State programs and achieve additional GHG emissions reductions. Successful implementation of the local strategies will rely on the combined participation of City staff along with Oroville residents, businesses, and community leaders.

The following sections summarize the State and local strategies included in the CAP. Estimated emissions reductions achieved by the CAP are presented, indicating that the City will meet and exceed its 2020 emissions reduction target. Costs, savings, and community co-benefits are also described. Please refer to Appendix D for additional information on each strategy, including detailed objectives and assumptions used to quantify emissions reductions and costs.

3.2 CAP Framework

3.2.1 Strategies and Action Areas

The CAP is composed of six State and 24 local strategies. Although identified individually, these strategies will be implemented together as part of a comprehensive GHG emissions reduction program. The local strategies align with the goals and policies outlined in the 2030 General Plan and are grouped into five action areas, as shown in Figure 3-1. The strategies include programs to improve building energy efficiency and renewable energy production, increase alternative modes of transportation, enhance natural areas, and reduce water consumption and waste generation.

3.2.2 Emissions Reductions

Emissions reductions achieved in 2020 are estimated for the majority of State and local strategies. Strategies that do not currently support a quantitative reduction analysis are evaluated qualitatively as low, medium, or high in terms of their emissions reduction potential. Although emissions reductions have not been quantified for these strategies, they are still a vital part of the Oroville CAP and ensure a comprehensive approach to climate action planning. Further development and implementation of these strategies may result in sufficient data to quantify the GHG reductions.

Figure 3-1. Action Areas to Reduce GHG Emissions

3.2.3 Cost Effectiveness

Private residents, businesses, utilities, and other public sector agencies will incur some costs to implement the GHG reduction strategies included in the CAP. In some cases, these entities will also realize long-term savings that can help recoup their initial investments. Costs and savings that would be incurred by residents and businesses were quantified for the local emissions reduction strategies. Economic effects are based on the best available data at the time of the CAP and represent total annual costs and savings in 2020. Costs and savings for strategies that do not currently support a quantitative analysis are assessed qualitatively. The following metrics are considered in the economic analysis and are reported in Table 3-3.

- **Net Present Value (NPV)**—provides the net cost/savings of the strategy in present value terms (i.e., discounted over the lifetime of the measure). A positive NPV indicates that a measure is cost-saving over its lifetime.
- **Cost per $MTCO_2e$**—is the ratio of the net cost of the strategy to the GHG reduction achieved. For this analysis, net costs are annualized, consistent with the GHG reductions achieved in 2020. The approach adjusts for the significant variation in the lifetime of an individual GHG reduction strategy (e.g., from energy-efficient household appliances that last 10 years to solar panels that could last up to 25 years), as well as variations in capital costs and annual cost savings.
- **Simple Payback Period**—represents the estimated number of years before the initial investment is repaid. It is estimated by dividing the total initial capital cost by the annual cost savings.

3.2.4 Community Co-Benefits

Implementation of the CAP will result in environmental and community co-benefits that supplement the expected emissions reductions. For example, measures to improve mobility and alternative modes of transportation will enhance walkability throughout the community. Active transport, like walking and biking, has been shown to substantially lower the burden of disease (Maizlish et al. 2011). Other strategies that target resource efficiency will conserve natural resources and may help lessen consumer sensitivity to changes in future energy prices. Finally, open spaces created and preserved by the CAP may offer aesthetic and recreational benefits for community members, as well as habitat for native wildlife and plants.

Anticipated community co-benefits associated with the CAP are listed in Figure 3-2.

Figure 3-2. Community Co-Benefits

3.3 Target Assessment and Strategy Evaluation

The combined implementation of the State and local strategies included in the CAP is expected to reduce 2020 community-wide GHG emissions by 60,270 $MTCO_2e$, which exceeds the 2020 emissions reduction target by 9,811 $MTCO_2e$. This is equivalent to removing more than 12,500 passenger vehicles from the road each year (United States Environmental Protection Agency 2014). As shown in Table 3-1 and Figure 3-3, the majority (85%) of emissions reductions are achieved by State programs, such as the Pavley standards and Renewables Portfolio Standard (RPS)[5], which is typical of other CAPs throughout California. Local strategies implemented by Oroville supplement reductions achieved by the State programs to meet and exceed the reduction target. Strategies not currently quantified, as well as local effects of the State's cap-and-trade program[6], will likely contribute additional reductions beyond those estimated in the CAP.

Table 3-1. Achieving Oroville's 2020 Emissions Reduction Target

Parameter	Emissions ($MTCO_2e$)
2020 BAU GHG Emissions Forecast (see Table 2-2)	195,786
2020 Emissions Reduction Target (11% below 2010 levels)[a]	145,326
$Total_1$ Reductions Needed to Reach Target	***50,459***
2020 Emissions Reductions from State Strategies	51,465
2020 Emissions Reductions from Local Strategies	8,805
Energy Efficiency and Renewable Energy	3,756
Land Use and Transportation	1,418
Waste Reduction	1,983
Water Conservation[b]	1,646
Trees and Agriculture	2
$Total_2$ GHG Reductions Achieved by the CAP	***60,270***
Emissions Reductions in Excess of Target ($Total_2$ minus $Total_1$)	9,811

Notes:

BAU = business as usual.

[a] Total GHG emissions in 2010 were 163,288 $MTCO_2e$; an 11% reduction equals 145,326 $MTCO_2e$.

[b] Water efficiency improvements will reduce water consumption, which will contribute to reductions in building energy use. For example, efficient faucets that use less water will require less energy for hot water heating. Most of the reductions achieved by WC-1 are associated with reduced hot water heating.

Community Choice Aggregation

The CAP includes an optional strategy—*Community Choice Aggregation*—through which the City would become a Community Choice Aggregator (CCA) and implement a voluntary program to achieve lower levels of GHG emissions for electricity than what Pacific Gas and Electric (PG&E) would provide. As a CCA, the City would supply electricity to customers within Oroville but would not own transmission and delivery systems. Developing and implementing a voluntary CCA that would achieve net reductions compared to PG&E's energy portfolio may not be feasible by 2020 due to programmatic and technical constraints. Accordingly, the strategy is considered optional and is not counted towards the City's 2020 emissions reduction target. Preliminary analysis indicates that if the City successfully implemented the strategy by 2020, an additional 2,500 $MTCO_2e$ (in addition to the State's RPS) could be reduced as a result of the CCA.

[5] Pavley will reduce GHG emissions from automobiles and light-duty trucks by 30% from 2002 levels by the year 2016. The RPS obligates certain utilities to procure at least 33% of retail sales from renewable resources by 2020.

[6] Cap-and-trade is a market-based regulation that will reduce GHGs by establishing a limit or "cap" on GHGs.

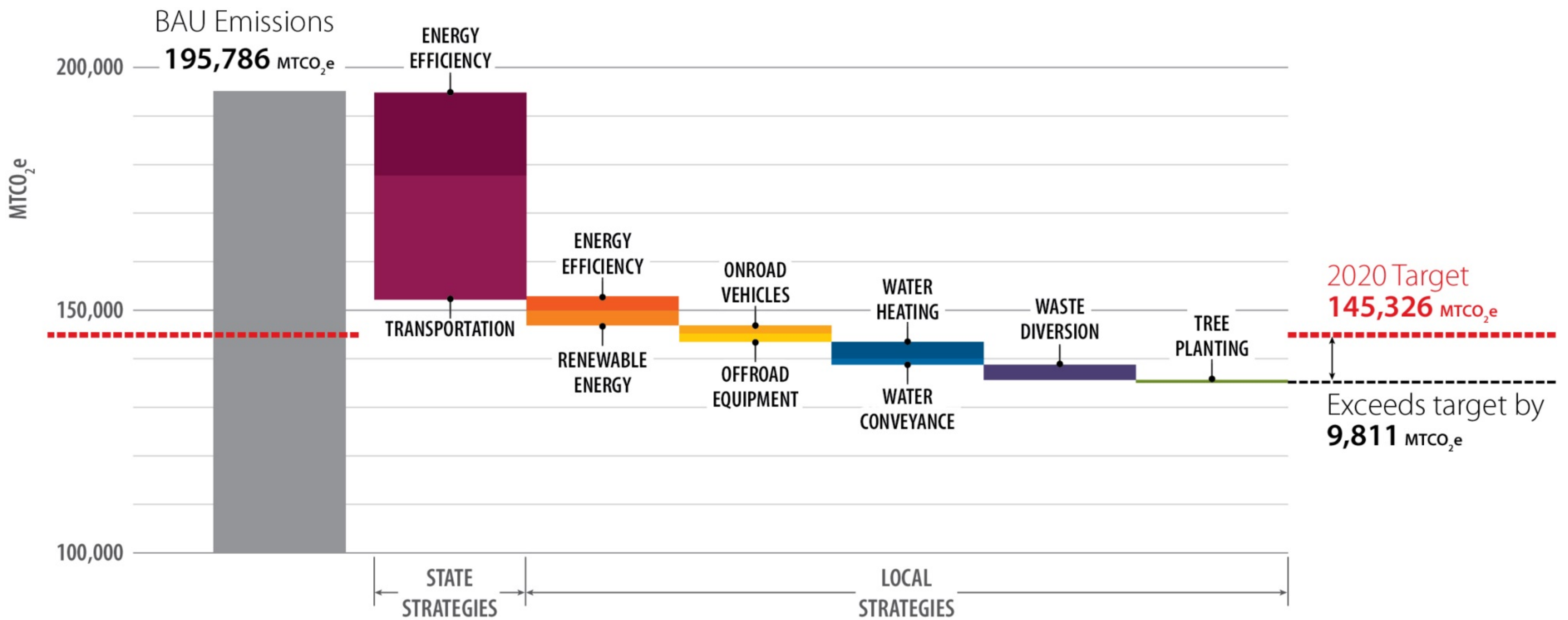


Figure 3-3. Achieving Oroville's 2020 Emissions Reduction Target

Table 3-2 presents a summary of the 2020 GHG reductions for the individual strategies. The strategy objectives are provided for reference. Table 3-3 and Figure 3-4 summarizes costs, savings, and expected co-benefits, as available. Estimated costs and savings would be incurred by the private sector (e.g., City residents and businesses). City costs associated with CAP implementation are not included in the analysis, but are discussed qualitatively in Chapter 4, *Emissions Reduction Implementation Program*. Expected co-benefits are summarized for each action area.

Table 3-2. Summary of 2020 GHG Emissions Reductions by CAP Strategy ($MTCO_2e$)

State Strategy	Objective	2020 GHG Reduction	% Total of Reductions
S-1. Renewables Portfolio Standard	Procure 33% of retail sales from eligible renewable sources	15,661	26.0%
S-2. Title 24 Standards for Commercial and Residential Buildings	Design buildings to conserve and reduce energy and water use	2,673	4.4%
S-3. Lighting Efficiency and Toxics Reduction Act	Reduce electricity use from indoor and outdoor lighting	2,380	4.0%
S-4. Residential Solar Water Heaters	Install solar water heating systems in residential buildings	54	0.1%
S-5. Pavley, Advanced Clean Cars, and Low Carbon Fuel Standard	Reduce GHG emissions from automobiles and light-duty trucks, and reduce the carbon content of transportation fuels	30,300	50.3%
S-6. Assembly Bill 32 Vehicle Efficiency Measures	Increase vehicle efficiency	397	0.7%

Action Area	Local Strategy	Objective	2020 GHG Reduction	% Total of Reductions
ENERGY EFFICIENCY AND RENEWABLE ENERGY	BE-1. Green Building Ordinance	Achieve 15% less energy use than the 2013 Title 24 requirements in new development	323	0.5%
	BE-2. Residential Energy Efficiency Retrofits	Achieve voluntary residential energy efficiency retrofit goals	624	1.0%
	BE-3. Nonresidential Energy Efficiency Retrofits	Retrofit existing nonresidential buildings to achieve a building-wide energy reduction of 20%	1,399	2.3%
	BE-4. Energy Efficient Lighting Standards	Reduce electricity consumption with energy-efficient lighting	156	0.3%
	BE-5. Solar Installations for New Development	Implement solar energy installation requirements for new buildings to increase renewable energy generation	184	0.3%
	BE-6. Solar Installations for Existing Development	Achieve voluntary solar installation goals for existing development	1,000	1.7%
	BE-7. Local Renewable Energy Development	Expand local renewable energy production to meet at least 25% of the City's municipal electricity demand	69	0.1%
LAND USE AND TRANSPORTATION	LUT-1. Residential and Commercial Density	Increase the density of residential and commercial development	Medium[a]	-
	LUT-2. Mixed-Use Development	Establish mixed-use development requirements for all specific plans	227	0.4%
	LUT-3. Balanced Mode Circulation Plan	Create and maintain a transportation system that is safe, efficient, and optimizes travel by all modes	Low[a]	-
	LUT-4. Pedestrian Network Improvements	Promote pedestrian friendly design within the city	486	0.8%
	LUT-5. Traffic Calming	Incorporate traffic calming improvements on 25% of streets and intersections in new development areas	18	0.0%
	LUT-6. Electric Vehicle (EV) Charging Stations	Expand public charging facilities to promote electric vehicle usage within the city and greater Butte County area	24	0.0%
	LUT-7. Voluntary Commute Trip Reduction (CTR) Programs	Support and expand voluntary CTR programs at businesses and employment facilities	265	0.4%
	LUT-8. Intelligent Transportation Systems (ITS)	Implement ITS for new roadways and existing congested corridors	Low[a]	-
	LUT-9. Idling Ordinance	Limit heavy-duty vehicle idling to 3 minutes to reduce exhaust emissions and fuel consumption	37	0.1%
	LUT-10. Electric-Powered Construction Equipment	Ensure that at least 25% of construction equipment on annual projects utilize electric power	317	0.5%
	LUT-11. Electric-Powered Landscaping Equipment	Pursue a voluntary goal for 5% of landscaping equipment operating in the city to be electric- or battery-powered	45	0.1%

Action Area	Local Strategy	Objective	2020 GHG Reduction	% Total of Reductions
WASTE REDUCTION	WR-1. Waste Diversion Goal	Divert from landfills at least 75% of waste generated in the city and 65% of construction materials and debris	1,983	3.3%
WATER CONSERVATION	WC-1. Per Capita Water Use Reduction[b]	Meet (or exceed) the State established per capita water use reduction goal[7] as identified by Senate Bill (SB) X7-7	1,646	2.7%
	WC-2. Recycled Water Use	Encourage recycled water use for non-potable sources	Low[a]	-
TREES AND AGRICULTURE	TR-1. Urban Forests	Plant at least 400 trees per year within the city	2	0.0%
	TR-2. Oak Tree Loss Mitigation Ordinance	Minimize oak trees losses from new development by requiring the replacement of removed trees	Low[a]	-
	TR-3. Local Food Initiatives	Incentivize and support local farmers markets and locally grown food	Low[a]	-

Notes:
Please refer to Appendix D for additional information on emissions reduction strategies and analysis methods.

[a] Emissions reduction strategies that do not currently support a quantitative assessment are qualitatively evaluated based on their likely GHG reduction potential, as defined below.
Low = less than 500 $MTCO_2e$ reduction.
Medium = 501 –1,000 $MTCO_2e$ reduction.
High = Greater than 1,000 $MTCO_2e$ reduction.

[b] Water efficiency improvements will reduce water consumption, which will likewise contribute to reductions in building energy use. For example, efficient faucets that use less water will require less electricity and natural gas for hot water heating. Most of the GHG reductions achieved by WC-1 are associated with reduced hot water heating.

[7] The State goal is a 20% reduction in per capita water use compared to baseline levels.

Table 3-3. Summary of Costs, Savings, and Benefits Associated with Local Emissions Reduction Strategies

Action Area	Local Strategy	Saving (cost) per MT Reduced	Net Present Value	Payback (years)	Co-Benefits[a]
ENERGY EFFICIENCY & RENEWABLE ENERGY	BE-1. Green Building Ordinance	$10–$220	$0.9–$0.05 million	6–13	
	BE-2. Residential Energy Efficiency Retrofits	$60–$240	$0.4–$1.7 million	6–11	
	BE-3. Nonresidential Energy Efficiency Retrofits	$510–$540	$8.3–$8.8 million	Less than 1	
	BE-4. Energy Efficient Lighting Standards	$1,000–$1,400	$1.7–$2.3 million	3–5	
	BE-5. Solar Installations for New Development[b]	DP: ($340)–$2 PPA: $110–$220	DP: ($0.9)–$0.004 million PPA: $0.3–$0.6 million	15–20	
	BE-6. Solar Installations for Existing Development[b]	DP: ($320–$60) PPA: $110–$220	DP: ($4.4–$0.8 million) PPA: $1.5–$3.0 million	16–19	
	BE-7. Local Renewable Energy Development[b]	DP: ($770–$100) PPA: $100–$210	DP: ($0.7–$0.1 million) PPA: $0.1–$0.2 million	16–25	
LAND USE & TRANSPORTATION	LUT-1. Residential and Commercial Density	-	-	-	
	LUT-2. Mixed-Use Development	Not estimated	Not estimated	Not estimated	
	LUT-3. Balanced Mode Circulation Plan	-	-	-	
	LUT-4. Pedestrian Network Improvements	Not estimated	Not estimated	Not estimated	
	LUT-5. Traffic Calming	Not estimated	Not estimated	Not estimated	
	LUT-6. Electric Vehicle (EV) Charging Stations	Not estimated[c]	Not estimated[c]	Not estimated[c]	
	LUT-7. Voluntary Commute Trip Reduction (CTR) Programs	Not estimated	Not estimated	Not estimated	
	LUT-8. Intelligent Transportation Systems (ITS)	-	-	-	
	LUT-9. Idling Ordinance	$430	Not estimated	0[d]	
	LUT-10. Electric-Powered Construction Equipment	Not estimated	Not estimated	Not estimated[e]	
	LUT-11. Electric-Powered Landscaping Equipment	Not estimated	Net Saving[f]	Not estimated[e]	
WASTE REDUCTION	WR-1. Waste Diversion Goal	($180–$50)	Not estimated	None (Net cost)	
WATER CONSERVATION	WC-1. Per Capita Water Use Reduction	Not estimated	Not estimated	Not estimated	
	WC-2. Recycled Water Use	-	-	-	

Action Area	Local Strategy	Saving (cost) per MT Reduced	Net Present Value	Payback (years)	Co-Benefits[a]
TREES AND AGRICULTURE	TR-1. Urban Forests	($36,000)	($1 million)	None (Net cost)	
	TR-2. Oak Tree Loss Mitigation Ordinance	-	-	-	
	TR-3. Local Food Initiatives	-	-	-	

Notes:

- = Refers to qualitative strategies that currently do not support a GHG reduction (see Table 3-2) or cost and savings analysis; DP = direst purchase; Not estimated = refers to strategies that do not currently support a quantitative cost and savings analysis, even though the strategy has been evaluated from an emissions reduction standpoint (see Table 3-2); PPA = power purchase agreement.

Please refer to Appendix D for additional information on emissions reduction strategies and analysis methods.

[a] See Figure 3-2 for the key to the co-benefits symbols.

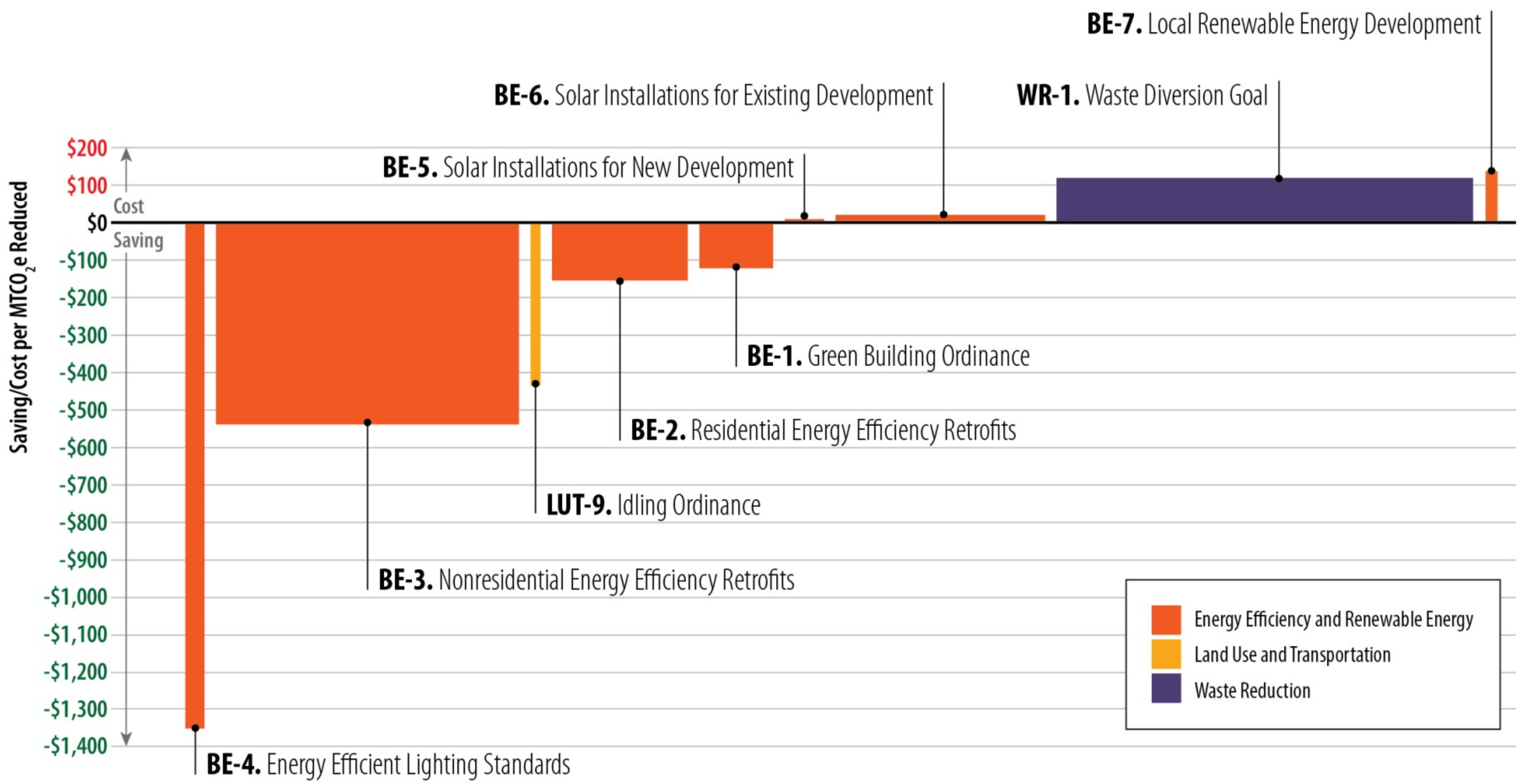
[b] The cost analysis considered two financing scenarios:
Direct Purchase (DP): The purchasing entity (e.g., homeowner for BE-5, City of Oroville for BE-7) is assumed to directly purchase and install the solar PV system.
Power Purchase Agreement (PPA): The purchasing entity enters into a PPA with a local company who owns and maintains the solar panels.

[c] Costs/savings are not estimated since they depend heavily on utility rate structures and revenues to the third-party operators.

[d] No upfront costs are assumed.

[e] Payback is not estimated since upfront equipment costs vary significantly based on features other than the energy source. Electric-powered construction and landscaping equipment are expected to provide annual savings relative to the operating costs for gas or diesel-powered equipment.

[f] Lifetime savings associated with an electric leaf blower or chainsaw estimated at between $3,000 and $4,000 per unit.



The height of the bar is equal to the cost per $MTCO_2e$ reduced (with cost savings descending from the x-axis marking zero cost). The width of the bar is equal to the GHG reduction (with wider bars signifying greater reductions). Strategies that do not support a quantitative cost analysis have been excluded from the figure.

Figure 3-4. Monetary Costs and Savings for Selected Strategies Relative to 2020 Emissions Reductions

3.4 Summary of Emissions Reduction Strategies

The following sections summarize the emissions reduction strategies included in the CAP. State programs and initiatives are discussed first. Local strategies that will be managed by the City are described in terms of the five action areas identified in Figure 3-1. Please refer to Appendix D for more specific details on each strategy. Chapter 4, *Emissions Reduction Implementation Program,* also includes additional information on how the strategies will be implemented, including primary actions, scheduling, and funding options.

3.4.1 Statewide Programs and Initiatives

Programs and initiatives undertaken by the State will contribute to local emissions reductions within the city. For example, the State's RPS will reduce the carbon content of electricity through requirements for increased renewable energy. Renewable resources, such as wind and solar power, produce electricity, just like coal and other traditional sources, but do not emit any GHGs. By generating a greater amount of energy through renewable resources, electricity provided to Oroville will be cleaner and less GHG-intensive than if the State had not required the RPS.

The City quantified six statewide initiatives that will contribute to community emissions reductions. The majority of emissions reductions are gained from building energy efficiency standards and mandates for renewable energy generation. Specifically, Title 24 standards for new residential and nonresidential buildings will require building shells and components be designed to conserve energy and water. The State's RPS will increase the amount of electricity generated by renewable resources, reducing GHG emissions from electricity consumption. Additional GHG reductions will be achieved by statewide initiatives to improve vehicle engine efficiency and reduce the carbon intensity of transportation fuels.

3.4.2 Local Strategies

Residential and nonresidential buildings within Oroville annually consume over 173 gigawatt-hours of electricity and 6.5 million therms of natural gas. Resources used to generate electricity, as well as the direct combustion of natural gas, emit more than 75,042 $MTCO_2e$, making building energy use the second largest source of community emissions (about 46%) in 2010. Increases in population and employment, coupled with rising temperatures and cooling demands, will continue to increase building energy use and associated GHG emissions in the future; by 2020, building energy emissions are forecast to exceed 92,000 $MTCO_2e$ and represent over 47% of the community emissions profile.

The Oroville CAP includes strategies that target both energy efficiency and renewable energy generation. Energy efficiency strategies reduce actual building energy consumption through efficient design, whereas renewable energy strategies directly reduce carbon emissions from electricity generation. Energy efficiency and renewable energy strategies both have upfront costs, but they usually result in long-term savings through reduced utility bills. The building energy strategies also achieve a diverse suite of community co-benefits, including reduced regional criteria pollutant emissions, improved home values, enhanced energy security, and job creation.

Seven building energy strategies are identified in the CAP and include a combination of regulatory and incentive-based approaches to reduce GHG emissions. Most of the strategies provide incentives to encourage voluntary improvements in energy efficiency and increased renewable energy generation. For example, BE-2, *Residential Energy Efficiency Retrofits,* and BE-3, *Nonresidential Energy Efficiency Retrofits,* focus on residential and nonresidential energy efficiency improvements in existing buildings. These strategies will reduce building energy consumption by providing rebates, low-interest financing, and other support for homeowners and businesses that can be used to complete energy efficiency retrofits. Similar support will be provided through BE-6, *Solar Installations for Existing Development*, which promotes solar energy installations in existing buildings. Public participation is essential to these incentive-based strategies.

In addition to voluntary and incentive-based approaches, the CAP includes two strategies that establish new regulatory procedures for construction. BE-1, *Green Building Ordinance*, targets energy efficiency and requires new development to exceed the requirements of Title 24, California's Building Code, that are applicable at the time of construction. BE-5, *Solar Installations for New Development*, also identifies solar installation requirements for a variety of land uses, including new single-family homes and commercial developments. The City will support project developers with implementation of both strategies by identifying grants and incentives and providing education and outreach.

The final two building energy strategies target GHG emissions from City-owned buildings and structures. Under BE-7, *Local Renewable Energy Development*, the City will develop and install sufficient local renewable energy to provide at least 25% of the City's municipal electricity demand. The City will also upgrade all streetlights to use energy efficient light fixtures as part of BE-4, *Energy Efficient Lighting Standards*. This strategy also includes incentives to encourage owners of existing residential and nonresidential buildings to replace outdoor lights with more efficient bulbs.

*Average includes costs/savings for only LUT-9. Qualitative information for other land use and transportation strategies is presented in Table 3-3.

Vehicle trips made by residents and employees are expected to increase steadily as new housing units are developed, new businesses are created or expanded, and new services are provided. By 2020, GHG emissions generated by transportation activities are expected to exceed 90,000 $MTCO_2e$ and represent about 46% of the 2020 BAU Forecast. Strategies to support alternative modes of transportation, improve transportation efficiency, and reduce vehicle miles traveled (VMT) are therefore an essential component of the Oroville CAP. These strategies can also have far-reaching community co-benefits, including reduced formation of smog and toxic air containments. Alternative modes of transportation, such as walking and biking, may also help increase physical activity levels and improve public health.

The CAP includes 11 strategies to reduce GHG emissions from onroad vehicles and offroad equipment (e.g., construction equipment). Several of these strategies promote an integrated, multi-modal transportation network that will support alternative forms of transportation. For example, LUT-3, *Balanced Mode Circulation Plan,* integrates complete street concepts into the City's planning and design standards. LUT-4, *Pedestrian Network Improvements,* will help eliminate barriers to walking and improve the connectivity of the existing pedestrian network. Traffic calming measures implemented as part of LUT-5, *Traffic Calming,* will also support walking and biking by creating roadways that are more conducive to non-motorized transportation. Finally, LUT-6, *Electric Vehicle (EV) Charging Stations,* promotes EV use.

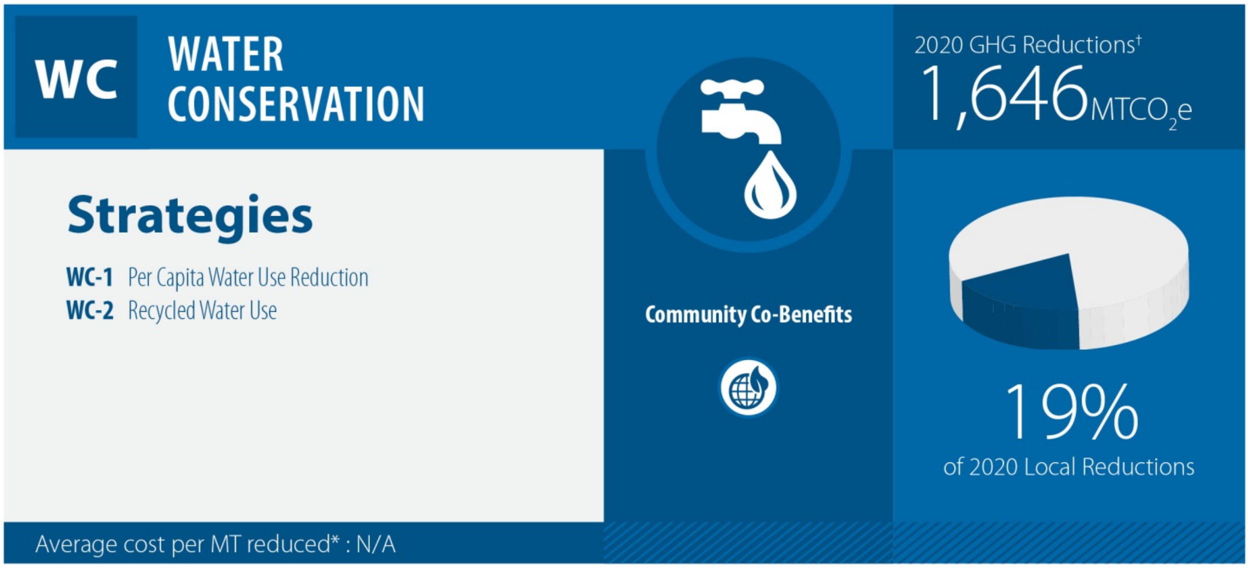
In addition to supporting alternative transportation, a number of strategies promote reduced vehicle travel and improvements to the existing efficiency of the transportation network. For example, LUT-1, *Residential and Commercial Density,* and LUT-2, *Mixed-Use Development,* directly target land use patterns to increase development density and improve the diversity of new specific plan areas. Together, these strategies will support shorter trips that can be accommodated by non-motorized and alternative transportation. LUT-7, *Voluntary Commute Trip (CTR) Reduction,* will also reduce vehicle trips by encouraging ride-sharing programs and employer-sponsored commuting programs. Finally, LUT-8, *Intelligent Transportation Systems (ITS),* will optimize signal coordination and traffic patterns along

State Route 162. Improving the efficiency of the transportation network allows vehicles to travel without excessive starting or stopping, which can reduce fuel consumption.

Specific strategies (i.e., LU-9, LU-10, and LU-11) to reduce GHG emissions generated by offroad equipment are also included in the CAP. These strategies establish idling limits and electrification goals for heavy-duty construction equipment and incentive programs for electric landscaping equipment.

City residents and businesses generate over 28,000 tons of waste annually, which generated about 4,100 $MTCO_2e$ in 2010 (about 2.5% of the total 2010 Inventory). Oroville has a comprehensive waste collection system that currently includes over 40 recycling and composting programs. These programs are designed to reduce the amount of trash that is sent to regional landfills. The programs collectively divert about 59% of all waste generated to recycling centers and other end uses. The City has adopted a waste diversion goal of at least 75% by 2020 to support existing programs and further reduce the amount of waste sent to regional landfills. The City has also established a waste diversion goal of at least 65% for construction and building materials and demolition debris.

The City recognizes that residents and business will play a vital role in achieving the waste diversion goals. Accordingly, WR-1, *Waste Diversion Goal,* outlines a number of local recycling and composting initiatives that the City will implement in conjunction with Recology. Increased outreach and education are important tools that the City will use to help encourage participation in recycling and diversion programs. New recycling requirements for businesses and some multi-family developments will also be established. The City will promote financing to support increased waste diversion, as well as provide food waste and other green waste receptacles at City facilities.



* Costs and savings were only quantified for the residential sector due to the inherent variability in the types of fixtures and strategies available to the nonresidential sector. Accordingly, an average cost per metric ton is not available.
† 89% of 2020 GHG reductions occur in the Building Energy sector as a result of reduced electricity and natural gas consumption for hot water heating.

Water supply and wastewater treatment represent about 1% of the City's 2010 Inventory. Although it is a relatively small component of the City's GHG portfolio, homes and businesses throughout Oroville consume a significant amount of water through indoor plumbing and outdoor irrigation. It is estimated that an average three-bedroom home uses 174,000 gallons of water each year. Water resources are an important part of the Oroville community and economy—the City is bordered by the Lake Oroville State Recreation Area and the Oroville Dam, which is the starting point of the State Water Project (SWP). The Feather River also provides an open space corridor through the center of the city and Oroville Wildlife Area. Given the potential for future reductions in water supplies as a result of climate change, conserving water for future generations and wildlife is a critical action area for the CAP.

The City has identified two strategies to enhance community water conservation and management. WR-1, *Per Capita Water Use Reduction*, outlines strategies to reduce water consumption consistent with SB X7-7.[8] The strategy promotes free water audits in conjunction with the three local water providers, as well as conservation programs to install ultra-low flush toilets and reduce outdoor water use. Water efficiency training, education, and outreach will also be provided. Water reductions achieved by WR-1, *Per Capita Water Use Reduction*, will not only help conserve water, but also contribute to building energy savings through reduced electricity and natural gas for hot water heating. WR-2, *Recycled Water Use*, will complement per capita water reduction efforts by encouraging recycled water use for non-potable sources, such as landscaping irrigation, dust control, or fire suppression.

[8] SB X7-7 requires urban water agencies throughout California to help achieve the statewide goal of a 20% per capita water use reduction by 2020. Executive Order B-29-15, which was issued on March 31, 2015, directs the Department of Water Resources to impose a 25% reduction in potable urban water usage (relative to 2013 conditions) through February 28, 2016. Accordingly, near-term emissions reductions achieved through statewide mandates will likely exceed emissions savings quantified for WR-1.

*Average includes costs/savings for only TR-1. Qualitative information for other land conservation strategies is presented in Table 3-3.

Natural communities and urban forests are dynamic ecosystems that provide environmental and aesthetic benefits. These areas help clean the air and water, strengthen the quality of place, reduce stormwater runoff, and create walkable communities. Natural communities and urban forests are generally considered *emissions sinks* because the vegetative materials absorb CO_2, a GHG, through photosynthesis. The City has been actively involved in programs to increase and maintain existing natural areas. The CAP builds on these programs through tree planting programs and local agricultural initiatives.

The CAP supports both the expansion of urban forests and the protection of existing oak trees. TR-l, *Urban Forests*, establishes a new urban tree program that will plant a minimum of 400 trees each year along urban corridors and in downtown areas. The program will be implemented through a street and public tree planting program, as well as through tree planting requirements for new development. The CAP will also minimize existing oak tree losses through TR-2, *Oak Tree Loss Mitigation Ordinance*. Under this strategy, the City will adopt a new oak tree ordinance that will require the replacement of oak trees and/or the payment of a fee to compensate for oak tree losses.

The final trees and agriculture strategy, TR-3, *Local Food Initiatives*, incentivizes and supports local farmers markets and locally grown food. Agricultural goods have been a staple in the local economy for over 150 years. Although Oroville does not have designated farm lands within the city limits, it is surrounded by prime farmland and several agricultural industries, including citrus and olive production. TR-3, *Local Food Initiatives*, not only encourages locally grown food within the greater Oroville area, but also provides City support and streamlined permitting for urban and small-scale agriculture within the city limits.

Chapter 4

Emissions Reduction Implementation Program

4.1 Introduction

This chapter describes the objectives, milestones, timeline, and processes for implementation of the emissions reduction strategies (please refer to Chapter 5, *Climate Change Adaptation*, for implementation details related to climate change adaptation). Establishing a robust management program is necessary to ensure the CAP meets its emissions reduction objectives and is implemented in a timely and efficient manner. Details on specific implementation actions for each strategy are provided, as well as potential funding options and milestones. Plans for outreach and education, monitoring and evaluation of the emissions reduction strategies, and future document updates are also described.

4.2 CAP Implementation Team

The City has designated a CAP implementation team (CIT) to lead and coordinate the City's efforts on implementation, monitoring, and management of the emissions reduction strategies. Composed of representatives from several City departments, the CIT will be under the leadership of the Community Development Department Director. CIT members will meet regularly and report directly to the City Council on progress towards attaining the 2020 emissions reduction target.

One of the main objectives of the CIT will be to maintain the strategy implementation schedules and ensure emissions reductions are achieved in a cost-effective manner. CIT representatives will also provide guidance and support to City staff on financial, programmatic, and technical matters. Protocols for monitoring, verifying, and reporting emissions reductions will be developed and managed by the CIT. This team will also be responsible for updating and adaptively managing the emissions reduction strategies based on real-time information collected through the monitoring and verification process. The CIT will serve as the external communication hub to climate change organizations and the members of the community.

Listed below are general implementation steps that the CIT will undertake to initially support implementation of the emissions reduction strategies.

- **Develop implementation plans for each emissions reduction strategy**. Implementation plans will include specific milestones, deadlines, funding opportunities, partners, programs, and other details, as necessary, to initiate implementation of the emissions reduction strategies.
- **Estimate project-specific costs**. The estimated costs/savings for the emissions reduction strategies are provided in Chapter 3, *Emissions Reduction Strategies*. During the implementation phase of each strategy, project-specific costs/savings will be prepared to provide a more accurate assessment of upfront investment needs, potential returns, and other financial planning needs.
- **Adopt or update ordinances and/or codes**. Some emissions reduction strategies will require amendments to the Oroville Municipal Code.
- **Establish partnerships**. Some of the emissions reduction strategies will require new program partnerships, both internal to the City and with external agencies, to leverage staff expertise and agency resources and to maximize funding opportunities.

- **Pursue funding sources**. Funding from State and federal agencies can support the implementation of the emissions reduction strategies. The City will pursue these and other emerging funding sources as a part of implementation efforts. The City will also consider internal funding sources such as facility master plan programs and capital improvement programs.
- **Create monitoring/tracking processes and indicators**. All of the emissions reduction strategies will require tracking and monitoring of program progress, particularly to identify and remedy any shortfalls in a timely manner. For each strategy, the City will identify monitoring and tracking procedures.
- **Engage the community and stakeholders**. The City will engage and educate the public and stakeholder groups in the implementation of each emissions reduction strategy. The City will solicit input to design effective implementation programs for emissions reduction strategies. Community engagement activities may include ongoing outreach to relevant stakeholder groups, providing clear and topic-specific messages on emissions reduction strategies, soliciting feedback, holding public meetings, connecting through existing events and online media, and providing informational materials.

4.3 Primary Actions and Supporting Measures

Successful implementation of the emissions reduction strategies requires the identification of key action items, known obstacles, and resources. While comprehensive implementation plans for each strategy will be developed over time, primary actions that the City will undertake to achieve the strategy objectives can be identified now. These actions, which are summarized in Tables 4-1 through 4-3, are related to the general implementation steps listed above but are specific to individual strategies. Tables 4-1 through 4-3 also summarize measures that will be implemented to support the primary action(s). These supporting measures are not exhaustive and may be modified during implementation of the emissions reductions strategies.

Table 4-1. Primary Actions and Supporting Measures for Building Energy Emissions Reduction Strategies

BE-1. Green Building Ordinance

BE-1.1. Adopt a Green Building Ordinance to keep 15% ahead of expected future updates to Title 24 through 2020.

- BE-1.a. Provide grants and other incentives and/or leverage outside grants, funding, and incentives to support green building
- BE-1.b. Provide green building outreach, training, and education. Prepare an Oroville green building design manual or provide existing resources developed by the Green Building Council or California Energy Commission to assist homeowners, building industry professionals, and project applicants in achieving compliance with the requirements of the Green Building Ordinance.

BE-2. Residential Energy Efficiency Retrofits

BE-2.1. Promote innovative, low-interest financing for voluntary energy efficiency retrofits for existing single-family and multi-family homes.

BE-2.2. Provide education and outreach on cost-effective retrofit packages.

- BE-2.a. Identify federal tax credits and local rebates to support energy efficiency programs. For example, partner with PG&E to implement and expand its residential rebate programs for energy efficiency upgrades.
- BE-2.b. Implement a low-income weatherization program.
- BE-2.c. Review existing City policies to identify potential barriers to energy efficiency retrofits and determine appropriate updates and revisions as needed.
- BE-2.d. Assign key staff members who understand the latest green technologies to serve as points of contact for energy efficiency improvement projects.
- BE-2.e. Provide funding to non–low income homeowners to cover 25% of the cost of the whole house retrofit.
- BE-2.f. Continue to support PACE financing districts to finance renewable energy and energy and water efficiency improvements. The PACE financing programs can be used to support multiple emissions reduction strategies, including BE-3, BE-5, BE-6, and WR-1.
- BE-2.g. Coordinate with Butte County, special districts, nonprofits, and other public organizations within the region to share resources and program development and implementation.

BE-3. Nonresidential Energy Efficiency Retrofits

BE-3.1. Promote innovative, low-interest financing for voluntary energy efficiency retrofits for existing nonresidential buildings.

BE-3.2. Provide education and outreach on cost-effective retrofit packages.

- BE-3.a. Promote individualized energy management services for large energy users by advertising existing utility programs.
- BE-3.b. Launch energy efficiency campaigns targeted at business. Provide public education on the need for energy efficiency and emissions reduction programs and incentives.
- BE-3.c. Utilize the energy efficiency ratings disclosed through Assembly Bill 1103 to target assistance programs on high use buildings based on energy use per square foot. Encourage building owners to upload their ratings to Portfolio Manager so they will be easily accessible to the general public.

BE-4. Energy Efficient Lighting Standards

BE-4.1. Replace all street lights with LED bulbs by 2020.

BE-4.2. Develop incentives to encourage the voluntary replacement of less efficient outdoor bulbs with energy efficient ones in existing residential and nonresidential buildings.

- No supporting measures identified at this time.

BE-5. Solar Installations for New Development

BE-5.1. Revise the Solar Energy Ordinance to require new residential projects of six units or more to install solar PV on 50% of new homes in the development.

BE-5.2. Revise the Solar Energy Ordinance to require new nonresidential projects larger than or equal to 25,000 square feet to incorporate onsite solar energy generation to provide a minimum of 25% of the project's energy needs.

- BE-5.a. Develop a partnership with PG&E to explore possibilities for solar energy production programs.
- BE-5.b. Identify federal tax credits and local rebates to support new solar programs.
- BE-5.c. Review existing City policies to identify potential barriers to new solar installation and determine appropriate updates and revisions as needed.
- BE-2.f. Continue to support PACE financing districts to finance renewable energy and energy and water efficiency improvements.
- BE-2.g. Coordinate with Butte County, special districts, nonprofits, and other public organizations within the region to share resources and program development and implementation.

BE-6. Solar Installations for Existing Development

BE-6.1. Provide education and outreach to support voluntary solar installations for existing homes and commercial and industrial buildings.

- Supporting actions similar to those presented in BE-5 could be used to help achieve the strategy objective.

BE-7. Local Renewable Energy Development

BE-7.1. Identify possible sites for renewable energy production using local renewable resources such as solar, wind, and hydro.

BE-7.2. Establish a protocol for reviewing a proposed alternative energy project against existing City policies and ordinances.

BE-7.3. Support PG&E's Green Option program to increase locally-produced solar energy.

- No supporting measures identified at this time.

Notes:
PACE = Property Accessed Clean Energy; PG&E = Pacific Gas and Electric.

Table 4-2. Primary Actions and Supporting Measures for Land Use and Transportation Emissions Reduction Strategies

LUT-1. Residential and Commercial Density

LUT-1.1. Continue to implement Section 26-22 of the Zoning Code, which provides density bonuses for projects with five or more units that include low income housing.

- No supporting measures identified at this time.

LUT-2. Mixed-Use Development

LUT-2.1. Require new specific plans to provide sufficient employment generating land uses to achieve a jobs-to-housing balance equal to the level provided in the incorporated communities of Butte County.

- No supporting measures identified at this time.

LUT-3. Balanced Mode Circulation Plan

LUT-3.1. Develop a toolkit that provides guidance for implementing transportation facilities based upon complete street concepts that support balanced use by all modes of travel, including pedestrians, bicyclists, motorists, and transit users.

- LUT-3.a. Update the City's engineering and street design standards to ensure consistency with complete streets concepts.
- LUT-3.b. Update and adopt refined street cross-sections to support complete streets.
- LUT-3.c. Evaluate the potential development of an interactive Google Maps tool that would highlight the shortest and most fuel efficient route for freight deliveries.

- LUT-3.d. Implement the *2010 Bicycle Transportation Plan* (47 projects throughout the city).

LUT-4. Pedestrian Network Improvements

LUT-4.1. Require new residential and commercial development to provide internal connections to existing and planned pedestrian networks.

LUT-4.2. Eliminate physical barriers, such as walls, landscaping, and slopes that impede pedestrian circulation.

- LUT-4a. Seek grants and other funding sources to fund external network pedestrian connectivity.

LUT-5. Traffic Calming

LUT-5.1. Modify City development standards to include specific development and roadway design standards to implement traffic calming measures.

- LUT-5.a. Seek grants and other funding to retrofit existing facilities with traffic calming measures.

LUT-6. Electric Vehicle (EV) Charging Stations

LUT-6.1. Provide public charging stations at key high use locations around the city (e.g., City Hall, the Centennial Cultural Center, shopping centers, libraries, hospital, and commercial areas).

LUT-6.2. Partner with private providers for pay charging stations.

- LUT-6a. Seek grants and other funding to provide charging stations.

LUT-7. Voluntary Commute Trip Reduction (CTR) Programs

LUT-7.1. Encourage businesses to provide CTR programs to at least 25% of employees.

LUT-7.2. Encourage businesses to set aside parking spaces at conveniently located commercial developments as park-n-ride spaces.

- LUT-7a. Provide outreach to support voluntary employer programs.

LUT-8. Intelligent Transportation Systems (ITS)

LUT-8.1. Optimize roadway operations through use of ITS techniques such as traffic signal coordination to improve traffic flow without the need for capacity improvements.

- LUT-8a. Seek grant and other funding opportunities to retrofit existing facilities with ITS infrastructure.

LUT-9. Idling Ordinance

LUT-9.1. Adopt an ordinance that limits idling time to 3 minutes for heavy-duty construction equipment.

- No supporting actions identified at this time.

LUT-10. Electric-Powered Construction Equipment

LUT-2.1. Require that at least 25% of construction equipment for new development utilize electric power instead of gasoline or diesel fuel.

- LUT-2a. Offer non-financial incentives such as procurement preference when bidding on City contracts.
- LUT-2b. Partner with the BCAQMD and ARB to leverage funding opportunities and financial incentives.

LUT-11. Electric-Powered Landscaping Equipment

LUT-3.1. Modify the Municipal Code to require new development include electrical outlets on the exterior of buildings.

LUT-3.2. Provide education and outreach on incentive programs and public health benefits associated with electric-powered landscaping equipment.

- LUT-3a. Implement incentive programs, such as a rebate for purchasing electric lawnmowers or other electric equipment.
- LUT-3b. Implement a lawnmower exchange program.

Notes:
ARB = California Air Resources Board; BCAQMD = Butte County Air Quality Management District.

Table 4-3. Primary Actions and Supporting Measures for Waste Reduction, Water Conservation, and Trees and Agriculture Emissions Reduction Strategies

WR-1. Waste Diversion Goal

WR-1.1. Require businesses and multi-family developments of five units or more that produce more than 4 cubic yards of solid waste per week to recycle.

WR-1.2. Require contractors to submit a recycling and reuse plan and use separate material bins at the construction site.

WR-1.3. Provide compost receptacles for food waste and other green waste produced in City facilities.

- WR-1a. Provide waste education and public outreach.
- WR-1b. Promote financing mechanisms and opportunities to increase waste diversion.
- WR-1c. Encourage local businesses to expand their recycling and composting efforts and to reduce packaging of products manufactured in the city.
- WR-1d. Enhance regional coordination on waste management practices and recycling, composting, and other diversion programs.
- WR-1e. Promote remote separation by working with independent recyclers to separate materials at waste recovery facilities.

WC-1. Per Capita Water Use Reduction

WC-1.1. Promote water audit programs in collaboration with efforts by local water purveyors that offer free water audits to large landscape accounts as well as single-family, multi-family, and commercial customers.

WC-1.2. Collaborate with purveyors to enact conservation programs for commercial, industrial, and institutional accounts and create programs to install ultra-low-flush toilets in facilities.

WC-1.3. Implement the Water Efficient Landscape Ordinance to reduce outdoor water consumption.

- WC-1a. Sponsor water efficiency training and certification for irrigation designers and installers and property managers.
- WC-1b. Provide public education and outreach to promote water conservation.

WC-2. Recycled Water Use

WC-2.1. Coordinate with the Sewerage Commission—Oroville Region, the two regional wastewater collection agencies, and the Public Works Department to assess the feasibility of producing and distributing recycled water within the city.

WC-2.2. Inventory potential non-potable uses of water for potential substitution by recycled and/or gray water.

WC-2.3. Consider programs to collect sub-potable storm water for onsite reuse for landscape irrigation.

- WC-2.a. Encourage the retrofit of irrigation systems to promote the use of recycled water at golf courses, parks and open spaces.
- WC-2.b. Collaborate with responsible agencies to encourage the use of recycled water where cost and energy efficiencies for its production, distribution, and use are favorable.
- WC-2.c. Participate in and support regional programs and projects that target the improvement and conservation of the region's groundwater and surface water supplies.

TR-1. Urban Forests

TR-1.1. Implement a street and public tree planting program.

TR-1.2. Adopt tree planting requirements for new residential and nonresidential development.

- No supporting measures identified at this time.

TR-2. Oak Tree Loss Mitigation Ordinance

TR-2.1. Adopt an Oak Tree Loss Mitigation Ordinance that requires the replacement of removed oak trees.

- No supporting measures identified at this time.

TR-3. Local Food Initiatives

TR-3.1. Provide incentives and guidelines for urban and small-scale agriculture.

- TR-3a. Provide City/community support and streamlined permitting for urban agriculture, including community gardens and urban farms.

4.4 Financing Strategies

The City, public agencies, and community members will incur both costs and savings from implementation of the local emissions reduction strategies. Primary costs are related to capital improvements and other investments, as well as operations and maintenance. Despite these upfront and ongoing costs, some strategies will result in long-term cost savings from reduced energy use and maintenance. Furthermore, there are many rebates, incentives, and grant programs available to reduce upfront capital costs, alleviate overall project costs, and support long-term initiatives. The City will have a leadership role in identifying and pursuing relevant funding for some candidate strategies, but the private sector will also need to pursue different funding options, as discussed below.

4.4.1 City and CAP-Level Financing

Table 4-4 summarizes the total upfront costs, annual savings/costs, and entities incurring the costs/savings for all quantified strategies. While Table 3-3 in Chapter 3, *Emissions Reduction Strategies,* presented metrics of cost-effectiveness (e.g., cost per $MTCO_2e$, net present value, and payback periods), Table 4-4 reflects the total upfront and annual costs and savings that would be incurred to achieve the emissions reduction target.

Ultimately, implementation of the CAP will require considerable investment from multiple entities. The following overall financing approach will help ensure the emissions reduction strategies are funded and implemented in a timely manner. A comprehensive funding program, including facility and capital improvement plans, will be developed over time.

- Pursue funding for strategies concurrently, whenever possible, to use funds most efficiently. Please refer to Appendix E for information on potential funding options that the City may explore.
- Leverage federal, State, and regional grants and other funding sources.
- Partner with other jurisdictions and regional entities to administer joint programs, and partner with the private sector on strategy implementation.

Table 4-4. Total Upfront Costs and Annual Savings/Costs Associated with CAP Implementation

Action Area	Strategy	Upfront (One-Time Cost)		Annual	
		Cost[a]	Incurring Entity	Saving (Cost) [a]	Incurring Entity
ENERGY EFFICIENCY AND RENEWABLE ENERGY	BE-1. Green Building Ordinance	\$700,000–\$1,600,000	• Building owners • Developers	\$100,000	• Building owners • Tenants
	BE-2. Residential Energy Efficiency Retrofits	\$1,700,000–\$3,000,000	• Homeowner • Multi-family residential building owners	\$300,000	• Homeowners • Tenants
	BE-3. Nonresidential Energy Efficiency Retrofits	\$200,000–\$700,000	• Building owners	\$700,000	• Building owners • Tenants
	BE-4. Energy Efficient Lighting Standards	\$800,000–\$1,300,000	• Building owners • City of Oroville	\$275,000	• Building owners • Tenants • City of Oroville
	BE-5. Solar Installations for New Development[b]	\$2,700,000–\$3,300,000	• Building owners • Developers	\$200,000 for DP and \$18,000–\$37,000 for PPA	• Building owners • Tenants
	BE-6. Solar Installations for Existing Development [b]	\$15,600,000–\$18,400,000	• Building owners	\$1,000,000–\$1,100,000 for DP and \$100,000–\$200,000 for PPA	• Building owners • Tenants
	BE-7. Local Renewable Energy Development[b]	\$1,300,000–\$1,700,000	• City of Oroville	\$60,000–\$100,000 for DP and \$7,000–\$14,000 for PPA	• Building owners • Tenants
LAND USE AND TRANSPORTATION	LUT-1. Residential and Commercial Density	Costs associated with density incentives (e.g., fee waivers) for low income housing projects with five or more units.	• City of Oroville	Savings associated with density bonuses for low income housing projects with five or more units. These strategies could support transportation savings from shorter trips that can be made by alternative transportation (e.g., walking, biking).	• Developers • Residents
	LUT-2. Mixed-Use Development	Negligible.[c]		Savings associated with requirements for mixed-use development. These strategies could support transportation savings from shorter trips that can be made by alternative transportation (e.g., walking, biking).	• Developers • Residents • Business owners
	LUT-3. Balanced Mode Circulation Plan	Costs include updating the City's engineering and street design standards, adopting refined street cross-sections, and evaluating development of an interactive Google Maps tool.	• City of Oroville	Saving associated with fuel efficiency and increased road safety.	• Pedestrians • Bicyclists • Transit users • Businesses with a delivery component

Action Area	Strategy	Upfront (One-Time Cost)		Annual	
		Cost[a]	Incurring Entity	Saving (Cost) [a]	Incurring Entity
	LUT-4. Pedestrian Network Improvements	Costs associated with building sidewalks and eliminating physical barriers (e.g., walls)	• Developers • City of Oroville	Saving associated with increased pedestrian safety and increased pedestrian access.	• Pedestrians
	LUT-5. Traffic Calming	Costs associated with upgrading traffic measures to support walking and biking.	• Developers • City of Oroville	Saving associated with increased pedestrian and bicycle safety and access.	• Pedestrians • Bicyclists
	LUT-6. Electric Vehicle (EV) Charging Stations	$96,000–$200,000	• Private companies operating the EV charging stations • City of Oroville (assumes 50% paydown of installation cost)	Annual costs and savings will depend on the fee structure implemented by the third-party operator.	• Private companies operating the EV charging stations • EV owners
	LUT-7. Voluntary Commute Trip (CTR) Reduction Programs	Costs associated with program design and set-up	• City of Oroville • Businesses	Annual costs to implement and support voluntary programs; savings associated with reduced gas consumption and car maintenance.	• City of Oroville • Vehicle owners • Businesses
	LUT-8. Intelligent Transportation Systems (ITS)	Unit cost for ITS can vary from $20,000–$29,000 depending on specifications	• City of Oroville	Savings associated with reduction in fatalities, injuries, repair costs associated with crashes, and reduced fuel consumption from improved transportation efficiency.	• Travelers
	LUT-9. Idling Ordinance	$0[a]	N/A	$16,000	• Vehicle owners
	LUT-10. Electric-Powered Construction Equipment	Upfront cost assumed to be negligible; equipment costs vary significantly based on other features besides energy source	• Equipment owners	Annual cost savings associated with an electric air compressor (128 kilowatts) estimated at $28,000 per unit. Purchase of a generator may be required to run the compressor.	• Equipment owners/renters
	LUT-11. Electric-Powered Landscaping Equipment	Upfront cost assumed to be negligible; equipment costs vary significantly based on other features besides energy source	• Equipment owners	Annual cost savings associated with an electric leaf blower or chainsaw estimated at between $500 and $600 per unit.	• Equipment owners/renters
WASTE REDUCTION	WR-1. Waste Diversion Goal	Costs associated with recycling and diversion facilities not quantified	N/A	($400,000–$90,000)	• City of Oroville • Waste haulers

Action Area	Strategy	Upfront (One-Time Cost)		Annual	
		Cost[a]	Incurring Entity	Saving (Cost)[a]	Incurring Entity
WATER CONSERVATION	WC-1. Per Capita Water Use Reduction	The incremental cost for high efficiency faucets, toilets, and showerheads is assumed to be zero. Weather-based irrigation systems could range from \$150–\$350 (residential) or \$1,500–\$4,000 (commercial)	• Homeowners • Building owners	Per home annual savings for upgraded indoor fixtures is estimated around \$200. Annual subscription services for smart irrigation systems can range up to \$50 for residential and \$200 for commercial.	• Homeowners, • Building owners • Tenants
	WC-2. Recycled Water Use	Costs are based on the electricity required to treat and distribute reclaimed water.	• City of Oroville • Utilities • Water customers	Savings are based on the reduced energy intensity associated with producing recycled water, compared to imported water.	• City of Oroville • Utilities • Water customers
TREES AND AGRICULTURE	TR-1. Urban Forests	\$300,000	• City of Oroville • Developers (due to tree planting requirements for new development)	(\$50,000) Savings associated with reductions in electricity due to shading from the newly planted trees. Costs associated with annual tree maintenance.	• City of Oroville • Building owners • Tenants
	TR-2. Oak Tree Loss Mitigation Ordinance	Costs associated with the purchasing and planting of new oak trees	• Developers	Savings associated with reductions in electricity due to shading from newly planted trees. Costs associated with annual tree maintenance.	• City of Oroville • Building owners • Tenants
	TR-3. Local Food Initiatives	Costs include supporting farmers markets and community gardens	• City of Oroville	Savings include decreased food transportation costs.	• Local food producers • Local food buyers

Notes:

[a] Staff time to prepare ordinances, develop new programs, or other staff costs associated with strategy development or implementation are not quantified in this analysis.

[b] The cost analysis considered two financing scenarios:
Direct Purchase (DP)**:** The purchasing entity (e.g., homeowner for BE-5, City of Oroville for BE-7) is assumed to directly purchase and install the solar PV system.
Power Purchase Agreement (PPA): The purchasing entity enters into a PPA with a local company who owns and maintains the solar panels.

[c] This strategy adds a requirement for new specific plans to provide sufficient employment generating land uses to achieve a jobs-to-housing balance equal to the level provided in the incorporated communities of Butte County. However, the strategy does not require any additional plans or revisions to existing plans, which would create new staff and resource burdens.

4.4.2 Community and Project-Level Financing

As shown in Table 4-4, implementation of the emissions reduction strategies will result in costs and saving for residents, businesses, and other members of the community. Since many of the strategies in the CAP are voluntary (such as energy efficiency and solar retrofits for existing buildings), the private sector will only incur associated costs and savings for those strategies they choose to implement. Some of the strategies, however, will be mandatory and require community action. It is also important to note that costs and savings associated with some strategies may not be borne by the same players. That is, the entity making the upfront investment is not always the entity that experiences the reduction in utility bills or other savings.

Various funding options are available to support the community with implementation of the emissions reduction strategies. These options can provide initial capital, reduce overall program costs, and support long-term strategy implementation. Table 4-5 provides an overview of potential funding sources for each of the five actions. Please refer to Appendix E for additional information on specific funding and financing options available to the community.

Table 4-5. Overview of Potential Community Funding Sources by Action Area

Action Area	Potential Community Funding Sources
Energy Efficiency and Renewable Energy	• Utility rebates (e.g., California Solar Initiative) • Federal tax credits for energy efficiency • Energy efficient mortgages and PACE • Power purchase agreements • Private equity funding
Land Use and Transportation	• Federal and State transportation funds • State alternative transportation assistance • Carl Moyer Program
Waste Reduction	• Private funds
Water Conservation	• Water service provider rebates
Trees and Agriculture	• Federal or State grants, private funds

The private sector incentives and rebates identified in Appendix E can significantly improve the economics of individual projects. For example, incremental upfront costs for a new commercial building to implement BE-1, *Green Building Ordinance*, which requires energy efficiency improvements beyond the 2013 Title 24 standards, are estimated to be around $40,000 (for a five-story office building of 52,900 square feet). Assuming eligibility requirements are met and incentives are available at the time of application, commercial building owners could recoup between 10% and 50% of that upfront cost by applying for PG&E's Savings by Design program.

Table 4-6 highlights costs and savings at the project-level for several emissions reduction strategies. All projects would require upfront costs, but ultimately result in cost savings over the lifetime of the improvement. Energy efficiency retrofits for an average existing multi-family home are anticipated to be one of the most cost-effective strategies, with a payback period of just 6 years.

Table 4-6. Example Project-Level Costs and Savings

Strategy	Project Description	Upfront Cost	Annual Savings	Net Lifetime Savings[a]	Payback (years)	Incurring Entity
BE-1. Green Building Ordinance	New commercial building of 10,580 square feet (one-story office building) exceeds Title 24 by at least 15%	$10,500–$27,300	$1,700–$4,100	$22,900–$55,200	7	Building developer
	New single-family house of 2,025 square feet exceeds Title 24 by at least 15%	$1,100–$1,700	$100	$500–$800	13–17	Building developer
BE-2. Residential Energy Efficiency Retrofits	Existing multi-family unit reduces energy consumption (electricity and natural gas) by at least 15%, relative to existing conditions	$2,500	$400	$5,100	6	Landlord/ homeowner
BE-5. Solar Installations for New Development	Residential unit installs a fixed tilt, rooftop 4 kW solar PV system through DP	$14,000–$16,000	$900	$8,600–$22,500	15–20	Homeowner
	Residential unit installs a fixed tilt, rooftop 4 kW solar PV system through a PPA	–[b]	$100–200	$2,500–$4,900	N/A	Homeowner
BE-6. Solar Installations for Existing Development	Commercial building installs a fixed tilt, roof-top 40 kWh solar PV system through DP	$120,400–$148,400	$7,800–$8,600	$46,500–$95,600	16–19	Building owner
	Commercial building installs a fixed tilt, roof-top 40 kWh solar PV system through a PPA	–[b]	$900–$1,700	$21,500–$43,000	N/A	Building owner
BE-7. Local Renewable Energy Development	Municipal property installs a 330 kW ground-mount, fixed tilt solar PV system through DP	$1,320,000–$1,650,000	$66,300–$81,600	$8,300–$72,400	15–25	City
	Municipal property installs a 330 kW ground-mount, fixed tilt solar PV system through a PPA	–[b]	$7,300–$14,600	$182,300–$364,700	N/A	City
WC-1. Per Capita Water Use Reduction	Single-family home installs energy- and water-efficient kitchen and bathroom faucets, showerheads, toilets, and dishwashers	-[c]	$100	$1,300	Net saving	Homeowner

Notes:

DP = direct purchase; kW = kilowatt; kWh = kilowatt-hour; PV = photovoltaic; PPA = power purchase agreement.

[a] Equal to the net present value of the project.

[b] Upfront cost paid by the solar provider.

[c] For faucets, toilets, and showerheads, very little price difference is found between higher and lower efficiency fixtures, and thus the incremental cost is assumed to be zero. Weather-based irrigation systems could range from $150–$350 per residential system, or $1,500–$4,000 per commercial system.

4.5 Implementation Schedule

Swift implementation of the emissions reduction strategies will occur following adoption of the CAP to ensure the City's target is achieved by 2020. The CIT will initially focus on developing key ordinances and programs, and then will shift to strategy implementation, program management, and emissions tracking. Specific timelines and milestone(s) for each strategy will be further developed based on the general schedule shown in Figure 4-1, with strategy implementation occurring in three groups.

Figure 4-1. Implementation Timeline for the Emissions Reduction Strategies

Implementation of the individual emissions reduction strategies will be led by the specific City divisions shown in Table 4-7, with support from the CIT. Private and other regional entities (e.g., Butte County Regional Transit) may be responsible for implementing specific projects under each strategy. The lead City division responsible for the primary implementation of each strategy is also shown in Table 4-7. The City may adjust this initial grouping as more specific implementation timelines are developed for each strategy. Final strategy prioritization will be based on the following factors.

- **Expected Reductions**. How effective is the strategy at reducing GHG emissions, and how quickly must reductions be achieved to meet the 2020 emissions reduction target?
- **Cost and Funding**. How much does the strategy cost? Is funding already in place?
- **Co-Benefits**. What community co-benefits does the strategy offer?
- **Community Impact**. What are the advantages and disadvantages of the strategy to the community as a whole?
- **Implementation Effort**. How difficult will it be to develop and implement the strategy? Are new ordinances and/or coordination with external organizations required?
- **Consistency with Existing Programs**. Does the strategy complement or extend existing programs?

Table 4-7. Implementation Group and Lead Oroville Departments for Emissions Reduction Strategies

	Strategy	Implementation Group	Lead City Division
ENERGY EFFICIENCY AND RENEWABLE ENERGY	BE-1. Green Building Ordinance	Group 1 (2016)	Building
	BE-2. Residential Energy Efficiency Retrofits	Group 1 (2016)	Building
	BE-3. Nonresidential Energy Efficiency Retrofits	Group 1 (2016)	Building
	BE-4. Energy Efficient Lighting Standards	Group 2 (2017)	Public Works
	BE-5. Solar Installations for New Development	Group 1 (2016)	Planning
	BE-6. Solar Installations for Existing Development	Group 1 (2016)	Planning
	BE-7. Local Renewable Energy Development	Group 2 (2017)	Planning
LAND USE AND TRANSPORTATION	LUT-1. Residential and Commercial Density	Group 1 (2016)	Planning
	LUT-2. Mixed-Use Development	Group 2 (2017)	Planning
	LUT-3. Balanced Mode Circulation Plan	Group 1 (2016)	Planning
	LUT-4. Pedestrian Network Improvements	Group 1 (2016)	Public Works
	LUT-5. Traffic Calming	Group 1 (2016)	Public Works
	LUT-6. Electric Vehicle (EV) Charging Stations	Group 2 (2017)	Public Works
	LUT-7. Voluntary Commute Trip Reduction (CTR) Programs	Group 2 (2017)	Planning
	LUT-8. Intelligent Transportation Systems (ITS)	Group 2 (2017)	Public Works
	LUT-9. Idling Ordinance	Group 3 (2018)	Public Works
	LUT-10. Electric-Powered Construction Equipment	Group 3 (2018)	Public Works
	LUT-11. Electric-Powered Landscaping Equipment	Group 2 (2017)	Public Works
WASTE REDUCTION	WR-1. Waste Diversion Goal	Group 1 (2016)	Public Works
WATER CONSERVATION	WC-1. Per Capita Water Use Reduction	Group 2 (2017)	Public Works
	WC-2. Recycled Water Use	Group 3 (2018)	Public Works
TREES AND AGRICULTURE	TR-1. Urban Forests	Group 1 (2016)	Parks & Trees
	TR-2. Oak Tree Loss Mitigation Ordinance	Group 1 (2016)	Planning
	TR-3. Local Food Initiatives	Group 1 (2016)	Planning

4.6 Outreach and Education

Community involvement is essential to successful implementation of the emissions reduction strategies, especially considering that several strategies depend on voluntary commitment, creativity, and participation. The City will collaborate with local businesses, community groups, residents, developers, and property owners to establish partnerships and encourage active involvement in the CAP. Periodic meetings will be held to provide information and inform the community on progress towards attaining the 2020 emissions reduction target. These meetings will provide an opportunity for collaboration and a mechanism for the City to receive feedback on potential improvements or changes to the emissions reduction strategies. Other outreach activities, including a public website and email flyers, will also be pursued to engage the public and solicit input, suggestions, and participation.

4.7 Evaluation and Monitoring

Regular monitoring is important to ensure programs are functioning as they were originally intended. Early identification of effective strategies and potential issues will enable the City to make informed decisions on future priorities, funding, and scheduling. Moreover, monitoring provides concrete data to document the City's progress in reducing GHG emissions.

Measuring current emissions levels will be an essential component of the monitoring and evaluation strategy. As shown in Figure 4-1, the City will prepare two emissions inventory updates for comparison to the 2010 Inventory and the 2020 emissions reduction target. The first inventory update will be conducted in 2017 based on 2016 GHG emissions data, and the second update will be conducted in 2019 based on 2018 GHG emissions data. These inventory updates will provide information regarding overall trends in community emissions. The updated inventories will be submitted to the City Council and distributed to the public for review. The assessments will report on emissions trends and indirect factors that may influence emissions, including temperature, changes in emissions factors (particularly for the power sector, whose sources may change due to drought and other conditions), employment, gross domestic product, and population.

Technologies, financing, regulations/policies, and behavior relevant to the emissions reduction strategies are constantly changing. Accordingly, the City will annually track the progress of each strategy. Effective monitoring of individual strategies will require regular data collection in each of the primary emissions sectors. For example, reports detailing annual building electricity usage and fuel consumption will be necessary. The CIT will coordinate with internal City departments, PG&E, and other stakeholders to obtain and consolidate information into a repository that can be used to evaluate the effectiveness of individual reduction measures. The CIT will also track the State's progress on implementing state-level actions. Close monitoring of actual reductions achieved by the State programs will allow the City to adjust the local emissions reduction strategies, if needed, to ensure the 2020 emissions reduction target is achieved.

Annual progress achieved by the State and local emissions reduction strategies will be reported to the City Council. Where annual reporting, inventory updates, or other information indicates that the emissions reduction strategies are not as effective as originally anticipated, the City will adaptively manage the CAP. At a minimum, the City will conduct a 3-year review of overall CAP effectiveness as part of its annual reporting in 2017. This will allow for potential mid-course adjustments prior to 2020.

4.8 Regional Collaboration

There are several regional partners and collaboration opportunities that could enhance the effectiveness of the emissions reduction strategies. The City will coordinate with the following partners to explore opportunities to leverage resources, support overall CAP management, and share information.

- **Butte County Air Quality Management District (BCAQMD)**. BCAQMD is the local agency responsible for developing and implementing air quality plans. BCAQMD also sponsors various air quality programs that may support implementation of several energy efficiency, transportation, and renewable energy strategies.
- **PG&E.** PG&E offers numerous incentives and rebate programs to encourage energy efficiency. Resources offered by PG&E may reduce program implementation and administration costs.

There may also be opportunities for cooperation on community-scale alternative energy installations (e.g., solar) and management of the CCA program.

- **Butte Regional Transit and Butte County Association of Governments (BCAG)**. To fully implement the local transportation strategies, collaboration with regional transportation agencies is necessary. It is essential that the City, Butte Regional Transit, and BCAG establish a shared vision for how transportation and land use planning can support sustainable growth, consistent with the goals of SB 375 and the sustainable communities strategy.
- **Butte County and Neighboring Cities.** Cooperation with Butte County and neighboring cities could help maximize efficiencies in implementing emissions reduction strategies. The City will coordinate with staff from these agencies to promote regional collaboration.
- **Domestic Water Providers**. The City is served by three domestic water providers—California Water Service Company (Cal Water), South Feather Water and Power Agency (SFWPA), and the Thermalito Water and Sewer District (TWSD). The City will work with these water providers to promote reductions in indoor and outdoor water use from existing developments and achieve the goals set forth by SB X7-7 and Executive Order B-29-15.
- **Sewage Commission—Oroville Region (SCOR).** The City is served by three wastewater collection agencies—City of Oroville, Thermalito Water and Sewer District, and Lake Oroville Area Public Utility District. These three agencies have a joint powers agreement with the SCOR to handle wastewater treatment and disposal. Coordination among all agencies will be necessary to support implementation of WC-1 and WC-2.
- **Recology Butte Colusa Counties (Recology).** The City contracts all solid waste collection and recycling services with Recology. The City will work with the collection agency to promote waste reduction, recycling, and composting, consistent with WR-1. The City and Recology may also be able to share facilities, programs, and incentives to help ensure the 75% waste diversion goal is achieved by 2020.

4.9 Plan Evolution and Long-Term Emissions Reduction

The emissions reduction strategies presented in the CAP were developed to reduce community emissions by 11% below 2010 levels by 2020. This goal is consistent with the goals and milestones outlined in AB 32. However, it is reasonably foreseeable that as California approaches 2020, statewide focus will shift to emissions reductions beyond 2020. This trend has been observed elsewhere through the United States, with New York City recently releasing a plan to reduce GHG emissions by 80% below 1990 levels by 2050. California Executive Order (EO) S-03-05, which was issued in 2005, articulates a similar long-term goal for the state. However, a detailed plan similar to the AB 32 Scoping Plan for how the State will meet this target has not been released.

As the year 2020 approaches, the City will develop reduction targets for years beyond 2020 to continue the City's commitment to reducing GHG emissions. City staff will propose a target for City Council adoption by January 1, 2020. The proposal will include an assessment of the potential impact on the community of meeting this target (e.g., monetary costs; co-benefit), as well as on the City's internal resources. The strategies included in this CAP will help to put the City on a path to achieve more substantial reductions in the years after 2020. However, it is likely the City will rely on analyses and programs currently under development by the ARB to support continuation of AB 32 and EO-S-03-05.

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Chapter 5
Climate Change Adaptation

5.1 Introduction

Climate change planning can be divided into two distinct, but not exclusive categories—mitigation and adaptation. Mitigation refers to minimizing the onset of climate change, primarily through adopting and implementing strategies like those described in Chapter 3, *Emissions Reduction Strategies*. Adaptation refers to reducing the impact of unavoidable climate change effects. While mitigation and adaptation have different objectives, single strategies can be used to simultaneously achieve both goals.

Unlike the previous CAP chapters, which target GHG reduction and lessening future climate impacts, the focus of this chapter is adapting to whatever climate change occurs. The chapter considers likely shifts in climate with regard to increases in ambient temperatures and extreme heat events, increased wildfire risk, decreased snowfall and winter snowpack, increased intensity and frequency of storms, and shifts in the growing season and species distribution. It provides an initial vulnerability assessment to identify community elements that are likely to be affected by these climate shifts, as well as suggested adaptation strategies to decrease local climate change effects to three valuable community elements—water supply, public health, and transportation infrastructure. The vulnerability assessment and adaptation strategies developed in this chapter are a starting point for the City's continued climate change adaptation planning.

5.2 Vulnerability Assessment

Climate change vulnerability is commonly defined as a function of exposure, sensitivity, and adaptive capacity, as defined below. Exposure and sensitivity are analyzed in this section and adaptive capacity is addressed in Section 5.3.

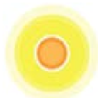
Exposure refers to the extent to which a community is subjected to climate change impacts. Communities will be differently exposed to various climate change effects. For example, due to Oroville's inland location, the entire community will not be exposed to sea level rise (and thus it is not included in this chapter). However, the community will likely be subjected to an increased future risk of severe wildfires. Section 5.2.1 identifies the climate change effects that are projected to occur in Oroville.

Sensitivity is the degree to which community elements, such as individuals or their assets, are adversely affected by climate change exposures. It is possible to be exposed to a climate change effect, but not vulnerable to consequence. For example, most healthy adults will adjust to small increases in average annual temperatures with little to no impact on their daily lives. Accordingly, characterizing the nature and magnitude of climate change exposures and sensitivities is critical for developing effective adaptation strategies (Cardona et al. 2012). Section 5.2.2 evaluates the sensitivity of various community elements to the climate change exposures identified in Section 5.2.1.

Adaptive Capacity describes the ability of a community element to adjust, repair, and/or respond to damage or climate variability.

5.2.1 Exposure—Climate Change Effects in Oroville

Current research efforts coordinated through the California Energy Commission (CEC) examine the specific changes to California's climate that will occur as Earth's surface warms. The CEC's Cal-Adapt website presents climate change predictions for the Oroville area, which are based on modeling of high and low GHG emissions scenarios. The website and other recent studies indicate that if GHG emissions continue to increase globally based on current trends, climate change could impact the city in the following ways (California Energy Commission 2014; California Natural Resources Agency 2009).



Increases in Ambient Temperatures and Extreme Heat Events. Average annual temperatures in the Oroville area are projected to increase by 3.5–6.3 degrees Fahrenheit (°F) by the end of the century, relative to historical averages (1961–1990). Heat waves and very high temperatures could also last longer and become more frequent. In addition, changes in ambient temperatures and extreme heat events could create conditions that are conducive to air pollution formation, which could further exacerbate existing air quality issues. Secondary impacts may include increased incidents of drought and rain-on-snow events if warm weather follows snowfall in the Sierra Nevada. Rain-on-snow events can cause large amounts of runoff that may stress local stormwater and drainage facilities (as discussed further below).

Increased Flooding. Heavy rains and rain-on-snow events in the Sierra Nevada could worsen flooding in Oroville due to the large volume of rain at one time, coupled with increased erosion and runoff. The Oroville Dam currently releases excess water during large rain events; a 150,000 cubic feet per second release would trigger disaster response teams to address potential flooding. For example, peak release during the devastating 1997 New Year's flood was approximately 160,000 cubic feet per second (California Department of Water Resources 1997). In comparison, average hourly outflows at Lake Oroville are typically around 30 to 40 cubic feet per second (California Department of Water Resources 2014a). A shift in precipitation patterns could increase the need for large-scale releases and the frequency of flooding events. Although the *2014 Butte County Local Hazard Mitigation Plan* (Local Hazard Mitigation Plan) rates the current probability of flooding in Oroville as "occasional/unlikely", the severity is rated as "catastrophic."

Decreased Snowfall and Winter Snowpack. The average early snowpack runoff in the Sierra Nevada has declined by 10% over the past century. Studies indicate that snowpack in the Sierra Nevada may be further reduced by 25–40%, relative to mid-century conditions, by 2050 (California Department of Water Resources 2009). As of June 2014, California is facing a severe drought and the snowpack in the Sierra Nevada is 12% of the annual average (California Department of Water Resources 2014b). Changes in snowfall and snow accumulation could reduce water supplies for all end users throughout the city. Flow levels for the Feather River may also be reduced, potentially affecting Lake Oroville and the Oroville Dam.

Increased Frequency and Intensity of Storms. Increased frequency and intensity of winter storm events could affect peak stream flows and increase flooding as large amounts of runoff move over pavement and other built surfaces. Although modeling results can vary, climate scientists predict an increase in warmer temperatures and atmospheric moisture, which can lead to an increase in heavy downpours during winter months (California Energy Commission 2012). Changes in precipitation patterns may amplify the existing flood risk in the city.

Increased Wildfire Risk. Warmer and drier conditions are expected to increase wildfire risk in the Oroville area by 13–52% by the end of the century, relative to 2010 levels. Anticipated changes in fire behavior suggest up to a three-fold increase in the potential area burned within the greater Oroville area. According to the Local Hazard Mitigation Plan, the current probability of wildfires in Oroville is "likely" and the severity is "critical" (see Figure 5-1).

Changes in Growing Season and Species Distribution. Changes in growing season conditions could cause variations in crop quality and yield. Plant and wildlife distributions may also be affected by changes in temperature, competition from colonizing species, regional hydrology, and other climate-related effects. These shifts could also increase the ability of disease vectors (organisms that transmit diseases, such as mosquitoes) to survive or thrive in areas that were previously uninhabitable.

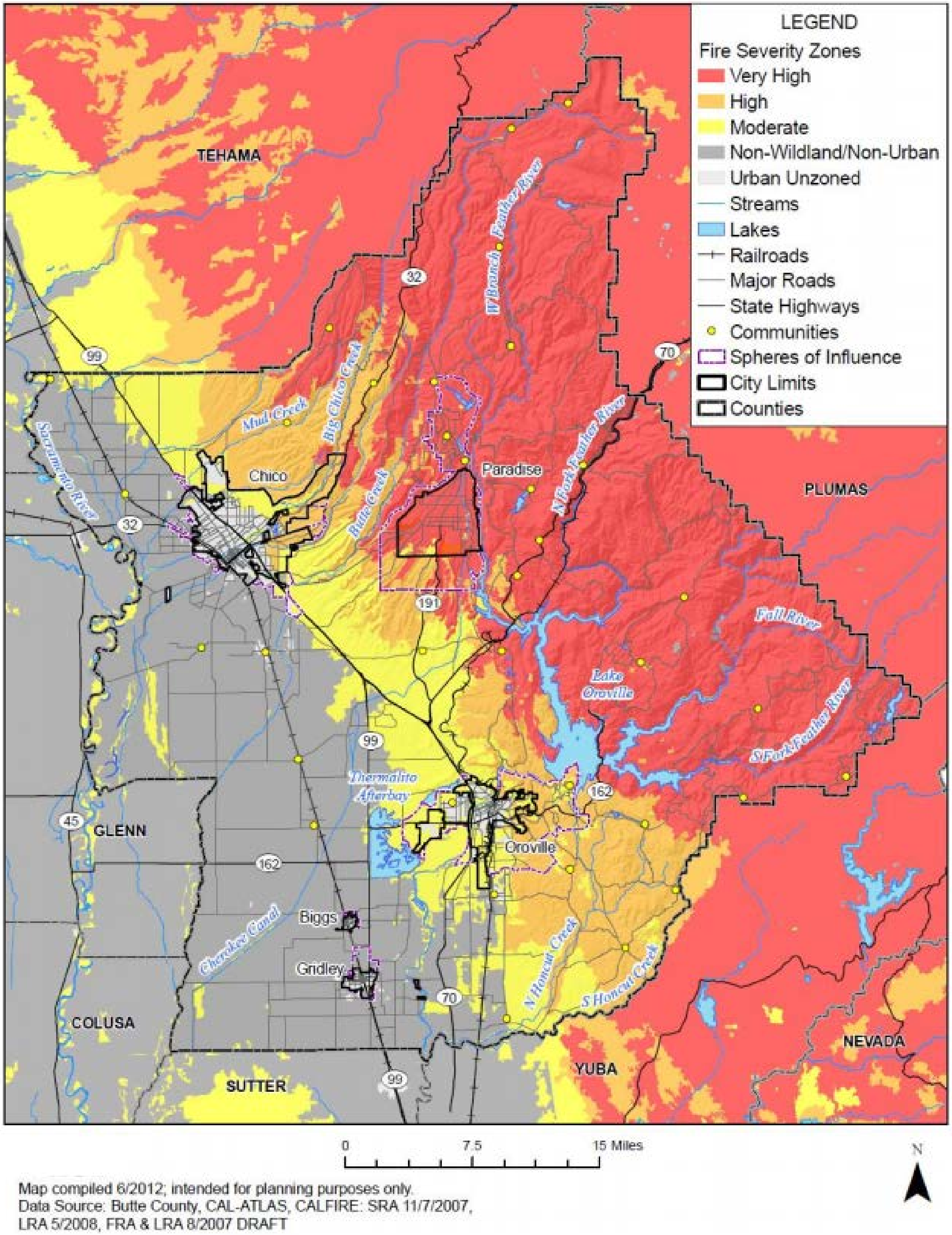


Figure 5-1. Fire Hazard Severity for the Oroville Area

5.2.2 Sensitivity to Climate Change Exposures

Section 5.2.1 indicates that Oroville will be exposed to variety of unavoidable climate change effects. However, as noted above, exposure does not necessarily mean that the community will be sensitive to the effect; individuals, their assets, and the environment may be exposed to a climate change threat but not sensitive to its consequence. For example, most healthy adults will adjust to small increases in average annual temperatures. Climate change threats for which a community element is not sensitive do not represent a significant vulnerability for which immediate action is necessary (Cardona et al. 2012). This section characterizes climate change sensitivity by analyzing the potential for exposure to climate change impacts to negatively affect community elements, including people, services, amenities, and structures.

Table 5-1 identifies whether community elements would be sensitive to the climate change exposures identified in Section 5.2.1. The community elements are drawn from the Oroville 2030 General Plan and are grouped into three categories—functions, structures, and people. Functions are services or amenities that serve the community wellbeing, such as the tourism and recreation industries. Structures are the various buildings and infrastructure throughout the city. Finally, people can be characterized by the diversity of ages, genders, ethnicities, and socioeconomic status within the community. Some populations are more sensitive to the impacts of climate change due to compromised health or limited access to resources, as discussed further below.

Sensitivity to climate change exposures is identified for each element as either *yes*, *no*, or *maybe*, which are defined below. Please refer to Appendix F for a brief discussion and justification for the ratings identified for each community element.

- ***Yes***—indicates the element would "most certainly" be affected by the climate change exposure. For example, government function has historically been adversely affected by extreme weather conditions, which can require equipment (computers, for example) to be shut down to avoid damage or even prevent employees from safely commuting to work. Accordingly, government continuity received a rating of *yes* for storms and flooding.

- **No**—indicates the element is not sensitive to the climate change exposure. For example, buildings and infrastructure would suffer no consequence from changes in species distribution. Accordingly, the majority of community elements within the structures category received a rating of *no* for changes in growing season and species distribution.

- **Maybe**—identifies elements that could be sensitive to climate change effects under certain conditions. For example, prolonged drought within northern California could threaten local food security and production. However, residents may be able to mitigate this effect by purchasing food from grocery stores or online when local supplies are insufficient. Accordingly, food security received a rating of *maybe* with respect to decreased snowpack.

It is important to note that Table 5-1 only identifies whether a community element is sensitive to a climate change exposure; it does not state the magnitude of potential consequence nor rank the relative importance of community elements. Careful examination of local factors and community feedback is required to precisely characterize the magnitude of climate change effects and potential damage that would be incurred in Oroville. Accordingly, the review provides an initial assessment of critical elements that should subsequently undergo comprehensive public review and analysis.

Table 5.1. Sensitivity of Community Elements to Climate Change Exposures

Community Element		Climate Change Exposure						
		Ambient Temperature	Extreme Heat	Decreased Snowpack	Storms	Flooding	Wildfire Risk	Growing Season / Species Distribution
Functions	Government Continuity	No	Maybe	No	Yes	Yes	Maybe	No
	Water/Sewer/Solid Waste Plant and Delivery	No	Maybe	No	Yes	Yes	Yes	No
	Water Supply	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Energy Delivery	Maybe	Yes	No	Yes	Yes	Yes	No
	Public Safety	No	Maybe	No	Yes	Yes	Yes	No
	Public Health	Maybe	Yes	Maybe	Yes	Yes	Yes	Yes
	Emotional and Mental Health	Maybe	Maybe	Maybe	Maybe	Maybe	Maybe	Maybe
	Business Continuity	No	Maybe	Maybe	Yes	Yes	Yes	Yes
	Housing Access	Maybe	Maybe	No	Yes	Yes	Yes	No
	Employment and Job Access	Maybe	Maybe	Maybe	Yes	Yes	Yes	Yes
	Food Security/Supply	Maybe	Maybe	Maybe	Maybe	Maybe	Maybe	Maybe
	Quality of Life	Maybe	Maybe	Maybe	Maybe	Maybe	Maybe	Maybe
	Social Services	No	Yes	No	Yes	Yes	Yes	No
	Ecological Function	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Tourism and Recreation	Maybe	Yes	Maybe	Yes	Yes	Yes	Yes
	Agriculture, Forest, and Fishery Productivity	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Industrial Operations	Maybe	Maybe	Maybe	Yes	Yes	Yes	No
Structures	Buildings: Residential, Commercial, Industrial, Government, Institutional	Maybe	Maybe	No	Yes	Yes	Yes	No
	Parks and Open Space	Yes	Maybe	Maybe	Yes	Yes	Yes	No
	Recreational Facilities	Maybe	Maybe	Maybe	Yes	Yes	Yes	No
	Transportation Facilities and Infrastructure	Maybe	Yes	No	Yes	Yes	Yes	No
	Lake Oroville Marina	Maybe	Maybe	Maybe	Yes	Yes	Yes	No
	Communication Infrastructure	No	Maybe	Maybe	Yes	Yes	Yes	No
	Dikes and Levees	Maybe	Maybe	Maybe	Yes	Yes	Maybe	No
People	General Population	No	Maybe	No	Yes	Yes	Maybe	Maybe
	Populations that are More Susceptible to Health Risks	Maybe	Yes	Maybe	Yes	Yes	Yes	Yes
	Populations with Limited Resources	Maybe	Yes	Maybe	Yes	Yes	Yes	Maybe

Appendix F contains a brief discussion and justification for the ratings identified for each community element.

Table 5-1 indicates that storms, flooding, and wildfires are likely to have the most widespread impact on community functions, structures, and people within the Oroville area. Although some community elements are more likely to be sensitive to a greater number of climate change effects (e.g., ecological function is sensitive to every effect), this does not imply that the element would necessarily be more severely impacted than an element that is only sensitive to one climate change effect. Accordingly, Table 5-1 provides a starting point for developing Oroville's climate change adaptation plan. The precise location, condition, and use of sensitive elements should be evaluated in consultation with City staff, businesses, and residents to identify effective adaptation strategies and policies.

5.3 Adaptation Strategy Development Framework

This section provides a framework for developing adaptation strategies in consultation with the community. Three important community elements—water supply, public health, and transportation infrastructure—are considered in this section. These elements were selected based on the Local Hazard Mitigation Plan, which identifies the elements as critical to community wellbeing, and Table 5-1, which indicates that these three elements are sensitive to multiple types of climate change exposure. The following information is provided for each element.

- **Description of Community Element**—provides a high-level overview of the element, including essential functions and importance to the community.
- **Sensitivity to Climate Change**—describes the climate change sensitivities (see Table 5-1).
- **Adaptive Capacity**—defines the ability of the element to adjust, repair, and/or respond to damage or climate variability.
- **Adaptation Strategies**—identifies adaptation strategies to decrease local climate change effects.

5.3.1 Water Supply

Description of the Water Supply Element

As previously discussed, the City is served by three domestic water providers—Cal Water, SFWPA, and the TWSD. Water supply for Cal Water is a combination of sources, including purchased water from PG&E and the SWP, as well as local groundwater extracted from aquifers of the Feather River (California Water Service Company 2011). Water delivered by SFWPA and TWSD is primarily sourced from surface water from the South Fork Feather River Watershed and Concow Lake/Wilnore Reservoir, respectively (South Feather Water and Power Agency 2012; Taber 2013). Although a small portion of the City's water supply, Lake Oroville and the Oroville Dam are also the starting point for the SWP. The SWP delivers water to over two-thirds of California's population and 750,000 acres of irrigated land (California Department of Water Resources 2010).

Sensitivity to Climate Change

Climate change could significantly impact water supply in Oroville and across the state. These impacts can cascade across several other community elements. For example, sufficient water supply is critical to local recreation, agriculture, fishing, and tourism. Specific sensitivities to each climate change exposure are further described below.

- **Ambient Temperature**. Increased air temperatures across the state may impact the demand for water from the SWP, as higher temperatures will require more water for agricultural production, industrial, and domestic uses. This could reduce local water availability.
- **Extreme Heat**. Extreme heat will increase the temporary demand for water resources, which could stress local water levels.
- **Increased Flooding**. Extreme flooding could damage the water supply infrastructure or cause downstream damage if it becomes necessary to release large amounts of excess water (above 150,000 cubic feet per second). Additionally, flooding may increase the turbidity and presence of debris in the supply and system.
- **Decreased Snowpack**. The Oroville Dam is fed by the snowpack in the Sierra Nevada mountain range. A decrease in the snowpack will directly impact the availability of water for the SWP and local resources.
- **Increased Storms**. Intense storms increase turbidity in water systems and the likelihood for landslides around these resources. This could increase the processing requirements for potable water resources. Frequent disturbances could disrupt the natural systems in local lakes, rivers, and streams.
- **Fire Risk**. An increased threat and incident of wildfires will add demand for limited water resources across the region, which could impact local water supplies.
- **Growing Season and Species Distribution**. A change in the growing season and species distribution may require more water to aid in adaptation. It could also impact the health of aquatic ecosystems.

Adaptive Capacity

The adaptive capacity of the water system is low. Extreme weather and decreased snowpack may require water management agencies to adjust management practices to accommodate reduced water levels. Water conservation efforts can greatly decrease the demand for water and better fit the available supply. Accordingly, emissions reduction strategies WC-1, *Per Capita Water Use Reduction*, and WC-2, *Recycled Water Use*, will simultaneously help reduce GHG emissions and contribute to the adaptive capacity of the water system.

Adaptation Strategies

Oroville's water supply is a critical asset for the local economy and important to the larger SWP. Local water management must consider the likely impacts of increased temperatures, wildfires, extreme heat, and storms. Table 5-2 summarizes adaptation strategies that can be implemented in addition to WC-1, *Per Capita Water Use Reduction*, and WC-2, *Recycled Water Use*, to improve the resiliency of the water system and decrease the magnitude of future climate change effects.

Table 5-2. Adaptation Strategies for Water Supply

Strategy	Description
Adapt-1. Xeriscaping	Promote water conservation and xeriscaping (i.e., climate appropriate landscaping) through City demonstrations and rebate programs
Adapt-2. Rain Barrels	Encourage the use of rain barrels to decrease runoff and lower the demand for potable water
Adapt-3. Low-Impact Development	Manage rainfall onsite through low-impact development and green infrastructure
Adapt-4. Open Space	Utilize open space in the floodplain with "safe-to-fail" infrastructure that can withstand periodic inundation that does not cause runoff that contaminates the water supply
Adapt-5. Slope Stability	Assess and reinforce the stability of slopes in forested areas that are likely to be deforested during wildfires
Adapt-6. Mapping Revisions	Complete timely revisions of floodplain maps
Adapt-7. Channel Restoration	Identify areas with channel erosion (such as the tributaries of Dry Creek) and develop restoration projects
Adapt-8. Infrastructure Planning	Assess drainage concerns in Oroville and update infrastructure plans to accommodate increased development and periods of increased runoff caused by extreme weather
Adapt-9. Regional Planning	Incorporate climate change projections into regional plans, including but not limited to the *Oroville 2030 General Plan*, *2014 Butte County Local Hazard Mitigation Plan*, *Butte County Flood Mitigation Plan*, *City of Oroville Design Guidelines*, and the *City of Oroville's Fire Hazard Objectives and Implementing Policies.*
Adapt-10. Agricultural Practices	Research and promote water-saving agricultural practices that will be successful under projected climatic conditions

5.3.2 Public Health

Description of Public Health Element

Oroville has a robust public health system. It includes hospitals, a network of community healthcare facilities, and emergency responders, including a fire department with 18 full time personnel, five support volunteers, and two interns.

Demographics and socioeconomics play important roles in access to public health. According to the U.S. Census (2014), approximately 8% of the population is below the age of 5 and 12% is over the age of 65. Nearly 17% of the population speaks a language other than English. Over half of the population lives in rental units, and a quarter of the population lives below the poverty line.

Sensitivity to Climate Change

Changes in the local climate can have significant and far-reaching public health consequences throughout the City. Sensitive populations—such as children, the elderly, and people with illnesses—are typically the most vulnerable to climate change effects, due to preexisting health or socioeconomic conditions. For example, individuals with limited mobility may be unable to evacuate during a flood or wildfire. People who do not speak English may also be at greater risk if they are unable to read or understand public service announcements. Likewise, people with limited income may not have the capacity to implement preventative strategies such as installing air conditioning or elevating structures above the flood zone.

The climate change exposures discussed in Section 5.2.1 have the potential to affect public health and community well-being in the following ways (Centers for Disease Control and Prevention 2010).

- **Ambient Temperature**. Increased average ambient temperatures could worsen preexisting cardiovascular and respiratory diseases due to both heat and deteriorating air quality.
- **Extreme Heat**. Extreme heat events increase the risk of heat-related illness (like heat rash) and death (like heat stroke).
- **Increased Flooding**. Flooding can cause direct physical harm to people, especially if the onset of the flood is rapid and there is insufficient time to evacuate. Hospitals and care facilities may experience an increase in emergency room visits during a major flood. If water and sewer facilities are damaged, additional strain may be placed on the public health facilities.
- **Decreased Snowpack**. A decreased snowpack is likely to threaten the availability of water and could impact the presence of waterborne diseases.
- **Increased Storms**. Intense storms could increase the risk of personal injury.
- **Fire Risk**. Wildfires could deteriorate air quality and worsen preexisting respiratory diseases as well as threaten lives and property.
- **Growing Season and Species Distribution**. A shift in the growing season may increase the risk of malnutrition and hunger from food shortages and rising agricultural prices. A shift in species distribution may increase the risk and/or prevalence of vector-borne and zoonotic (trans-species) diseases like West Nile Virus.

Ultimately, deteriorating air quality, wildfires, increase in vector-borne and water-borne diseases, and extreme weather could lead to an overall increased need for emergency response to address rising public health concerns. The stress related to coping with the health or socioeconomic impacts of climate change may also impact the emotional and mental health of residents.

Adaptive Capacity

Many of the emissions reduction strategies outlined in the CAP will provide a healthier and more sustainable way of living. For example, strategies designed to reduce vehicle trips and improve the transportation network can also improve air quality by reducing vehicle congestion and fossil fuel combustion. Strategies that promote alternative modes of transportation can also create opportunities to increase physical activity through walking and biking. Similarly, strategies to support local food systems can supplement healthy lifestyles throughout the community by improving access to nutritious and locally grown foods.

Some populations have a higher adaptive capacity than others. For example, healthy adults with access to disposable income will be able to more easily adjust habits and purchasing to adapt to changing conditions. Additionally, the public health system in Oroville can adjust practices to ensure that emerging health threats and extreme events are adequately addressed. Overall, the adaptive capacity of the public health system is moderate.

Adaptation Strategies

The public health benefits provided by the CAP make climate action planning a mutually beneficial strategy for reducing GHG emissions and for improving community well-being. Additional adaptation strategies to support public health are summarized in Table 5-3.

Table 5-3. Adaptation Strategies for Public Health

Strategy	Description
Adapt-11. Disease Tracking	Increase research and tracking for water-borne, air-borne, and vector-borne diseases that may not have posed a threat in the region in the past. Shifts in the growing season, poor air quality, and contaminated water may introduce new diseases for which the public health system is unprepared
Adapt-12. Warning Alert Systems	Improve warning alert systems and public service announcements. Oroville should evaluate its emergency announcement systems to make sure that vulnerable populations receive early warning for heat advisories, wildfires, and storms
Adapt-13. Public Shelters	Identify public buildings that can be used as shelters and cooling centers
Adapt-14. Education and Outreach	Provide information about health concerns—emerging diseases, prevention, care, and how to cope with extreme heat
Adapt-15. Sustainable Building Materials	Use cool roofs, green roofs, and cool pavement to decrease ambient temperatures and the need for air conditioning during hot weather

5.3.3 Transportation Infrastructure

Description of the Transportation Infrastructure Element

Roadway, public transit, railroad, and aviation systems provide the transportation network for the movement of people and freight in the city. Highways 70 and 162 are the primary intercity and regional transportation corridors. The City's public transit system consists of bus services, shuttle services, taxi services, and park-and-ride facilities; however, this system has low service frequency and low average daily ridership because the automobile is the primary mode of transportation in Oroville. Commercial intercity bus service is provided by Greyhound, and the Greyhound Bus Station is identified as a critical facility in the *Butte County Flood Mitigation Plan*. Oroville is served by the Union Pacific Railroad, which runs the Feather River Corridor line that serves on average 6–26 trains per day. Aviation transportation is served by the Oroville Municipal Airport, which serves on average about 99 aircraft per day.

Transportation infrastructure is critical; its failure could affect most community services and populations.

Sensitivity to Climate Change

According to the *2007 Butte County Multi-Jurisdictional All-Hazard Pre-Disaster Mitigation Plan*, a number of main roads in Oroville are vulnerable to flooding, including Bridge Street, Foothill Boulevard, Lincoln Street, Montgomery Street, Orange Avenue, Table Mountain Boulevard, and Washington Avenue. All of these roads except for Table Mountain Boulevard are also at risk from dam failure. Foothill Boulevard and Table Mountain Boulevard are vulnerable to wildfires and landslides. The 2007 Disaster Plan and 2014 Local Hazard Mitigation Plan also identify the Oroville Municipal Airport as being at risk of flooding, dam failure, wildfires, and landslides. The Feather River Corridor rail line is also vulnerable to flooding due to its location by the river.

Climate change is projected to exacerbate existing risks, as further described below.

- **Ambient Temperature**. Higher temperatures will result in greater need for cooling in vehicles and terminals, increasing water and energy demand.

- **Extreme Heat**. An increase in the frequency and intensity of extreme heat events can cause more rapid deterioration of road and runway asphalt. Extreme high temperatures can also expand and buck railway tracks and joints, as well as overheat electrical systems and communications equipment.
- **Increased Flooding**. Increased risk of flooding can damage transportation infrastructure and disrupt travel. For example, heavy precipitation events can cause flooding of roadways, flooding of railway tracks and stations, washout of rail track supports (ballast), and closures of airport runways.
- **Decreased Snowpack**. It is unlikely that a decrease in the snowpack will negatively impact the transportation infrastructure.
- **Increased Storms**. Increased frequency and intensity of storms can increase the risk of landslides causing damage to the transportation system.
- **Wildfire Risk**. Increased wildfire risk can increase disruption of transportation services. Smoke from wildfires can reduce visibility, leading to closures of roadways, railways, and airports. Wildfires can also directly damage transportation structures if flames get too close.
- **Growing Season and Species Distribution**. Transportation infrastructure will not be affected by a shift in the growing season or species distribution.

Adaptive Capacity

The adaptive capacity for transportation resources varies by asset type and condition. For example, vehicles operating on the public transportation network may be able to be easily relocated during a flood event. However, the adaptive capacity of fixed infrastructure—such as roads, airport runways, and rail tracks—varies, depending in part on the type of material used during construction. For example, different mixes of asphalt pavements are suited for high temperatures, and other mixes minimize cracking under low temperatures. Materials that can withstand extreme heat and periodic inundation will have a greater capacity to withstand a shift towards a warmer climate. Redundancy can be another form of existing adaptation in transportation systems. For example, services and infrastructure that can be used as alternatives to damaged infrastructure increase the City's ability to accommodate disruptions to the transportation network.

The City has secured funding to widen a 2.7-mile stretch of Highway 70 from two to four lanes from Highway 162 through the Highway 70/Ophir Road intersection. The City is also planning to expand a number of local roadways. Strategies to improve public transit and regional mobility are also outlined in BCAG's regional transportation plan. These expansions can increase the adaptive capacity of the roadway system through improvements in design and materials and by providing alternative routes. The adaptive capacity of Oroville's aviation system is low, as Oroville Municipal Airport is the only airport in the city.

Adaptation Strategies

The Oroville transportation network is a critical asset for the local economy. It is therefore important that local management considers the likely impacts of increased temperatures, wildfires, floods, and landslides. Implementation of the land use and transportation strategies will improve public transportation, mobility, and access throughout Oroville, which could facilitate community evacuation during disaster events. Table 5-4 outlines additional adaptation strategies that may reduce the severity of these climatic change effects. Many of these strategies are consistent with recommendations from the *Butte County Multi-Hazards Mitigation Plan*.

Table 5-4. Adaptation Strategies for Transportation Infrastructure

Strategy	Description
Adapt-16. Tracking Metrics	Develop tracking metrics to understand the impacts of weather events on the transportation system and to inform future strategies; metrics may include the frequency, causes, and costs of weather-related disruptions as well as the response to those disruptions
Adapt-17. Drainage Capacity	Increase drainage capacity by improving retention basins and storm runoff system to protect transportation infrastructure from flooding
Adapt-18. Emergency Service Access	Construct roads and bridges for increased water service access to help combat wildfire
Adapt-19. Weed Abatement	Expand weed abatement to reduce the impact of wildfire to transportation infrastructure
Adapt-20. Evacuation Programs	Improve public notification and evacuation programs during extreme events
Adapt-21. Construction materials	Use flexible, expandable materials in railway systems and improved asphalt/ concrete mixtures for roads and runways to reduce the impact of extreme heat events
Adapt-22. Maintenance Activities	Shorten maintenance periods to accommodate changes in temperature and precipitation
Adapt-23. Redundancy	Develop redundant services to accommodate disruptions, taking into consideration the costs of building redundancy into the system versus the benefits of reducing impacts from extreme weather events
Adapt-24. Siting Risk	Consider flooding, wildfire, and landslide risks when siting new transportation structures; incorporate climate change information into the design of new transportation assets

5.4 Climate Change Adaptation Plan Development and Implementation

The preceding sections identify vulnerabilities and suggest adaptation strategies for three critical community elements—water supply, public health, and transportation infrastructure—and offer a framework for developing locally relevant strategies for other community elements. This section describes the processes for expanding this initial analysis into a robust climate change adaptation plan that can be integrated into existing local planning and preparedness activities.

5.4.1 CAP Implementation Team (CIT)

As discussed in Chapter 4, *Emissions Reduction Implementation Program*, the CIT will lead and coordinate implementation of the emissions reduction strategies. In concert with these activities, the CIT will provide guidance and support for developing and implementing the climate change adaptation strategies and larger climate change adaptation plan. As previously discussed, Table 5-1 provides an initial assessment of critical elements that should subsequently undergo comprehensive review with public input. The CIT can build on this analysis and coordinate with regional and community partners, as described further in Section 5.4.2, to develop targeted adaptation strategies for other community elements that will be exposed to climate change effects.

The CIT will be responsible for selecting the most appropriate adaptation strategies for Oroville and identifying the staff and agencies that will implement those strategies. The framework provided in Section 5.3 and Section 5.4.3 for water supply, public health, and transportation infrastructure can be used as an initial template to develop and prioritize adaptation strategies. Implementation programs for each selected strategy that include specific milestones, deadlines, funding opportunities, partners, and public outreach will be developed and coordinated by the CIT.

5.4.2 Community and Stakeholder Outreach

Community and stakeholder input are critical for defining how the community will be affected by climate change. Public feedback is also necessary to develop effective adaptation strategies that can be seamlessly integrated into everyday life. The City will collaborate with local businesses, community groups, residents, developers, and property owners to solicit feedback on climate change exposures and potential adaptation strategies. Periodic meetings will be held to receive input and update the public on adaptation plan development. Outreach activities will be similar to those conducted for emissions reduction strategies identified in the CAP and may include flyers, emails, targeted meetings, and online media.

In addition to engaging the public and targeted industry groups, there are several regional partners that could assist in the development and implementation of the adaptation strategies. The City will coordinate with the following partners to explore opportunities to leverage resources and support for overall adaptation strategy implementation.

- **Butte County Health Department**. The Butte County Health Department is responsible for ensuring that health services are available and accessible. The City will work with department staff on development and implementation of adaptation strategies related to public health. The City will also coordinate with the department on emergency response and resource planning to address future shifts in temperature, air quality, disease vectors, and storms.
- **Butte County and Neighboring Cities**. Butte County prepares a number of regional plans, including the *Butte County Flood Mitigation Plan* and the *Butte County Multi Hazards Mitigation Plan*. The City will coordinate with the County to promote regional collaboration, ensure that climate projections will be considered in regional planning efforts, and advocate for the adoption of adaptation strategies that increase regional resiliency.
- **Butte County Office of Emergency Management**. The Office of Emergency Management is responsible for preparing the County for extreme events. The City will coordinate local emergency response strategies with the County to potentially leverage resources and increase regional cohesion.
- **California Department of Forestry and Fire Protection (CAL FIRE)**. CAL FIRE is responsible for protecting protect people and property within California from wildfires. CAL FIRE may also assist or take the lead on emergency response to other disasters, such as flooding and earthquakes. The City will collaborate with CAL FIRE to address the growth threat of local wildfires. The City works directly with CAL FIRE, as they are contracted by Butte County to provide fire services for the entire County.
- **California Department of Transportation (Caltrans)**. Caltrans is responsible for State highways and freeways, including Highway 70 and State Route 162 in Oroville. The City will coordinate closely with Caltrans to avoid climate-related closures and damage to State roadways.

- **Domestic Water Providers**. The City will work with the three local water service providers to promote implementation of adaptation options associated with the water supply.

5.4.3 Strategy Evaluation and Prioritization

Evaluating and prioritizing adaptation strategies are critical for managing and allocating resources efficiently and economically. Table 5-5 provides an evaluation template for the three elements evaluated in Section 5.3. The following information is considered in the table, although the City can modify and expand the parameters as needed to support local planning efforts.

- **Climate Exposure and Vulnerability Addressed**. In Table 5-1, these columns identify the primary climate exposure and vulnerability addressed by the strategy. It should be noted that some adaptation strategies may address multiple exposures and vulnerabilities. For example, managing rainfall onsite as part of Adapt-3, *Low-Impact Development,* can help increase infiltration and also address the vulnerability in the water supply.
- **Cost and Benefit**. Ratings for implementation costs and benefits associated with each strategy are shown. Implementation costs would be incurred by the City and range from relatively low costs (like those associated with administrative changes) to relatively high costs (like those associated with changes to major infrastructure projects). Accordingly, costs are ranked into low, medium, and high categories. Community benefits are also rated as low, medium, and high; strategies with low ratings would have localized benefits, and strategies with high ratings would have more widespread benefits. Generally speaking, a strategy's cost rating is equal to or lower than its benefit rating. For example, the City could implement Adapt-1, *Xeriscaping*, in part by creating and promoting demonstration gardens. This type of program would require the City to allocate staff hours to publicize the program, but it would not require changes in major infrastructure (cost = L), and the community benefit would be realized at the parcel or neighborhood scale (benefit = L–M). Conversely, increasing citywide drainage capacity under Adapt-17, *Drainage Capacity*, may require significant infrastructure investment (cost = M–H), but this action would benefit larger portions of the community (benefit = H).

Table 5-5. Evaluation Framework for Climate Change Adaptation Strategies

Strategy	Climate Exposure Addressed	Vulnerability Addressed	Cost[a]	Benefit[b]
Adapt-1. Xeriscaping	Snowpack	Water Supply	L	L–M
Adapt-2. Rain Barrels	Snowpack	Water Supply	L	L
Adapt-3. Low-Impact Development	Snowpack; Storms	Water Supply; Buildings	L	M
Adapt-4. Open Space	Storms	Water Supply; Buildings	M	M
Adapt-5. Slope Stability	Wildfires; Storms	Water Supply; Buildings	M–H	M–H
Adapt-6. Mapping Revisions	Storms	Water supply; Buildings; People	M	M–H
Adapt-7. Channel Restoration	Storms; Wildfires	Water Supply; Buildings; People	M	M–H
*Adapt-8. Inf*rastructure Planning	Storms; Wildfires	Water Supply; Infrastructure	M–H	M–H
Adapt-9. Regional Planning	All climate exposures	All vulnerabilities	L–M	M–H
Adapt-10. Agricultural Practices	All climate exposures	Water Supply; Food Security; Ag, Forest, and Fishery Production	L–H	M–H
Adapt-11. Disease Tracking	Species Distribution	People	M	M–H
Adapt-12. Warning Alert Systems	Heat; Storms; Flooding; Wildfire	People	M	M–H
Adapt-13. Public Shelters	Heat; Storms; Flooding; Wildfire	People	L	M–H
Adapt-14. Education and Outreach	Heat; Storms; Flooding; Wildfire; Species Distribution	People	L	M–H
Adapt-15. Sustainable Building Materials	Temperatures; Heat	People	L	L–H
Adapt-16. Tracking Metrics	Temperatures; Heat; Storms; Flooding; Wildfire	Transportation Infrastructure; Buildings	L	M–H
Adapt-17. Drainage Capacity	Storms; Flooding	Transportation Infrastructure; Buildings	M–H	H
Adapt-18. Weed Abatement	Wildfire	Transportation Infrastructure; Buildings	L–M	L–H
Adapt-19. Evacuation Programs	Storms; Flooding; Wildfire	People	L	M
Adapt-20. Construction Materials	Temperatures; Heat; Storms; Flooding; Wildfire	Transportation Infrastructure; Buildings	M	M–H
Adapt-21. Maintenance Activities	Temperatures; Storms; Flooding	Transportation Infrastructure; Buildings	M	M–H
Adapt-22. Redundancy	Heat; Storms; Flooding; Wildfire	Transportation Infrastructure	L–H	M–H
Adapt-23. Siting Risk	Heat; Storms; Flooding; Wildfire	Transportation Infrastructure; Buildings	L–H	M–H

Notes:
[a] *Cost* refers to the City's implementation cost—ratings are low (L), medium (M), and high (H).
[b] *Benefit* refers to community benefit—ratings are low (L), medium (M), and high (H).

The CIT will use the template provided in Table 5-5 as a starting point to evaluate and prioritize all adaption strategies. Prioritization will strive to balance costs, benefits, and overall effectiveness with respect to climate change adaptation. Low cost initiatives with high community benefits will be implemented first, followed by higher-cost strategies that require long-term infrastructure improvements. The CIT will coordinate with the community and regional stakeholders when finalizing the strategy prioritization framework.

5.4.4 Financing Strategies

Several adaptation strategies can be integrated into existing processes and decision-making with minimal to no additional cost. Likewise, strategies that require significant upfront investment may contribute to long-term cost savings through increased preparedness and disaster response. Federal and State funding may also be available to offset costs. For example, the Federal Emergency Management Agency's Community Rating System provides incentives for community floodplain management activities. The Centers for Disease Control and the California Department of Public Health also offer financing for projects that improve air quality and public health. Private funding may also be available through the Rockefeller Foundation's Resilient Cities program.

In addition to securing funding for adaptation projects, the City will also look for opportunities to integrate adaptation concepts into funding applications for existing projects. Partnering with local academic institutions, such as Butte College and/or California State University, Chico, may also help leverage resources and advance adaptation planning. For example, the college and/or university may be able to sponsor an adaptation study or pilot project. The CIT will be responsible for identifying funding and partnering opportunities.

5.4.5 Phasing and Scheduling

Implementation of the adaptation strategies will be phased to best integrate new policies and projects into the City's decision-making process. The City of Oroville Fire, Police, Public Works, and Community Development Departments will play integral roles in managing applicable adaptation strategies. The CIT will also coordinate efforts with local and regional agencies. Key priorities for the four implementation phases are described below.

Phase 1—Climate Change Adaptation Plan

The City will choose a set of climate scenarios that will inform the adaptation plan and future planning activities. The forecasts presented in Section 5.1 may be sufficient to support initial activities. However, the City may wish to invest in more localized models to provide more robust and comprehensive climate predictions for the Oroville area. The City will finalize the adaptation plan and strategies for reducing local climate change effects on critical community elements.

Phase 2—Planning Framework

The adaptation strategies will be evaluated and prioritized (see Section 5.4.3) in terms of cost, community benefits, and required resources to support implementation. The City will also review existing emergency management and land use planning documents to identify revisions or updates needed to integrate climate change adaptation concepts. Existing data tracking and monitoring practices conducted by the City and local agencies will also be reviewed to identify opportunities to integrate climate data. For example, the Butte County Health Department may add tracking measures to identify correlations between climate factors and disease outbreaks, emergency room visits, and extreme heat related illnesses. Finally, the CIT will establish a long-term planning framework to support implementation and monitoring of the adaptation strategies.

Phase 3—Priority Strategies

The City will implement low cost initiatives and strategies with high community benefits. Low cost initiatives, such as promoting the use of rain barrels (Adapt-2) and preparing public shelters (Adapt-13), can be implemented through improved communications and coordination. Because the primary cost associated with these strategies is staff time, they can be implemented relatively quickly with low costs. Additionally, State and federal funding may be available to implement strategies that yield high community benefits (e.g., Adapt-5).

Phase 4—Long-Term Infrastructure

As is feasible, the City will implement higher-cost strategies that require long-term infrastructure improvements. These strategies will typically include large projects with high upfront investment, such as expanding the drainage infrastructure capacity (Adapt-17). Large long-term projects may require additional funding and should be completed in conjunction with existing infrastructure planning processes.

While these four primary phases have been identified to support implementation of the climate change adaptation plan, long-term management will require some flexibility. Funding for any particular project or set of projects may become available at any time through outside organizations or federal or State programs. Similarly, external events may heighten the need for immediate implementation of some projects. For example, it is likely that resources will be available for water conservation during a time of drought, and Oroville will be prepared to take advantage of those opportunities as they arise.

Chapter 6

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Appendix A
Relevant Greenhouse Gas Legislation and Regulations

This appendix provides additional information federal, State, and regional Greenhouse Gas (GHG) legislation applicable to the City of Oroville's (City's) efforts to reduce GHG emissions and implement the City's Climate Action Plan (CAP). Figure A-1 displays a timeline of key regulatory activity.

Federal Legislation

Although there is currently no federal overarching law specifically related to climate change or the reduction of GHGs, regulation under the federal Clean Air Act (CAA) is underway with the U.S. Environmental Protection Agency (EPA) in a lead role. Although periodically debated in Congress, no federal legislation concerning GHG limitations is likely in the foreseeable future, and the current administration is presently only focused on executive branch action using existing authorities.

Massachusetts, et al. vs. U.S. Environmental Protection Agency (2007)

Twelve U.S. states and cities, including California, in conjunction with several environmental organizations, sued to force EPA to regulate GHGs as a pollutant pursuant to the 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.

United States Environmental Protection Agency Endangerment Finding (2009)

In its Endangerment Finding, the EPA Administrator found that GHGs in the atmosphere threaten the public health and welfare of current and future generations. The Administrator also found that the combined emissions of GHGs from new motor vehicles and new motor vehicle engines contribute to the GHG pollution that threatens public health and welfare. Although the Endangerment Finding does not place requirements on industry, it was an important step in EPA's process to develop regulation. This measure was a prerequisite to finalizing EPA's proposed GHG emission standards for light-duty vehicles.

United States Environmental Protection Agency Cause or Contribute Finding (2010)

In its Cause or Contribute Finding, the EPA Administrator found that the combined emissions of GHGs from new motor vehicles and new motor vehicle engines contribute to the GHG pollution that threatens public health and welfare (U.S. Environmental Protection Agency 2010).

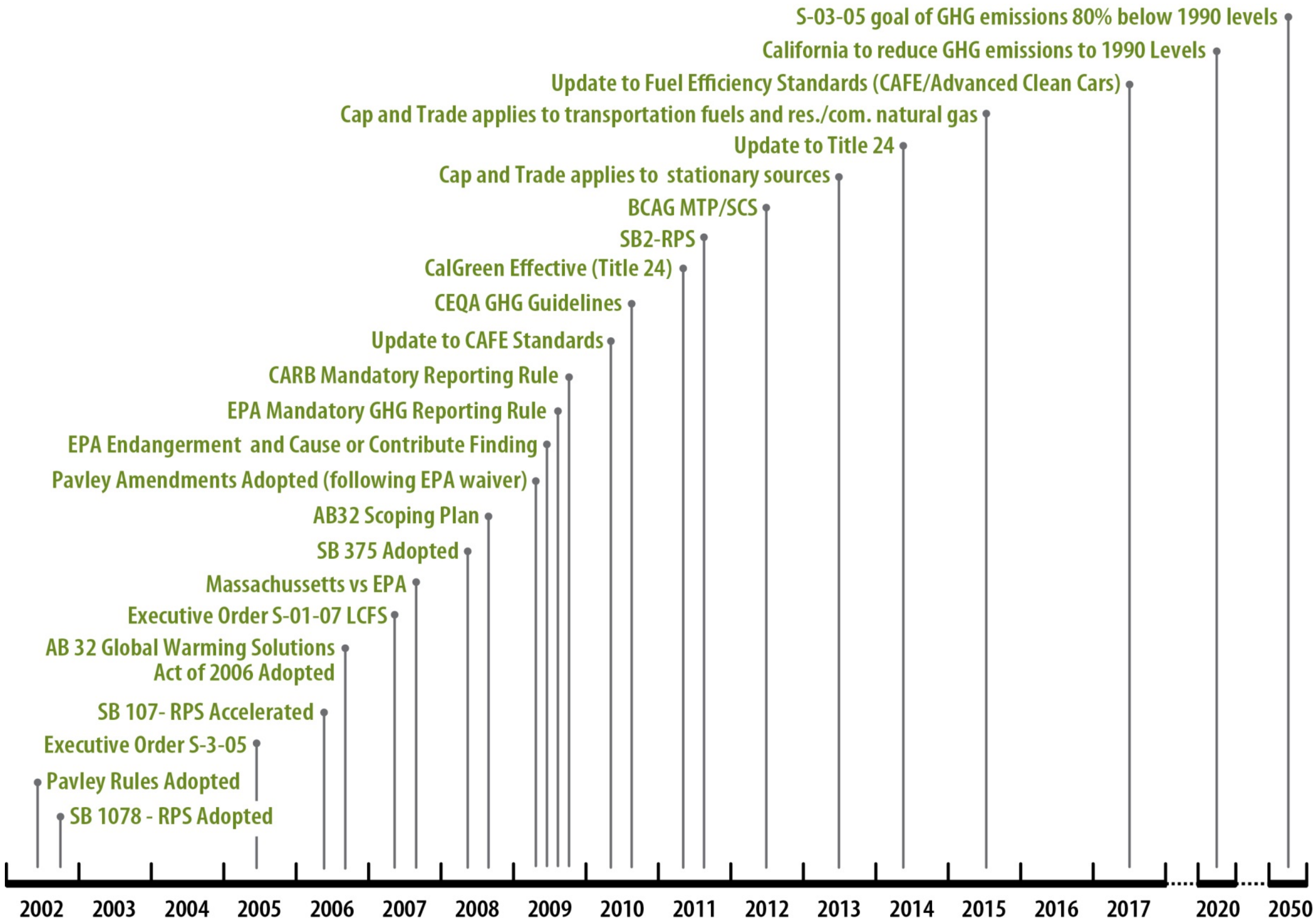

Figure A-1. Key Milestones in Climate Legislation

United States Environmental Protection Agency Mandatory Reporting Rule for GHGs (2009)

Under the Mandatory Reporting Rule, suppliers of fossil fuels, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons of carbon dioxide equivalent ($MTCO_2e$) or more of GHGs per year are required to report annual emissions to the EPA. The mandatory reporting rule does not limit GHG emissions but establishes a standard framework for emissions reporting and tracking of large emitters (U.S. Environmental Protection Agency 2010).

Update to Corporate Average Fuel Economy Standards (2010/2012)

The current Corporate Average Fuel Economy (CAFE) standards (for model years 2011–2016) incorporate stricter fuel economy requirements promulgated by the federal government and California into one uniform standard. Additionally, automakers are required to cut GHG emissions in new vehicles by roughly 25% by 2016 (resulting in fleet average of 35.5 miles per gallon [mpg] by 2016). Rulemaking to adopt these new standards was completed in 2010. California agreed to allow automakers who show compliance with the national program to also be deemed in compliance with State requirements. The federal government issued new standards in 2012 for model years 2017–2025, which will require a fleet average in 2025 of 54.5 mpg.

EPA Regulation of Stationary Sources under the Clean Air Act (2010 and Ongoing)

Pursuant to its authority under the CAA, the EPA has been developing regulations for new stationary sources such as power plants, refineries, and other large sources of emissions. Pursuant to the 2013 *President's Climate Action Plan*, the EPA will be directed to also develop regulations for existing stationary sources.

State Legislation

California has adopted statewide legislation addressing various aspects of climate change and GHG emissions mitigation. Much of this legislation is not directed at citizens or jurisdictions specifically, but rather establishes a broad framework for the State's long-term GHG reduction and climate change adaptation program. The prior and current governors have also issued several executive orders related to the State's evolving climate change policy. Of particular importance to local governments is the direction provided by the AB 32 scoping plan, which recommends local governments reduce their GHG emissions by a level consistent with State goals.

Summaries of key policies, legal cases, regulations, and legislation at the federal and State levels that are relevant to the City are provided below. Figure A-1 displays a timeline of key State and federal regulatory activities.

Executive Order S-03-05 (2005)

Executive Order (EO) S-03-05 established the following GHG emission reduction targets for California's State agencies.

- By 2010, reduce GHG emissions to 2000 levels.
- By 2020, reduce GHG emissions to 1990 levels.
- By 2050, reduce GHG emissions to 80% below 1990 levels.

Executive orders are binding only on State agencies. Accordingly, EO S-03-05 will guide State agencies' efforts to control and regulate GHG emissions but will have no direct binding effect on local government or private actions. The Secretary of the California Environmental Protection Agency (CalEPA) is required to report to the Governor and State legislature biannually on the impacts of global warming on California, mitigation and adaptation plans, and progress made toward reducing GHG emissions to meet the targets established in this executive order.

Assembly Bill 1493—Pavley Rules (2002, Amendments 2009, 2012 rule-making)

Known as *Pavley I*, Assembly Bill (AB) 1493 standards are the nation's first GHG standards for automobiles. AB 1493 requires the California Air Resources Board (ARB) to adopt vehicle standards that will lower GHG emissions from new light duty autos to the maximum extent feasible beginning in 2009. Additional strengthening of the Pavley standards (referred to previously as *Pavley II* and now referred to as the *Advanced Clean Cars* measure) has been proposed for vehicle model years 2017–2025. Together, the two standards are expected to increase average fuel economy to roughly 43 mpg by 2020 and reduce GHG emissions from the transportation sector in California by approximately 14%. 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.

EPA and ARB have worked together on a joint rulemaking to establish GHG emissions standards for model-year 2017–2025 passenger vehicles. As noted above, the federal government completed rulemaking in 2012 that resulted in the adoption of new standards that would lead to a fleet average of 54.5 mpg in 2025. Also in 2012, ARB strengthened its Zero Emission Vehicle (ZEV) program to require 15% of automakers' annual new vehicle sales in California to be ZEV or transitional-ZEV by 2025.[1]

Senate Bills 1078/107 and Senate Bill 2 (2011)—Renewables Portfolio Standard

Senate Bills (SB) 1078 (2002), 107 (2006) and 2 (2011), California's Renewables Portfolio Standard (RPS), obligates investor-owned utilities (IOUs), energy service providers (ESPs), and Community Choice Aggregators (CCAs) to procure additional retail sales per year from eligible renewable sources with the long-range target of procuring 33% of retail sales by 2020. The California Public Utilities Commission (CPUC) and California Energy Commission (CEC) are jointly responsible for implementing the program.

[1] These categories include all-battery electric vehicles, plug-in hybrid electric vehicles, hydrogen fuel cell vehicles, and hydrogen internal combustion vehicles.

Assembly Bill 32—California Global Warming Solutions Act (2006)

AB 32 codified the State's GHG emissions target by requiring that the State's global warming emissions be reduced to 1990 levels by 2020. Since being adopted, ARB, CEC, CPUC, and the Building Standards Commission have been developing regulations that will help meet the goals of AB 32 and EO S-03-05. The Scoping Plan for AB 32 identifies specific measures to reduce GHG emissions to 1990 levels by 2020, and requires ARB and other State agencies to develop and enforce regulations and other initiatives for reducing GHGs. Specifically, the Scoping Plan articulates a key role for local governments, recommending they establish GHG reduction goals for both their municipal operations and the community consistent with those of the State.

The AB 32 Scoping Plan establishes a framework for achieving statewide GHG reductions required by AB 32. Specifically, the scoping plan describes a list of measures that the State will undertake, and the anticipated GHG reductions associated by these measures, by 2020. Because the State does not have jurisdictional control over all of the activities that produce GHG emissions in California, the AB 32 Scoping Plan articulates a unique role for local governments in achieving the State's GHG reduction goals.

Executive Order S-01-07—Low Carbon Fuel Standard (2007)

EO S-01-07 essentially mandates that (1) a statewide goal be established to reduce the carbon intensity of California's transportation fuels by at least 10% by 2020 and (2) a Low Carbon Fuel Standard (LCFS) for transportation fuels be established in California.[2]

Senate Bill 375—Sustainable Communities Strategy (2008)

SB 375 provides for a new planning process that coordinates land use planning, regional transportation plans, and funding priorities in order to help California meet the GHG reduction goals established in AB 32. SB 375 requires regional transportation plans, developed by metropolitan planning organizations (MPOs) to incorporate a sustainable communities strategy (SCS) in their regional transportation plans (RTPs). The goal of the SCS is to reduce regional vehicle miles traveled (VMT) through land use planning and consequent transportation patterns. The regional targets were released by ARB in September 2010. SB 375 also includes provisions for streamlined California Environmental Quality Act (CEQA) review for some infill projects such as transit-oriented development.

The Butte County Association of Governments' (BCAG's) *2012 Metropolitan Transportation Plan* includes the region's SCS and was adopted on December 13, 2012.

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[2] The ARB approved the LCFS on April 23, 2009 and the regulation became effective on January 12, 2010. The U.S. District Court for the Eastern District of California ruled in December 2011 that the LCFS violates the Commerce Clause of the U.S. Constitution. The ARB appealed this ruling in 2012 and on September 18, 2013, a 9th U.S. Circuit Court of Appeals panel upheld the LCFS, ruling that the program does not violate the Commerce Clause and remanded the case to the Eastern District.

California Energy Efficiency Standards for Residential and Nonresidential Buildings—Green Building Code (2011), Title 24 Update (2014)

California has adopted aggressive energy efficiency standards for new buildings and has been continually updating them for many years. In 2008, the California Building Standards Commission adopted the nation's first green building standards, which include standards for many other built environment aspects apart from energy efficiency. The California Green Building Standards Code (proposed Part 11, Title 24) was adopted as part of the California Building Standards Code (24 California Code of Regulations [CCR]). Part 11 establishes voluntary standards that became mandatory in the 2010 edition of the code, including planning and design for sustainable site development, energy efficiency (in excess of the California Energy Code requirements), water conservation, material conservation, and internal air contaminants. The current energy efficiency standards were last adopted in 2013 and took effect on January 1, 2014. The standards are planned to be updated periodically in the future.

California Air Resources Board Greenhouse Gas Mandatory Reporting Rule Title 17 (2009)

In December of 2007, ARB approved a rule requiring mandatory reporting of GHG emissions from certain sources, pursuant to AB 32. Facilities subject to the mandatory reporting rule must report their emissions from the calendar year 2009 and have those emissions verified by a third party in 2010. In general the rule applies to facilities emitting more than 25,000 $MTCO_2e$ in any given calendar year or electricity generating facilities with a nameplate generating capacity greater than 1 megawatt (MW) and/or emitting more than 25,000 $MTCO_2e$ per year. Additional requirements also apply to cement plants and entities that buy and sell electricity in the state.

State of California Environmental Quality Act Guidelines (2010)

The State CEQA Guidelines require lead agencies to describe, calculate, or estimate the amount of GHG emissions that would result from a project. Moreover, the State CEQA Guidelines emphasize the necessity to determine potential climate change effects of the project and propose mitigation as necessary. The State CEQA Guidelines confirm the discretion of lead agencies to determine appropriate significance thresholds, but require the preparation of an environmental impact report (EIR) if "there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding compliance with adopted regulations or requirements" (Section 15064.4).

The guidelines were updated in 2010 to address GHG emissions. State CEQA Guidelines section 15126.4 includes considerations for lead agencies related to feasible mitigation measures to reduce GHG emissions, which may include, among others, measures in an existing plan or mitigation program for the reduction of emissions that are required as part of the lead agency's decision; implementation of project features, project design, or other measures which are incorporated into the project to substantially reduce energy consumption or GHG emissions; offsite measures, including offsets that are not otherwise required, to mitigate a project's emissions; and, measures that sequester carbon or carbon-equivalent emissions.

GHG Cap-and-Trade Program (2013)

On October 20, 2011, ARB adopted the final cap-and-trade program for California. The California cap-and-trade program will create a market-based system with an overall emissions limit for affected sectors. The program is currently proposed to regulate more than 85% of California's emissions and will stagger compliance requirements according to the following schedule: (1) electricity generation and large industrial sources (2013); (2) fuel combustion and transportation (2015). The first auction occurred in late 2012 with the first compliance year in 2013.

Sustainable Groundwater Management Act (2014)

The Sustainable Groundwater Management Act of 2014 (SGMA) provides a framework for sustainable management of groundwater supplies by local authorities. The act requires local groundwater sustainability agencies to assess groundwater conditions and adopt locally-based management plans. While the primary purpose of the SGMA is not GHG emissions reduction, the plan includes investments for water conservation, water recycling, and expanded water storage, all of which will contribute to indirect emissions reductions in the water sector. The plan is intended to increase the reliability of the California water supply over the next 20 years.

Regional Regulation

Butte County Air Quality Management District

The AB 32 Scoping Plan does not provide an explicit role for local air districts with respect to implementing AB 32, but it does state that the ARB will work actively with air districts in coordinating emissions reporting, encouraging and coordinating GHG reductions, and providing technical assistance in quantifying reductions. The ability of air districts to control GHG emissions is provided primarily through permitting, as well as through their role as a CEQA lead or commenting agency, the establishment of CEQA thresholds, and the development of analytical requirements for CEQA documents.

The Butte County Air Quality Management District (BCAQMD) has jurisdiction over local air quality in Butte County. BCAQMD has not adopted rules or regulations establishing limits on GHG emissions from specific projects or thresholds of significance for GHG emissions at the project level. While the BCAQMD's *CEQA Air Quality Handbook* does include a brief discussion about consistency with AB 32, the District only recommends that a qualitative discussion of GHGs be included for air quality analyses of "sizable projects"(Butte County Air Quality Management District 2008).

Butte County Association of Governments

BCAG is the federally designated MPO for Butte County. BCAG develops regional plans for transportation, growth management, hazardous waste management, housing, and air quality. BCAG's *Metropolitan Transportation Plan/Sustainable Communities Strategies* (MTP/SCS) outlines BCAG's plan for integrating transportation and land use planning in response to projected growth, housing needs, changing demographics, and transportation demands in compliance with the GHG emissions reduction goals set forth by the ARB per SB 375 (see above).

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Appendix B

City of Oroville Community and Municipal–Operations 2010 Baseline Greenhouse Gas Emissions Inventories

City of Oroville

Community and Municipal-Operations 2010 Baseline Greenhouse Gas Emissions Inventories

Photo by Arthur Devol

Final Report

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Tables and Figures

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Executive Summary

This report documents the results of the 2010 baseline greenhouse gas (GHG) emissions inventories for community-wide activities and sources, and the municipal operations of the City of Oroville. With the support of Pacific Gas and Electric Company (PG&E), and guidance from City of Oroville staff and ICLEI – Local Governments for Sustainability USA, Sierra Business Council (SBC) conducted all emissions estimations following the Local Government Operations Protocol (LGOP) and the U.S. Community Protocol (USCP). More information on the boundaries used to define the emissions inventoried and the protocols used in the development of the inventories is provided in the Inventory Methodology section of this report.

Included in this report are estimates of the City of Oroville's GHG emissions resulting from community-wide activities in 2010, as well as emissions specifically from the City's 2010 municipal operations. A summary of these community-wide activities and municipal-operations activities are provided here. The Inventory Results section of this report provides a detailed profile of emissions for each sector. This report is intended to guide local GHG emissions reduction efforts, to provide a baseline against which the City will be able to compare future performance and to use in demonstrating progress in reducing emissions.

Community-Wide Inventory Emissions Summary

In 2010, the City of Oroville's residents and businesses emitted an estimated 163,288 metric tons of carbon dioxide equivalent (CO2e) as reported in the community-wide inventory. Carbon dioxide equivalent is calculated using the Global Warming Potential (GWP) of each gas, which is a measure of the amount of warming a GHG may cause over a 100-year time horizon, measured against the amount of warming caused by carbon dioxide. Converting all emissions to equivalent carbon dioxide units allows for the consideration of different GHGs in comparable terms. As recommended by the USCP, the Local Government Significant Influence framework was used to determine the emissions included in the community-wide inventory. This framework includes emissions produced by the community for which the City has the ability to influence through outreach, education, incentive, or regulatory programs and policies.

Figure ES-1 summarizes the community-wide GHG emissions, which the City of Oroville has the greatest potential to influence. As can be seen in Figure ES-1, the largest contributor to community emissions in the inventory is the Community Transportation Sector, which includes on-road cars, trucks and buses, as well as off-road vehicles and mobile equipment. Values presented in tables and figures may not sum to totals because of rounding.

Figure ES-1: 2010 Community GHG Emissions Summary (Metric Tons CO_2e)

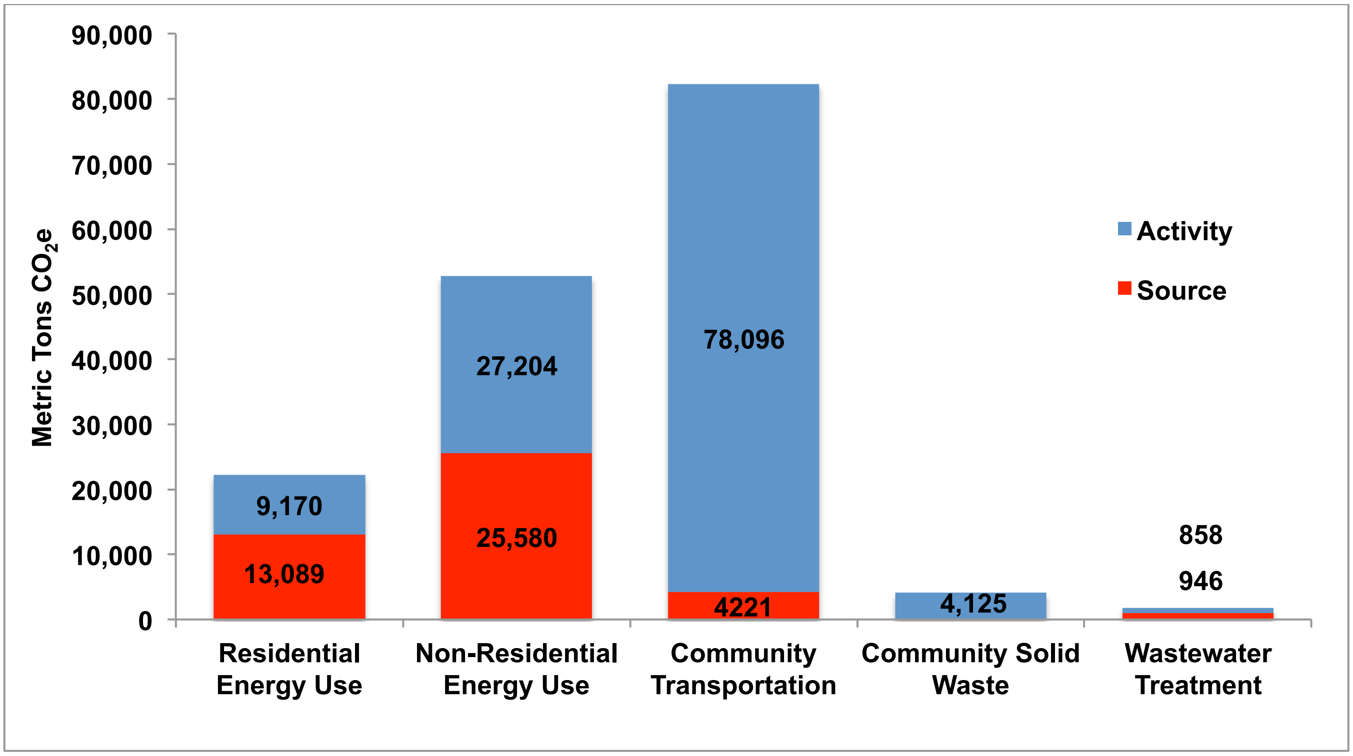

Table ES-1 presents the GHG emissions generated by community activities and sources in Oroville in more detail as well as additional emissions from POPI and Oroville Cogen, which are located within Oroville's city limits but are not directly tied to community activities. Table ES-1 also includes Information Items, which are GHG emissions that are reported separately in GHG inventories to prevent double counting with other reported emissions or by USCP guidance. Information Items reported in the community-wide inventory include: emissions associated with the collection and transportation of community-generated solid waste (emissions that are included with the Community Transportation Sector emissions), SC-OR's energy use and treatment emissions for treating wastewater from Oroville only (which is included in SC-OR total emissions reported in the Wastewater Treatment Sector), biogenic CO_2 emissions from burning of wood for residential heating and biogenic CO_2 emissions from burning wood at the POPI biomass plant. Biogenic CO_2 is not included in GHG emissions inventories because the same CO_2 would be produced if the wood (or other organic material) were left to decompose naturally and can be considered part of the natural carbon cycle.

Table ES-1: 2010 Community GHG Emissions Summary (Metric Tons CO_2e)

Sector	Metric Tons CO_2e	Source / Activity
Residential Energy Use		
Electricity Use	8,179	Activity
Stationary Combustion	13,089	Source
Transmission and Distribution Losses	991	Activity
Total Residential Energy Use	**22,259**	
Non-Residential Energy Use		
Electricity Use	24,346	Activity
Stationary Combustion	25,580	Source
Transmission and Distribution Losses	2,858	Activity
Total Non-Residential Energy Use	**52,784**	
Community Transportation		
On-Road Transportation	78,096	Activity
Off-Road Vehicles and Mobile Equipment	4,221	Source
Total Community Transportation	**82,317**	
Community Solid Waste		
Community-Generated Solid Waste	4,125	Activity
Total Community Solid Waste	**4,125**	
Water Supply / Wastewater Treatment		
Wastewater Treatment (SC-OR and septic -process, fugitive and diesel)	946	Source
Electricity Use Associated with all Wastewater Treatment	358	Activity
Electricity T&D Losses Associated with Wastewater Treatment	44	Activity
Electricity Use Associated with Potable Water	406	Activity
Electricity T&D Losses Associated with Potable Water	50	Activity
Total Water / Wastewater Treatment	**1,804**	
Total Community Emissions	**163,288**	
Other Emissions Sources within the Community		
Power Generation Facilities (POPI & Oroville Cogen)	11,390	Source
Total Other Emissions Sources within the Community	**11,390**	
Information Items		
Collection and Transportation of Community Solid Waste	549	Activity
Oroville-Only Wastewater (SC-OR Treatment, Effluent and Diesel)	372	Source
Oroville-Only Wastewater (SC-OR Electricity Use and T&D)	220	Activity
Biogenic CO_2 Emissions (Residential Wood Home Heating)	7,531	Source
Biogenic CO_2 Emissions (POPI Biomass Plant)	127,281	Source

Municipal-Operations Inventory Emissions Summary

In 2010, the City of Oroville's municipal operations emitted an estimated 1,252 metric tons of CO_2e accounted for within the municipal-operations inventory. As recommended by the LGOP, the Operational Control framework was used to determine the emissions included in the municipal-operations inventory. The Operational Control framework includes emissions sources and activities for which the City has full authority to introduce and implement operational policies. The municipal-operations inventory also includes two sectors for which the City has less control: emissions from employee-generated solid waste and emissions from employees' personal commutes to work. The LGOP strongly recommends including these optional emissions, even though the City does not have full operational control.

Figure ES-2 summarizes the municipal-operations GHG emissions by sector. As shown, the largest sector of emissions within the municipal-operations inventory in 2010 was the Vehicle Fleet, which includes all municipal vehicles as well as off-road vehicles and mobile equipment.

Figure ES-2: 2010 Municipal-Operations GHG Emissions Summary (Metric Tons CO_2e)

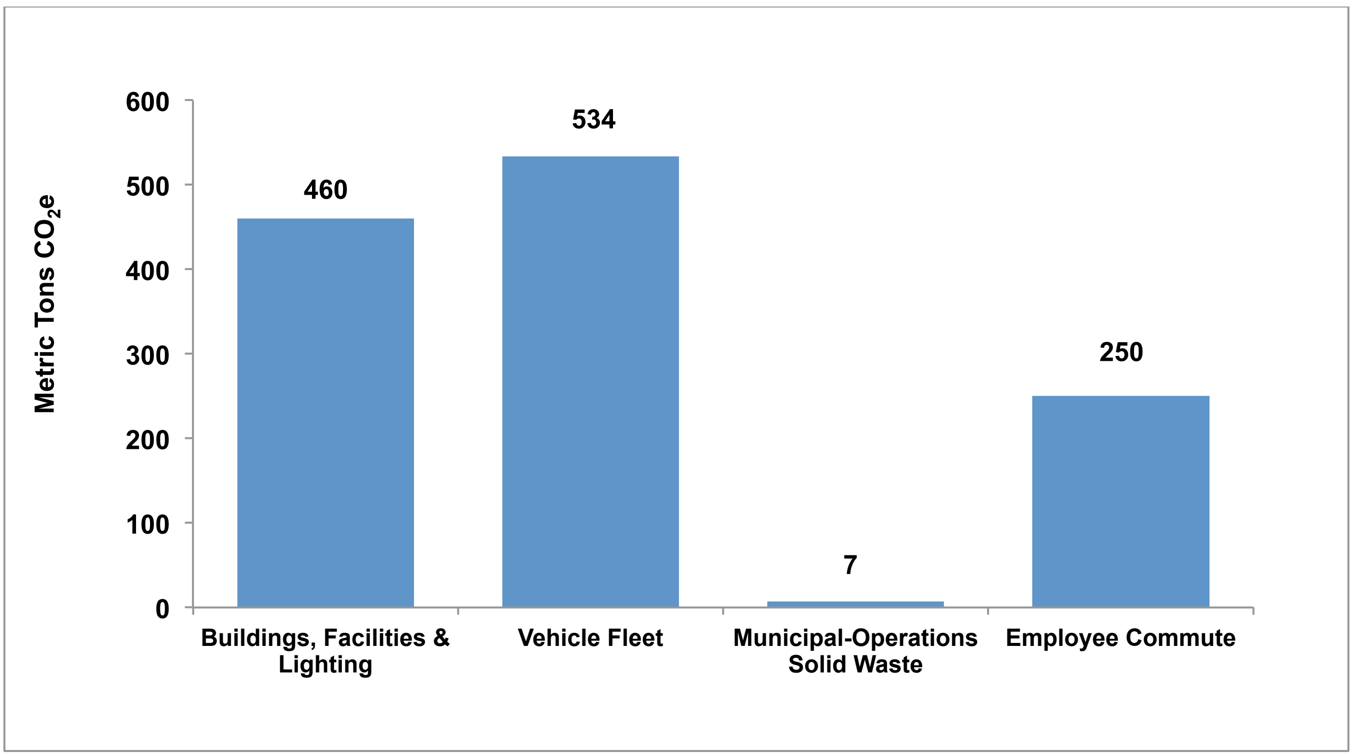

Table ES-2 presents the municipal-operations GHG emissions in more detail as well as additional Information Items that are not shown in Figure ES-2. Information Items are GHG emissions sources that are reported separately in GHG inventories to prevent double counting with other reported emissions or by USCP guidance. The Information Items presented in Table ES-2 include: R-12 refrigerants used in pre-1995 vehicle air conditioning (an ozone depleting substance currently being phased out worldwide), PG&E owned and operated LS-1 designated streetlights, and community-generated solid waste (e.g. from park and city trash bins) as distinguished from municipal-operations solid waste.

Table ES-2: 2010 Municipal-Operations GHG Emissions Summary (Metric Tons CO_2e)

Municipal-Operations Sectors	Metric Tons CO_2e	Reporting Scope
Buildings and Facilities		
Electricity Use - Buildings	142	Scope 2
Stationary Combustion (Natural Gas)	102	Scope 1
Electricity Use - Public Lighting	170	Scope 2
Electricity Use - Water / Wastewater	8	Scope 2
Electricity Transmission and Distribution Losses	39	Scope 3
Total Building and Facilities	**460**	
Vehicle Fleet		
On-Road Gasoline Vehicles	355	Scope 1
On-Road Diesel Vehicles	123	Scope 1
Off-Road Equipment All Fuel	27	Scope 1
Leaked R-134a Refrigerant	29	Scope 1
Total Vehicle Fleet	**534**	
Municipal-Operations Solid Waste		
Municipal-Operations Solid Waste	7	Scope 3
Total Municipal-Operations Solid Waste	**7**	
Employee Commute		
Employee Commute Emissions	250	Scope 3
Total Employee Commute	**250**	
Total Municipal-Operations Emissions	**1,252**	
Information Items		
Ozone Depleting Substances (Vehicle Fleet R-12)	69	
LS-1 Lighting	1	
Community-Generated Solid Waste	16	

Introduction

The City of Oroville is a rural community located on the Feather River below Lake Oroville in California's Northern Sacramento Valley at the foot of the Sierra Nevada Foothills. Sixty-five miles north of Sacramento, the City was incorporated in 1906. Oroville covers approximately 13 square miles. In 2010, the inventory year, Oroville's population was 15,529, with community employment of 4,500.

Every day, the City of Oroville plays host to a variety of activities crucial to a properly functioning and robust community; burning fuel for transportation, collecting and treating waste, lighting, heating and cooling buildings. All of these activities contribute either directly or indirectly to the addition of carbon dioxide and other greenhouse gases (GHGs) into the environment.

In California, governments, businesses and the general public are placing increasing focus on quantifying and reducing GHG emissions. Additionally, California's regulatory environment is shifting towards establishing policies relating to GHG emissions reductions. Specific regulatory policies and goals are discussed in more detail in the California Policy section to follow. Due to these drivers and other motivations, the City of Oroville directed the Sierra Business Council, with the support of PG&E, to conduct baseline inventories of GHG emissions resulting from both community activities and sources, and Oroville's municipal-operations in 2010. This report documents the findings and methodologies of the 2010 baseline community-wide and municipal-operations inventories.

Figure 1: Oroville's Public Safety Facility

Photo from City of Oroville.

The City of Oroville has already implemented programs that have or will lead to ancillary benefits in the form of energy conservation and greenhouse gas mitigation.

- Formal commitment to adopting a Climate Action Plan by March 31, 2015.
- Lead-by-example actions to reduce government-operations emissions including solar installations on municipal buildings, electric vehicles in the vehicle fleet and other energy-efficiency measures.
- Business engagement and recognition programs through Property Assessed Clean Energy (PACE) program and CALGREEN building codes.
- Recycling and waste reduction programs including a concerted recycling program for municipal operations.
- Energy-efficiency incentive program for residents with financing of energy efficiency and solar projects using the Property Assessed Clean Energy (PACE)

Pacific Gas and Electric Company-Sponsored Inventory Project

This project was made possible by PG&E's Government and Community Partnerships Program with funding from California utility customers under the auspices of the California Public Utilities Commission. The Government and Community Partnerships Program assists local governments by providing easy-to-understand information, technical expertise, and financial resources to support local climate action planning. The Government and Community Partnerships Program is designed to help local governments and communities achieve GHG reduction goals while simultaneously reducing energy costs and improving air quality.

Climate Change Background

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Abundant scientific evidence shows that human activities are increasing the concentration of GHGs and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other GHGs into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise.

The Intergovernmental Panel on Climate Change (IPCC) is the scientific body charged with bringing together the work of thousands of climate scientists. The IPCC's Fourth Assessment Report states: "warming of the climate system is unequivocal."[1] Furthermore, the report finds that "most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations."

Analysis released in January 2011 by NASA's Goddard Institute for Space Studies shows that global average surface temperatures in 2010 "tied" 2005 as the warmest on record (the difference is smaller than the uncertainty in comparing the temperatures of recent years).[2] The next warmest years, also with very close average temperatures, are 1998, 2002, 2003, 2006, 2007, and 2009. The period from January 2000 to December 2009 is the warmest decade on record, followed by the 1990's, then the 1980's respectively. The steady uptick in average temperatures will likely have significant negative impacts on California's environment and economy if action is not taken to greatly reduce GHG emissions.

Reducing fossil fuel use in the community has many benefits in addition to reducing greenhouse gas emissions. Retrofitting homes and businesses to be more efficient creates local jobs, reduces energy costs, improves air quality, and in combination with increased opportunities for walking and bicycling improves community members' health. In addition, money not spent on energy is more likely to be spent at local businesses, improving the local economy.

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[1] 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, 104 pp.

[2] Goddard Institute for Space Studies, "Research Finds 2010 Tied for Warmest Year on Record," 2011, 18 Jan. 2011, <http://www.nasa.gov/topics/earth/features/2010-warmest-year.html>.

Regional and Local Impacts

The City of Oroville, like all communities in the Sacramento Valley, faces challenges associated with climate change in the region. Increased frequency and altered timing of flooding will increase risks to agriculture, people, ecosystems and infrastructure. Potential impacts on water resources include reduced mountain snowpack, delayed snow accumulation, earlier snow melting and ultimately shortages in runoff and water supply. Extended droughts may increase soil erosion. Changes in rainfall patterns, water supply and alteration of fragile ecosystems are likely. Since local economies in the area rely heavily on these resources for agriculture, tourism, recreation and other industries; climate change may negatively affect economic activity in Oroville, and ultimately impact quality of life for community members.

California Policy

California has been a leader in developing policies that aim to reduce GHG emissions, and these policies are some of the drivers behind the completion of GHG inventories at the local level. Three of these policies are described here.

State Emissions Reduction Targets

California passed the Global Warming Solutions Act (AB 32) in 2006, which charged the California Air Resources Board (ARB) with implementing comprehensive regulatory, reporting and market mechanisms to achieve quantifiable reductions in GHG emissions statewide. AB 32 requires statewide GHG emissions be reduced to 1990 levels by 2020. This reduction will be accomplished through a comprehensive suite of actions, the most visible of which is an enforceable statewide cap on GHG emissions that went into effect in 2012. Additionally, Executive Order S-3-05 establishes a long-range target of 80% below 1990 levels by 2050. The Executive Order is binding only on State agencies, and has no force of law for local governments; however, the signing of S-3-05 sent a clear signal to the California Legislature on the long-range goal for California.

The AB 32 Scoping Plan provides guidance on how local governments can help the State reach these goals; specifically the Plan suggests that local governments establish an emissions reduction goal of 15 percent below "current" levels by 2020.[3] Oroville's GHG emissions inventory is intended to enable the City to develop effective GHG reduction policies in line with these state goals and programs and track emissions reduction progress.

Senate Bill 375 and Metropolitan Planning Organizations

Senate Bill (SB) 375, signed in September 2008, aligns regional transportation planning efforts, regional GHG reduction targets and land use planning and housing allocation efforts. SB 375 requires each Metropolitan Planning Organization (MPO) adopt a Sustainable Community Strategy (SCS) as part of the MPO's Regional Transportation Plan (RTP) that sets land use allocation and transportation investments necessary to meet GHG emissions reduction targets for the region.

[3] The AB 32 Scoping Plan is available at: http://www.arb.ca.gov/cc/scopingplan/scopingplan.htm

With the assistance of the Regional Targets Advisory Committee (RTAC) and in consultation with the MPOs, ARB provided each affected region with reduction targets for GHGs emitted by passenger cars and light trucks for 2020 and 2035. Oroville is within the Butte County Association of Governments (BCAG), the federally designated MPO for Butte County, which adopted a SCS in December, 2012. BCAG's SCS, approved by ARB, is expected to help California reach its greenhouse gas reduction goals, with reductions in regional per capita transportation emissions of 2% by 2020 and 2% by 2035, exceeding the established targets.

California Environmental Quality Act

Another policy driver for climate action planning in California is SB 97, which established that GHG emissions and their impacts are appropriate subjects for analysis under the California Environmental Quality Act (CEQA). This law, passed in 2007, directed the State's Office of Planning and Research (OPR) to develop CEQA guidelines on the mitigation of GHG emissions for agencies, such that they may follow appropriate standards on calculating GHG emissions from projects, determine potential significance, and implement mitigation measures if necessary and feasible. In addition to establishing the 2050 reduction target described above, Governor Schwarzenegger's Executive Order S-3-05 reinforces these goals and sets a schedule for the reporting of both the measured impacts of climate change upon California's natural environment and the emissions reduction efforts undertaken by a myriad of state, regional, and local groups.

Energy-Efficiency and Renewable Energy Standards

California's Renewable Portfolio Standard (RPS) requires investor-owned utilities, electric service providers and community choice aggregators to increase procurement from eligible renewable energy resources to 33 percent of total procurement by 2020.

California's Building Energy Efficiency Standards (California Code of Regulations, Title 24, Part 6) were recently updated to require new buildings to become even more energy-efficient than under the current code. The new 2013 standards, which become effective in July 2014, will increase the efficiency of new construction by 20 percent for residential uses and 25 percent for nonresidential uses, compared to the 2008 Title 24 standards currently in effect (CEC 2013).

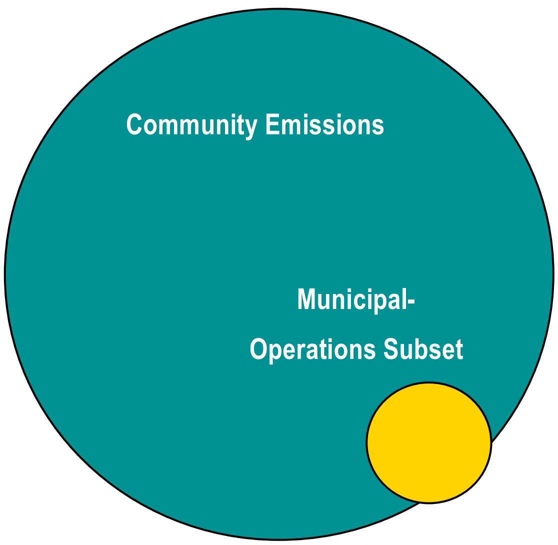
Inventory Methodology

This section provides information on the protocols and specific inventory methodologies used in the development of the community-wide and municipal-operations GHG emissions inventories.

Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible GHG emissions reductions requires identifying baseline levels and sources of emissions in the community. As local governments have continued to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential.

Figure 2: Municipal-Operations Inventory as a Subset of the Community-Wide Inventory.



Standard processes of accounting for emissions have been developed to which these inventories adhere. This inventory uses the approach and methods provided by the U.S. Community Protocol (USCP) and the Local Government Operations Protocol (LGOP), both of which are described below.[4]

Note that the municipal-operations inventory is a subset of the community inventory. For example, data on non-residential energy use by the community includes energy consumed by municipal buildings, and community vehicle miles traveled include miles driven by municipal fleet vehicles. While the majority of municipal-operations are captured within the community-wide inventory, there are potential emissions from municipal buildings or facilities located outside of the City limits that are not captured in the community-wide inventory. This relationship is illustrated in Figure 2.

U.S. Community Protocol

The USCP was released by ICLEI in October 2012, and represents a new national standard in guidance to help U.S. local governments develop effective community GHG emissions inventories. It establishes reporting requirements for all community GHG emissions inventories, provides detailed accounting guidance for quantifying GHG emissions associated with a range of emissions sources and community activities, and provides reporting frameworks to help local governments customize their community GHG emissions inventory reports based on their local goals and capacities.

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[4]Local Government Operations Protocol (LGOP). http://www.icleiusa.org/programs/climate/ghg-protocol/ghg-protocol
U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions. http://www.icleiusa.org/tools/ghg-protocol/community-protocol.

The State of California Governor's Office of Planning and Research recommends that California local governments follow the USCP when undertaking their greenhouse gas emissions inventories. SBC used the USCP to inventory the City Oroville's community emissions.

Local Government Operations Protocol

In 2008 ICLEI, ARB, and the California Climate Action Registry (CCAR) released the LGOP to serve as the national standard for quantifying and reporting GHG emissions from local government (or municipal) operations. The purpose of the LGOP is to provide the principles, approach, methodology, and procedures needed to develop a municipal-operations GHG emissions inventory. SBC used the LGOP to inventory the City Oroville's municipal-operations emissions.

Greenhouse Gas Emissions

The USCP and LGOP recommend assessing emissions from the six internationally recognized GHGs regulated under the Kyoto Protocol and listed in Table 1. The municipal-operations inventory included analysis of emissions of each of these gases, although no perfluorocarbons or SF_6 emissions were found. Emissions of hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride were not included in the community-wide inventory because of the difficulty in obtaining data on these emissions at a community scale.

Greenhouse gas emissions are commonly aggregated and reported in terms of equivalent carbon dioxide units, or CO_2e. This standard is based on the Global Warming Potential (GWP) of each gas, which is a measure of the amount of warming a GHG may cause over a 100-year time horizon, measured against the amount of warming caused by carbon dioxide. Converting all emissions to equivalent carbon dioxide units allows for the consideration of different GHGs in comparable terms. For example, methane is twenty-five times more powerful than carbon dioxide in its warming effect over 100 years; so one metric ton of methane emissions is equal to twenty-five metric tons of carbon dioxide equivalents. Table 1 presents the GWPs of the commonly occurring GHGs according to the Intergovernmental Panel on Climate Change's 4th Assessment Report.[5]

Table 1: Greenhouse Gases

Greenhouse Gas	Chemical Formula	Global Warming Potential
Carbon Dioxide	CO_2	1
Methane	CH_4	25
Nitrous Oxide	N_2O	298
Hydrofluorocarbons	Various	38-12,200
Perfluorocarbons	Various	9,500-18,200
Sulfur Hexafluoride	SF_6	32,600

[5] http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

Quantifying Greenhouse Gas Emissions

Establishing a Base Year

The inventory process requires the selection of a base year in order to compare baseline emissions against current and future emissions inventories. The City Oroville's baseline GHG emissions inventories use 2010 for the base year; selected because it is one of the earliest years for which relatively comprehensive data is available. The emissions quantified in this report will serve as the baseline for the development of emissions forecasts and for comparison with emissions in future inventories to track progress in emissions reductions.

Establishing Boundaries

Setting an organizational boundary for GHG emissions accounting and reporting is an important step in the inventory process. The organizational boundary for an inventory determines which aspects of municipal operations and community activities are included in the emissions inventory and which aspects are excluded.

Community-Wide Inventory Boundaries

Under the USCP, there are three available reporting frameworks; Local Government Significant Influence, Community-Wide Activities and Household Consumption. The USCP recommends the Local Government Significant Influence framework because this framework emphasizes policy relevance, highlighting emissions sources and activities that the local government has the greatest opportunity to address. The Local Government Significant Influence framework also includes all five of the Basic Emissions Generating Activities required by the USCP to be protocol compliant: 1) Use of Electricity by the Community, 2) Use of Fuel in Residential and Non-Residential Stationary Combustion Equipment, 3) On-Road Passenger and Freight Motor Vehicle Travel, 4) Use of Energy in Potable Water and Wastewater Treatment and Distribution and 5) Generation of Solid Waste by the Community. For this reason, the community-wide inventory was conducted according to the Local Government Significant Influence framework. In order to provide as complete a picture as possible of all of the direct GHG emissions produced within the community, this report also presents other large GHG sources within the community.

Several potential emissions sources were omitted from this inventory because of data limitations or uncertainty in the emissions calculation methodologies. These emissions sources include emissions from passenger rail and air travel by community members, leaked refrigerants and fire suppressants in the community, emissions associated with the cultivation of agriculture and livestock, emissions from forest fires, forest management activities and crop burning.

Municipal-Operations Inventory Boundaries

Under the LGOP, two frameworks can be used for reporting emissions at the municipal-operations level: operational control or financial control. A local government has operational control over an emissions source if it has full authority to introduce and implement policies or programs that impact the emissions source. A local government has financial control if the emissions source is fully consolidated in financial accounts. The LGOP strongly encourages local governments to utilize operational control as the organization boundary for a municipal-operations emissions inventory. Operational control is believed to most accurately represent the emissions sources that local governments can directly influence, and this boundary is consistent with other environmental and air quality reporting program requirements. For this reason, the municipal-operations inventory was conducted according to the operational control framework.

Quantification Methods

All of the emissions in this report were quantified using calculation-based methodologies. Calculation-based methodologies calculate emissions using activity data and emissions factors, in accordance with the following basic equation: *Activity Data x Emissions Factor = Emissions.* Activity data refers to the relevant measurement of energy use or other GHG-generating processes such as fuel consumption by fuel type, metered annual electricity consumption and annual vehicle miles traveled. Standard emissions factors were used to convert activity data into the associated emissions. Emissions factors are typically expressed in terms of emissions per unit of activity data (e.g. lbs CO_2/kWh of electricity). Please refer to the appendices provided for a detailed listing of the activity data and emissions factors used in development of these inventories.

Evaluating Emissions

There are several important concepts involved in the analysis of emissions arising from many different sources and chemical/mechanical processes throughout the community. There are four main emissions types discussed throughout this report.

- **Stationary or mobile combustion:** These are emissions resulting from on-site combustion of fuels (natural gas, diesel, gasoline, etc.) to generate heat, electricity, or to power vehicles and mobile equipment.
- **Purchased electricity, heat or steam:** These are emissions produced by the combustion of fuels by utilities or other facilities outside of the operational control of the City Oroville or community members.
- **Fugitive emissions:** These are emissions that result from the unintentional release of GHGs into the atmosphere (leaked refrigerants, methane from waste decomposition, etc.).
- **Process emissions**: These are emissions from physical or chemical processing (e.g., wastewater treatment).

Sources and Activities

Communities contribute to greenhouse gas emissions in many ways. Two central categorizations of emissions are used in the community inventory: 1) GHG emissions that are produced by "sources" located within the community boundary, and 2) GHG emissions produced as a consequence of community "activities" and may be produced outside of the community boundary.

Table 2: Source vs. Activity

Source	Activity
Any physical process inside the jurisdictional boundary that releases GHG emissions into the atmosphere (for example, natural gas combusted at homes and business)	**The use of energy, materials, and/or services by members of the community that result in the creation of GHG emissions that may be outside of the community boundaries (for example, electricity used at homes and business)**

By reporting on both GHG emissions sources and activities, local governments can develop and promote a deeper understanding of GHG emissions associated with their communities. A purely source-based emissions inventory could be summed to estimate total emissions released within the community's jurisdictional boundary. In contrast, a purely activity-based emissions inventory could provide perspective on the efficiency of the community, even when the associated emissions occur outside the jurisdictional boundary. Sometimes an emissions category could be considered a source and an activity, for example, fuel use for heating is both a source of emissions within the community as well as a community activity. In cases such as this, the emissions are considered a source. The division of emissions into sources and activities replaces the scopes framework that is used in municipal-operations inventories.

Emissions by Scope

For the municipal-operations inventory, emissions are categorized by scope, rather than into sources and activities. The Scopes framework identifies three scopes for municipal-operations emissions:

- **Scope 1:** All direct stationary combustion, fugitive and process emissions from a facility or piece of equipment operated by the local government. Examples include tailpipe emissions from local government vehicles, and emissions from a furnace in a local government building.

- **Scope 2:** Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, and cooling. Scope 2 emissions occur as a result of activities that take place within the organizational boundary of local government, but that rely upon emissions-producing processes often located outside of the organizational boundary.

- **Scope 3:** All other indirect or embodied emissions not covered in Scope 2 that occur as a result of activity within the organizational boundary. Examples include emissions associated with the disposal of solid waste generated by the local government and the emissions associated with employees' personal commute to work.

The LGOP requires reporting of all Scope 1 and Scope 2 emissions within the local government's operational or financial control. Using the scopes framework helps prevent double counting of emissions, specifically where one jurisdiction's Scope 2 emissions from electricity use could potentially be another jurisdiction's Scope 1 emissions from the stationary combustion of fuels to produce electricity. For this reason, Scopes can with caution be summed within a jurisdiction though should not be summed across jurisdictions. In addition to the categories in the Scopes framework, emissions sources may also be highlighted as Information Items.

Information Items

Information Items are emissions sources that are reported separately in the GHG inventories either to prevent double counting with other included emissions or by USCP guidance. When the Information Items are reported to prevent double counting, they provide context or a more complete picture of emissions.

A common source of emissions that is categorized as an information item per USCP guidance is carbon dioxide emitted in the combustion of biogenic fuels. Local governments, industrial facilities and community members will often burn fuels that are of biogenic origin (wood, landfill gas, organic solid waste, biofuels, etc.) to generate heat or electricity. Carbon dioxide emissions from the combustion of biogenic fuels are not included in Scope 1 emissions, in accordance with established international principles. Methane and nitrous oxide emissions from biogenic fuels are considered Scope 1 stationary combustion emissions and are included in the stationary combustion sections for the appropriate facilities.

These principles indicate that biogenic fuels, if left to decompose in the natural environment, would release CO_2 into the atmosphere, where it would then enter back into the natural carbon cycle. Therefore, when wood or another biogenic fuel is combusted, the resulting CO_2 emissions are akin to natural emissions and should therefore not be considered as human activity-generated emissions. The CH_4 and N_2O emissions, however, would not have occurred naturally and are therefore included as Scope 1 emissions. Because there is continued debate over true effect of biogenic fuels, the emissions from the combustion of biogenic fuels are included as information items.

Another common source of emissions that is categorized as an information item is ozone-depleting substances used as refrigerants. Ozone-depleting substances are regulated under the Montreal Accord and are therefore not considered GHG emissions under the Kyoto Protocol. The most common ozone-depleting refrigerants, R-12 and R-22, are reported as information items because they have global warming potential (GWP) and will be replaced by (non-ozone depleting) refrigerants with GWP, whose emissions will be reported in future GHG inventories. Information items quantified for this report include:

- **Municipal-Operations Inventory**
  - Ozone depleting refrigerants (R-12 in fleet vehicles).
  - PG&E owned and operated lighting paid for by the City of Oroville (designated LS-1 by PG&E).
  - Solid waste produced by the community at parks and museums operated by Oroville
- **Community-Wide Inventory**
  - Emissions from the transportation and collection of community-generated solid waste (which are included in the Community Transportation Sector emissions).
  - Emissions from Oroville-generated wastewater treatment (which are included in the total wastewater treatment emission).
  - Emissions from electricity used for Oroville-generated wastewater treatment (which are included in the total wastewater treatment electricity use emissions).
  - Biogenic emissions generated from burning wood in residences.
  - Biogenic emissions generated from burning wood at the POPI biomass plant.

Included Sources and Activities

Tables 3 and 4 document all of the emissions sources and activities included in the community-wide and municipal-operations inventories. For a full list of all potential emissions included and excluded for the community-wide inventory please refer to Appendix A.

Table 3: Sources and Activities Included in City of Oroville Community GHG Inventory

Sector	Source	Activity	Information Items
Residential Energy Use	Stationary Fuel Combustion in the Community	Electricity Use in the Community and the Associated Transmission and Distribution Losses	Biogenic Fuel Combustion (Wood for Home Heating)
Non-Residential Energy Use	Stationary Fuel Combustion in the Community	Electricity Use in the Community and the Associated Transmission and Distribution Losses	Biogenic Fuel Combustion in the Community (POPI wood)
Community Transportation	Off-Road Vehicles and Other Mobile Equipment in the Community	Fuel Use in On- Road Passenger, Freight and Transit Vehicles Associated with Community Land Uses	
Community Solid Waste		Future Decomposition of Solid Waste Produced by the Community in 2010	Collection and Transportation of Solid Waste Produced by the Community
Wastewater Treatment	Emissions from Wastewater Treatment Facilities in the Community	Electricity Use Associated with Potable Water & Wastewater Management	Oroville-Generated Wastewater Treatment
Other Emissions Sources in the Community	Power Generation in the Community		

Table 4: Emissions Included in City of Oroville Municipal-Operations GHG Inventory

Sector	Scope 1	Scope 2	Scope 3	Information Items
Buildings and Facilities	Natural Gas and Diesel Fuel Use	Electricity Use	Transmission and Distribution Losses	PG&E LS-1 Lighting
Vehicle Fleet	Gasoline and Diesel Fuel Use and HFC-134a Refrigerant			R-12 Refrigerant
Municipal-Operations Solid Waste			Future Emissions from the Decomposition of Municipal-Operations 2010 Generated Solid Waste	Community-Generated 2010 Solid Waste
Employee Commute			Gasoline and Diesel Fuel Use	

Significance Thresholds

Within any inventory, there will be emissions sources that fall within Scope 1 or Scope 2 and are minimal in magnitude or difficult to accurately measure. Within the context of community-wide and municipal-operations inventories, emissions from leaked refrigerants and backup generators are common sources of these types of emissions. For these less than significant emissions sources, the LGOP specifies that up to 5 (five) percent of total emissions can be reported using methodologies that deviate from the recommended methodologies in the LGOP. In the context of registering emissions with an independent registry (such as the Climate Action Registry), emissions that fall under this significance threshold are called ***de minimis***.

Project Resources

This report was made possible by the expertise and resources provided by the Statewide Energy Efficiency Collaborative (SEEC) and ICLEI – Local Government for Sustainability.

Statewide Energy Efficiency Collaborative

The Statewide Energy Efficiency Collaborative (SEEC) provides support to cities and counties to help them reduce GHG emissions and save energy. SEEC is an alliance between three statewide non-profit organizations and California's four Investor-Owned Utilities. SEEC provides education and tools at no cost to representatives of local governments within California, as well as state and regional government agencies, districts and school districts. This inventory leveraged the expertise and tools provided by SEEC and ICLEI.

All SEEC tools are available at no cost to California local governments and their representatives at www.californiaSEEC.org. The following tools should be saved as resources and supplemental information to this report:

- The "Master Data Workbooks" that contains most or all of the raw data (including emails), data sources, emissions, notes on inclusions and exclusions, and reporting tools
- Detailed instructions documents to assist with data collection, emissions calculations and inventory reporting

Climate and Energy Management Suite

To facilitate efforts to measure GHG emissions as a first step towards reducing them, ICLEI on behalf of SEEC, developed the ClearPath California Climate and Energy Management Suite (CEMS) in order to provide a no-cost, easy-to-use online tool for California local governments to calculate, monitor and forecast community-wide and municipal-operations GHG emissions. CEMS was developed to assist in the preparation of USCP and LGOP compliant GHG inventories.

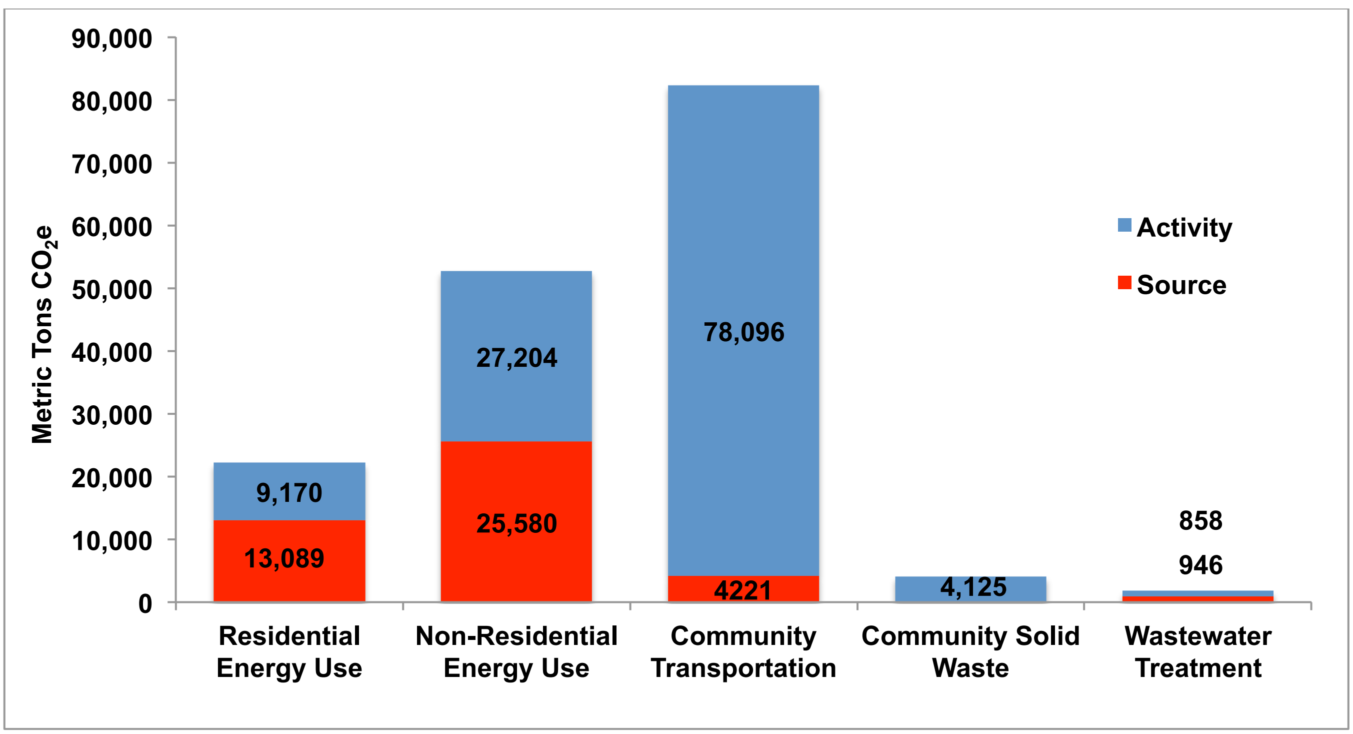
Community Emissions Inventory Results

The community-wide inventory includes estimates of Oroville's GHG emissions resulting from community activities as a whole in 2010. The community-wide inventory was conducted under the Local Government Significant Influence framework of the Community Protocol. This framework is designed to highlight emissions sources and activities where the City has the greatest influence through education, outreach, incentive or regulatory policies and programs. For more information on the Local Government Significant Influence framework and specific inventory methods please refer to the Inventory Methodology section of this report and the USCP.

Emissions Summary

In 2010, Oroville's residents and businesses emitted an estimated 163,288 metric tons of CO_2e included in the community-wide inventory. Figure 3 summarizes the community GHG emissions for which the City of Oroville has the greatest potential to influence as sources and activities. As can be seen in Figure 3, the largest contributor of community-inventory emissions is community transportation, which includes on-road passenger, freight and public transit vehicles as well as off-road vehicles and mobile equipment. Values presented in tables and figures may not sum to totals because of rounding.

Figure 3: 2010 Community GHG Emissions Summary (Metric Tons CO_2e)



Community GHG emissions categorized as source emissions are those that are produced within the community boundaries. Community GHG emissions categorized as activity emissions are those that are produced due to activities of community members, and may result in emissions within or outside of the community boundaries. The most common example of a community activity is electricity use, where the electricity is consumed within the community though the emissions are produced at power plants spread throughout region.

Table 5 presents details of the community GHG emissions as community activities and community sources, as well as additional stationary sources within Oroville's boundaries (POPI and Oroville Cogen plants). Table 5 also includes additional Information Items that are reported here separately for context. Information Items are emissions that are reported separately in GHG inventories either to prevent double counting with other included emissions or by USCP guidance.

Information Items reported in this community-wide inventory include: emissions associated with the collection and transportation of community-generated solid waste (emissions that are included with the Community Transportation Sector emissions), SC-OR's energy use and treatment emissions for treating wastewater from Oroville only (which is included in SC-OR energy use and treatment total emissions), biogenic CO_2 emissions from burning of wood for residential heating and biogenic CO_2 emissions from burning wood at the POPI biomass plant. Biogenic CO_2 is not included in GHG emissions inventories, by protocol guidance, because the same CO_2 would be produced if the wood (or other organic material) were left to decompose naturally and can be considered part of the natural carbon cycle.

Emissions from fuels consumed at power plants located within the jurisdictional boundary of the City of Oroville are reported as Other Emissions Sources in the Community because of the potential overlap with the emissions associated with community electricity use. While the fuel is consumed locally in Oroville and produces emissions locally, the electricity generated is fed into the general electricity network and consumed by households and business wherever it is needed throughout the region. When Oroville residents and businesses turn on the lights, they aren't solely consuming electricity produced by the local power plant; rather, they are consuming electricity produced by a variety of sources including solar, wind, hydroelectric, biomass, natural gas, and coal. Therefore, the emissions from community electricity use are reported as part of the community GHG inventory while the direct emissions from power plants are not included in the community's GHG emissions total. This allows communities to account for emissions based on local consumption rather than the number of generation facilities that are located within the community. The emissions from the power generating facilities (POPI and Oroville Cogen) are reported here for additional context.

Table 5: 2010 Community GHG Emissions Summary (Metric Tons CO_2e)

Sector	Metric Tons CO_2e	Source / Activity
Residential Energy Use		
Electricity Use	8,179	Activity
Stationary Combustion	13,089	Source
Transmission and Distribution Losses	991	Activity
Total Residential Energy Use	**22,259**	
Non-Residential Energy Use		
Electricity Use	24,346	Activity
Stationary Combustion	25,580	Source
Transmission and Distribution Losses	2,858	Activity
Total Non-Residential Energy Use	**52,784**	
Community Transportation		
On-Road Transportation	78,096	Activity
Off-Road Vehicles and Mobile Equipment	4,221	Source
Total Community Transportation	**82,317**	
Community Solid Waste		
Community-Generated Solid Waste	4,125	Activity
Total Community Solid Waste	**4,125**	
Water Supply and Wastewater Treatment		
Wastewater Treatment (SC-OR and septic -process, fugitive and diesel)	946	Source
Electricity Use Associated with all Wastewater Treatment	358	Activity
Electricity T&D Losses Associated with Wastewater Treatment	44	Activity
Electricity Use Associated with Potable Water	406	Activity
Electricity T&D Losses Associated with Potable Water	50	Activity
Total Water / Wastewater Treatment	**1,804**	
Total Community Emissions	**163,288**	
Other Emissions Sources within the Community		
Power Generation Facilities (POPI & Oroville Cogen)	11,390	Source
Total Other Emissions Sources within the Community	**11,390**	
Information Items		
Collection and Transportation of Community Solid Waste	549	Activity
Oroville-Only Wastewater (SC-OR Treatment, Effluent and Diesel)	372	Source
Oroville-Only Wastewater (SC-OR Electricity Use and T&D)	220	Activity
Biogenic CO_2 Emissions (Residential Wood Home Heating)	7,531	Source
Biogenic CO_2 Emissions (POPI Biomass Plant)	127,281	Source

Residential Energy Use

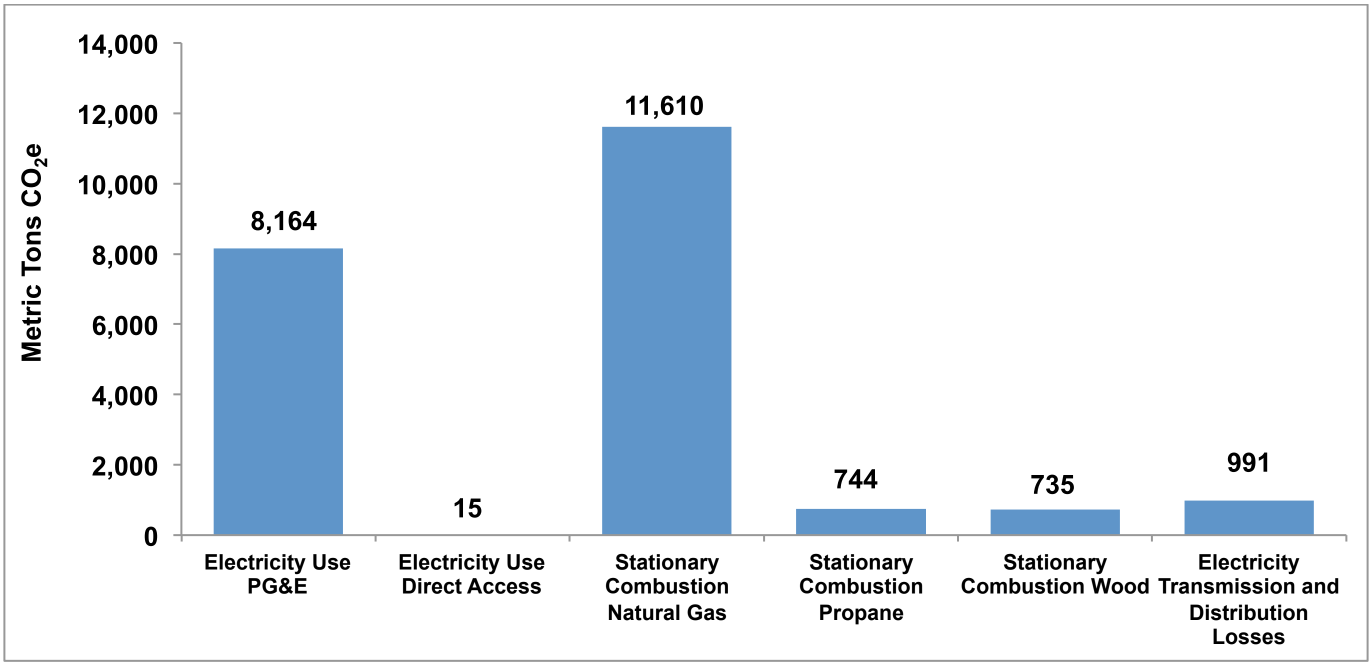
Oroville's residential energy use generated an estimated 22,259 metric tons of CO_2e in 2010. These emissions were calculated using 2010 electricity and natural gas consumption data provided by PG&E and the California Energy Commission, and estimates of non-utility fuel use based on U.S. Census Bureau data and California average per-household fuel use by fuel type. Non-utility fuels include propane and wood, both commonly used fuels for residential home heating, water heating, and cooking. Biogenic emissions from wood combustion are reported as an Information Item based on protocol guidance. Appendix B provides detailed residential energy use activity data, emissions factors and calculation methods. Table 6 and Figure 4 illustrate the breakdown of residential energy use GHG emissions.

Data on fuel used specifically for residential emergency generators and other equipment, such as lawnmowers, was not available. Emissions resulting from this fuel use are included in the off-road equipment emissions estimates in the Transportation Sector. GHG emissions associated with residential transportation, solid waste and wastewater are accounted for in the community transportation, community solid waste and wastewater treatment emissions totals, respectively.

Table 6: 2010 Residential Energy Use Emissions Summary (Metric Tons CO_2e)

Residential Energy Use	Metric Tons CO_2e
Electricity Use – PG&E	8,164
Electricity Use – Direct Access	15
Stationary Combustion – Natural Gas	11,610
Stationary Combustion – Propane (LPG)	744
Stationary Combustion – Wood	735
Electricity Transmission and Distribution Losses	991
Total Residential Energy Use	**22,259**
Information Items	
Stationary Combustion – Wood (Biogenic CO_2)	7,531

Figure 4: 2010 Residential Energy Use Emissions Summary (Metric Tons CO_2e)



Non-Residential Energy Use

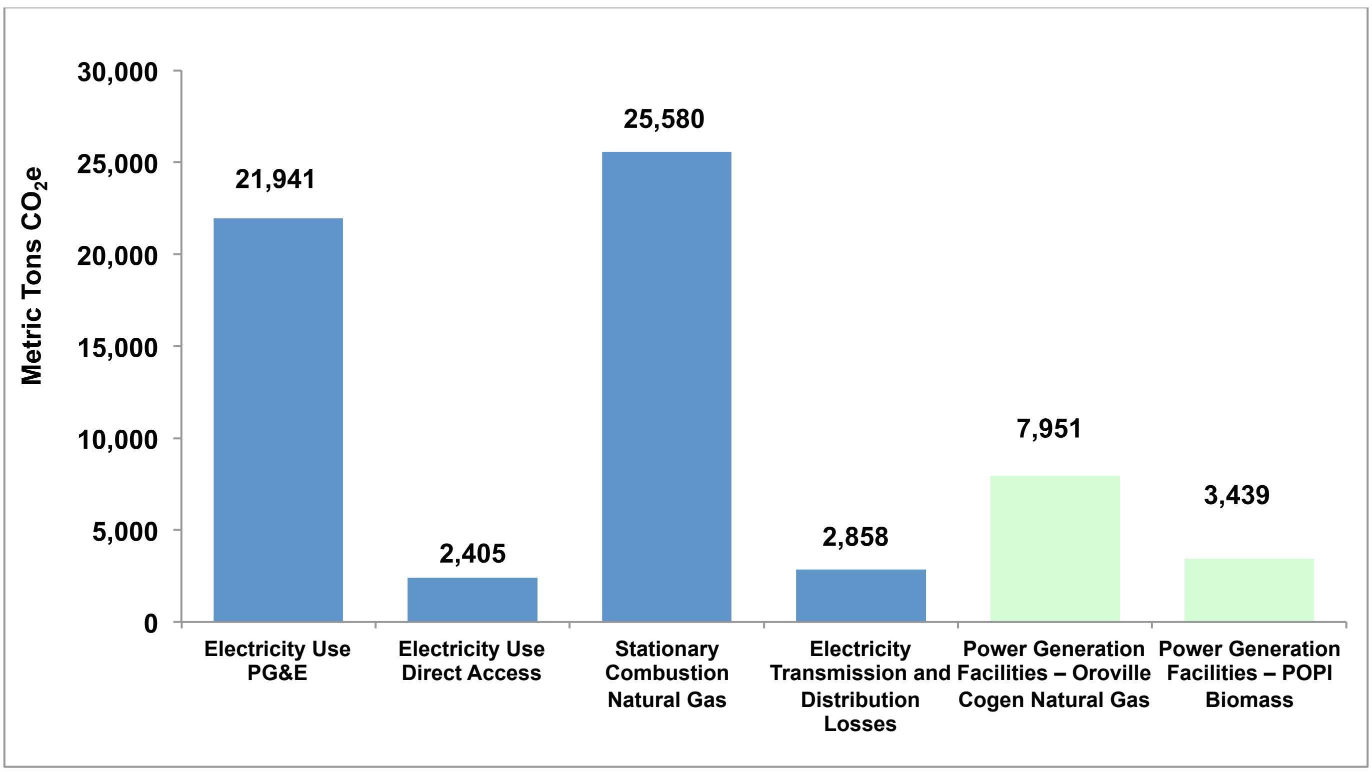
Non-residential energy use in Oroville generated an estimated 52,784 metric tons of CO_2e in 2010. These emissions were calculated using 2010 electricity and natural gas consumption data provided by PG&E and the California Energy Commission. Fuel use emissions data from utility-scale power generation, excluded from PG&E natural gas data, were collected from California Air Resources Board and are reported separately from the non-residential energy use total because of the potential for overlap with the reported emissions from electricity use. PG&E electricity used for potable water supply and wastewater treatment in Oroville has been subtracted from the non-residential total and reported under the Water Supply and Wastewater Treatment Sector. Biogenic CO_2 emissions from biomass combustion are also reported as an Information Item. Appendix C provides detailed non-residential energy use activity data, emissions factors and calculation methods. Table 7 and Figure 5 illustrate the breakdown of the non-residential energy use GHG emissions.

Small-scale non-residential non-utility fuel use data was not available and therefore could not be included in this inventory, but any emissions associated with non-residential mobile equipment, such as generators, forklifts and grounds equipment was included in the off-road equipment emissions estimates in the Transportation Sector. GHG emissions associated with non-residential transportation, solid waste and wastewater are accounted for in the community transportation, community solid waste and wastewater treatment emissions totals, respectively.

Table 7: 2010 Non-Residential Energy Use Emissions Summary (Metric Tons CO_2e)

Non-Residential Energy Use	Metric Tons CO2e
Electricity Use – PG&E (excluding water and wastewater treatment)	21,941
Electricity Use – Direct Access	2,405
Stationary Combustion – Natural Gas	25,580
Electricity Transmission and Distribution Losses	2,858
Total Non-Residential Energy Use	**52,784**
Other Emissions Sources in the Community	
Power Generation Facilities – Oroville Cogen Natural Gas	7,951
Power Generation Facilities – POPI Biomass	3,439
Total Other Emissions Sources in the Community	**11,390**
Information Items	
Power Generation Facilities – POPI Biomass (Biogenic CO_2)	127,281

Figure 5: 2010 Non-Residential Energy Use Emissions Summary (Metric Tons CO_2e)



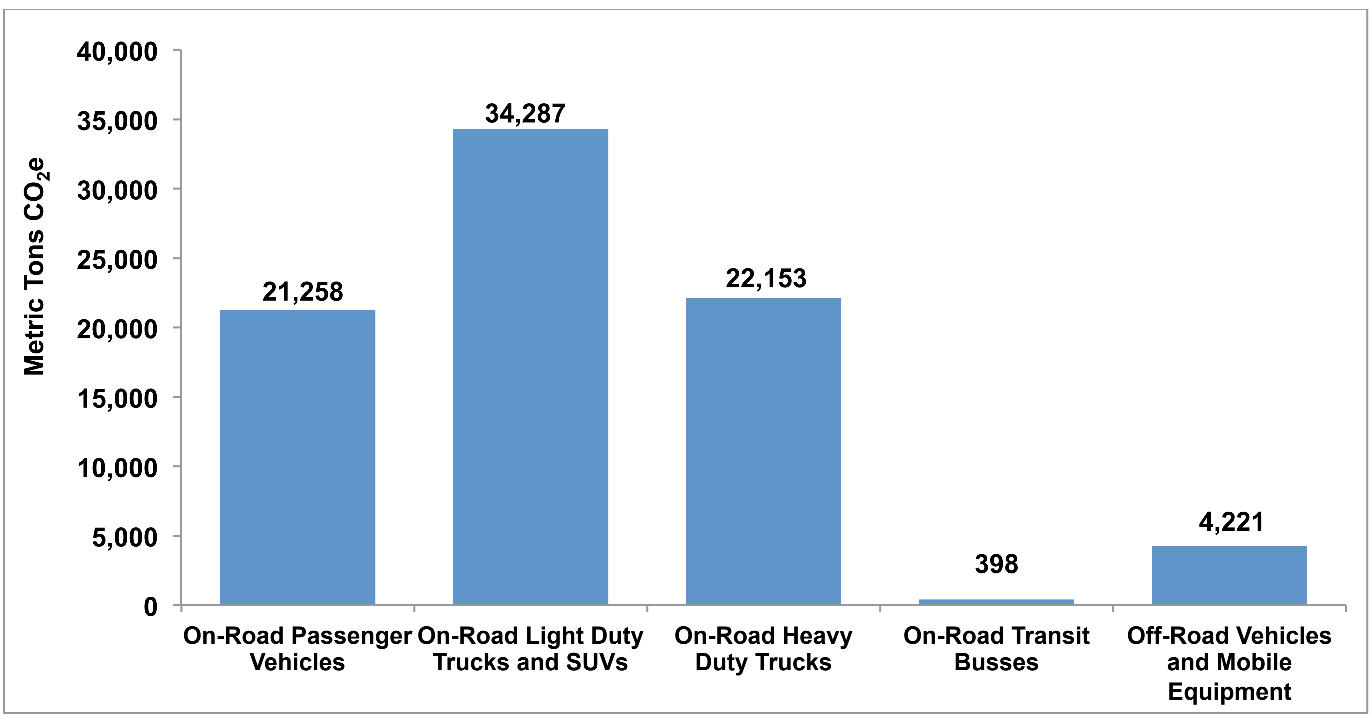
Community Transportation

Oroville's community transportation generated an estimated 82,317 metric tons of CO_2e in 2010. The community transportation analysis includes emissions from estimated community vehicle travel in the region with an origin or destination in Oroville. Also included are emissions from the use of off-road vehicles and equipment. Appendix D provides detailed community transportation activity data, emissions factors and calculation methods. Table 8 and Figure 6 illustrate the breakdown of community transportation GHG emissions. Emissions from passenger rail and air travel of area residents were not included in the analysis.

Table 8: 2010 Transportation Emissions Summary (Metric Tons CO_2e)

Community Transportation	Metric Tons CO_2e
On-Road Passenger Vehicles	21,258
On-Road Light Duty Trucks and SUVs	34,287
On-Road Heavy Duty Trucks[6]	22,153
On-Road Urban Busses	398
Off-Road Vehicles and Mobile Equipment	4,221
Total Community Transportation	**82,317**

Figure 6: 2010 Community Transportation Emissions Summary (Metric Tons CO_2e)



6 Heavy Trucks category includes school busses and "other" busses but not urban busses.

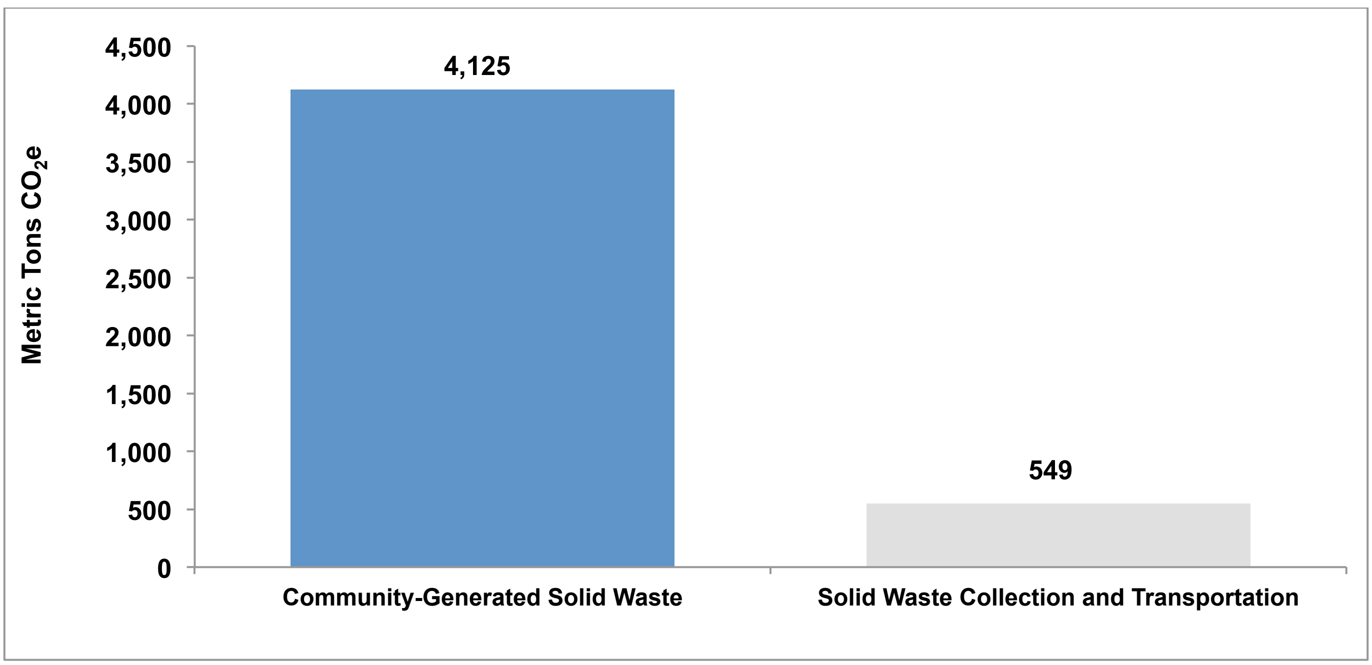
Community Solid Waste

Oroville's community-generated solid waste resulted in estimated emissions of 4,125 metric tons of CO_2e in 2010. Solid waste emissions are an estimate of methane generated from the anaerobic decomposition of organic wastes (such as paper, food scraps, plant debris, wood, etc.) that are deposited in a landfill. This inventory accounts for the future emissions from solid waste generated by the community in 2010. Additionally, simplified emissions estimates for the collection and transportation of community-generated solid waste are reported as an Information Item. The collection and transportation emissions provide additional context to the Solid Waste Sector, though the emissions are included in the total Community Transportation Sector emissions. Table 9 and Figure 7 detail community-generated solid waste emissions. Appendix E provides detailed community solid waste activity data, emissions factors and calculation methods.

Table 9: 2010 Community Solid Waste Emissions Summary (Metric Tons CO_2e)

Community Solid Waste	Metric Tons CO_2e
Community-Generated Solid Waste	4,125
Total Community Solid Waste	**4,125**
Information Items	
Collection and Transportation of Community Solid Waste	549

Figure 7: 2010 Community Solid Waste Emissions Summary (Metric Tons CO_2e)



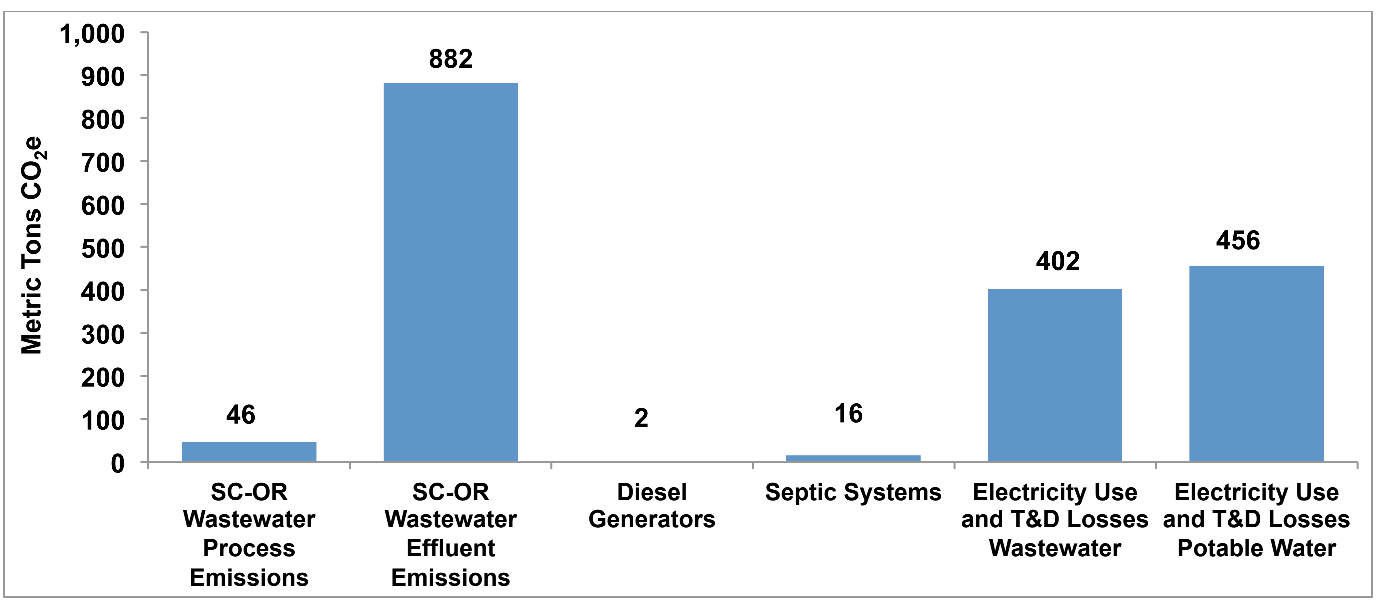
Water Supply and Wastewater Treatment

Oroville's potable water supply and wastewater treatment sector generated an estimated 1,804 metric tons of CO_2e in 2010. Included are 944 metric tons of process and fugitive emissions from the SC-OR wastewater treatment plant (WWTP) and septic systems within the City of Oroville. The remainder is largely from electricity use and a minor amount of diesel use. Wastewater process and fugitive emissions were calculated using population-based methodologies with site-specific operating information and standard emissions factors. Table 10 and Figure 8 detail wastewater treatment emissions. Appendix F provides detailed wastewater treatment activity data, site-specific operating processes, emissions factors and calculation methods. Appendix C provides detailed activity data, emissions factors and calculation methods for the energy used by water supply and wastewater treatment facilities.

Table 10: 2010 Water / Wastewater Treatment Emissions Summary (Metric Tons CO_2e)

Water / Wastewater Treatment	Metric Tons CO_2e
SC-OR Wastewater Treatment (Process Emissions)	46
SC-OR Wastewater Effluent (Fugitive Emissions)	882
Diesel Generators	2
Septic Systems	16
Electricity Use Associated with Wastewater Treatment	358
Electricity T&D Losses Associated with Wastewater Treatment	44
Electricity Use Associated with Potable Water	406
Electricity T&D Losses Associated with Potable Water	50
Total Water / Wastewater Treatment	**1,804**
Information Items	
Oroville-Only Wastewater (SC-OR Treatment, Effluent and Diesel)	372
Oroville-Only Wastewater (SC-OR Electricity Use and T&D)	220

Figure 8: 2010 Water / Wastewater Treatment Emissions Summary (Metric Tons CO_2e)



City of Oroville Community Emissions Efficiency Metrics

Community emissions efficiency metrics can be useful for measuring progress in reducing GHG emissions and for comparing one community's emissions with neighboring cities or counties and against regional and national averages.[7] That said, due to differences in emissions inventory methods, it can be difficult to get a directly comparable per capita emissions number, and one must be cognizant of this margin of error when comparing figures. All efforts were made to estimate a community emissions total and community emissions efficiency metrics that will be comparable to other communities operating under the Significant Influence framework of the USCP.

Table 11 presents community efficiency metrics calculated as part of this inventory. These metrics only include emissions directly tied to community activities: residential and non-residential energy use (including electricity transmission and distribution losses), on-road and off-road transportation, community generated solid waste, and emissions associated with the water supply and wastewater treatment.

Table 11: City of Oroville 2010 Community GHG Emissions Efficiency Metrics

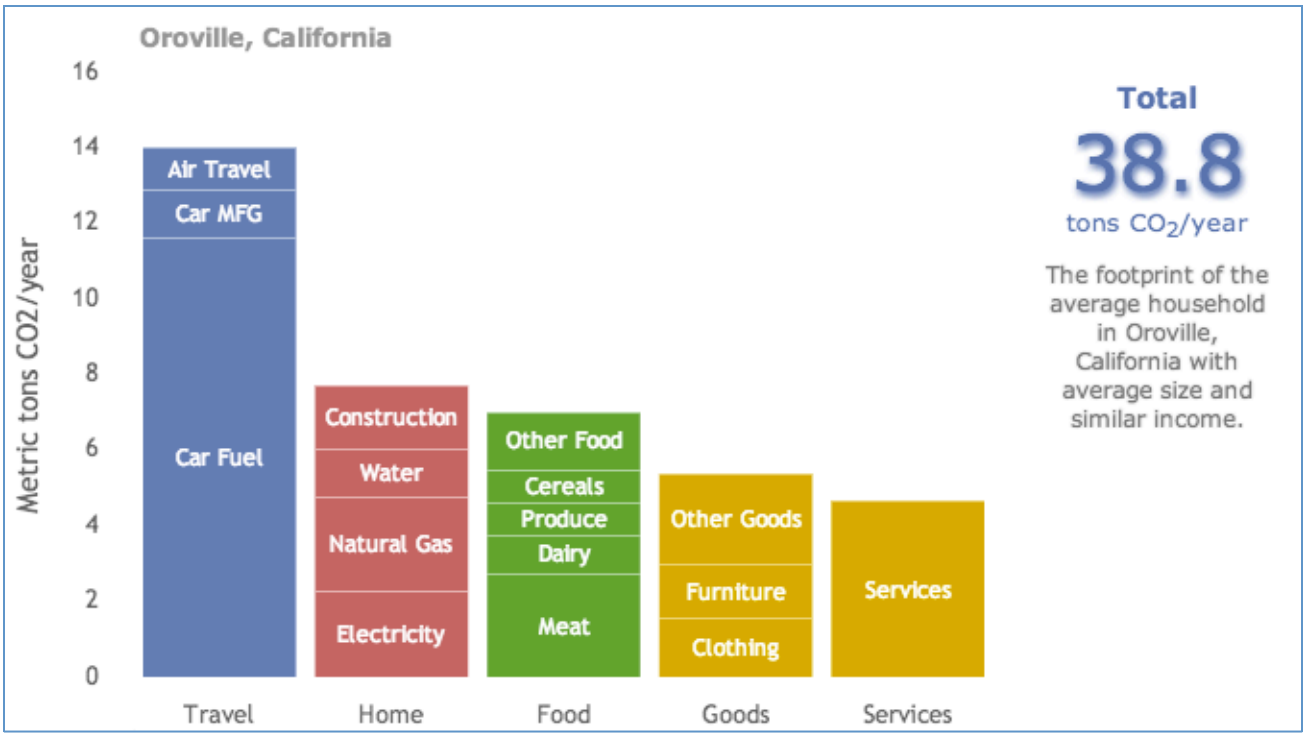
Community Emissions Efficiency Metrics	
Estimated 2010 Population	15,529
Estimated 2010 Households	5,648
Estimated 2010 Employment	4,500
Estimated 2010 Service Population (Population + Employment)	20,029
Community GHG Emissions (Metric Tons CO_2e)	163,288
GHG Emissions / Service Population (Metric Tons CO_2e)	8.2
GHG Emissions / Resident (Metric Tons CO_2e)	10.5
GHG Emissions / Household (Metric Tons CO_2e)	28.9

[7] Per capita CO_2e emissions were 24.3 metric tons per year for the United States and 13.0 metric tons per year for California. World Resources Institute: http://www.laedc.org/sclc/documents/Global_AB32Challenge.pdf.

Cool California Household Consumption GHG Estimates

It is important to understand that the efficiency metrics presented in the inventory are not the same as the carbon footprint of the average individual or household living in Oroville. The carbon footprint includes other activities (e.g. air travel, consumption of goods and services, and upstream emissions) not measured in this inventory. For comparison purposes, Figure 9 presents the results of a simplified household consumption GHG Inventory for Oroville produced by Cool California and available at www.coolcalifornia.org. Additionally, Cool California allows residents and business within Oroville to develop a simplified consumption-based GHG Inventory to calculate their individual carbon footprints and learn ways to reduce their personal carbon footprints while saving money in the process.

Figure 9: Cool California Household Consumption GHG Estimate (Metric Tons CO_2e)[8]



[8] Household consumption estimate developed using Cool California Calculator. Available at: www.coolcalifornia.org/calculator

Municipal-Operations Inventory Results

This section presents a detailed analysis of emissions resulting from the City of Oroville's municipal operations. As described in the Inventory Methodology section of this report, municipal-operations emissions are considered a subset of community-wide emissions. The municipal-operations emissions included in this inventory were determined using the operational control framework discussed in the Inventory Methodology section. The operational control framework includes emissions sources and activities for which the City has the full authority to introduce and implement operating policies. The municipal-operations inventory also includes two additional emissions sectors for which the City of Oroville has less control: emissions from employee-generated solid waste and emissions from employees' personal commutes to work. The LGOP strongly recommends including these optional sources even though the City does not have full operational control.

Emissions Summary

In 2010, the City of Oroville's municipal operations generated 1,252 metric tons of CO_2e reported in the municipal-operations inventory. Figure 10 summarizes the municipal-operations GHG emissions. As shown, the largest sector of emissions within the municipal-operations inventory in 2010 was the vehicle fleet, which includes all municipal vehicles as well as the off-road vehicles and mobile equipment.

Figure 10: 2010 Municipal-Operations GHG Emissions Summary (Metric Tons CO_2e)

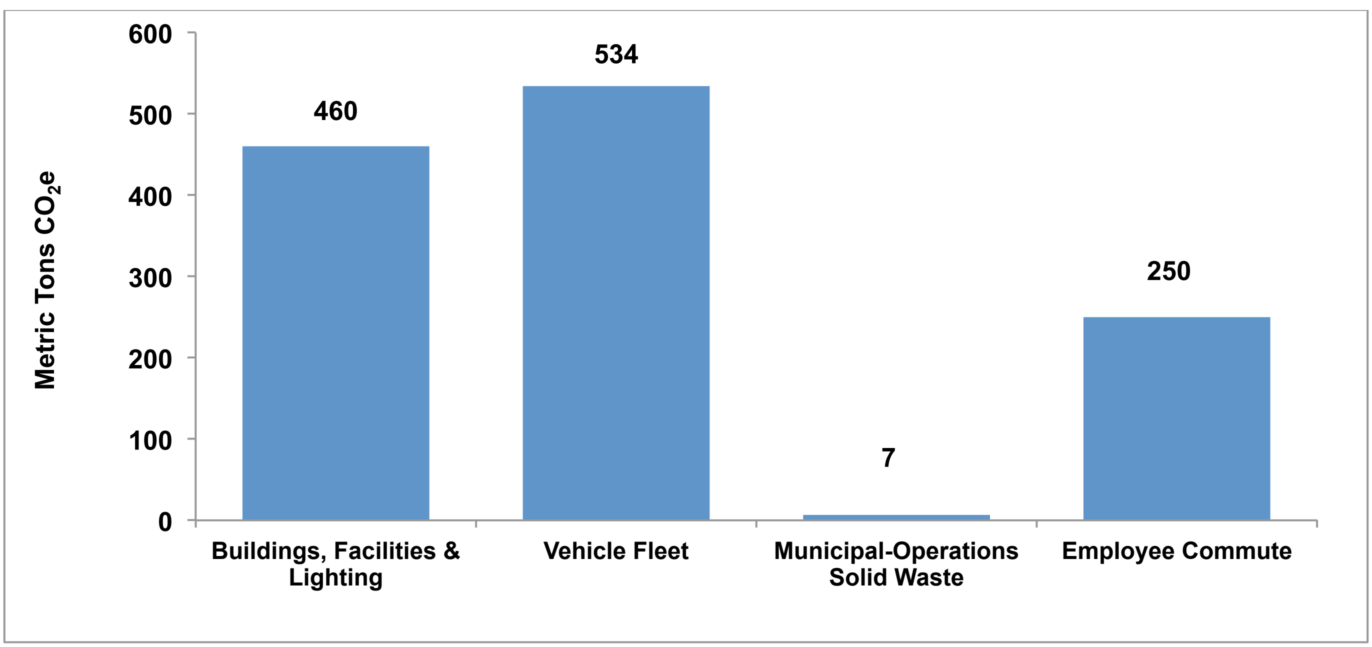


Table 12 presents detailed municipal-operations GHG emissions as well as additional Information Items that are not shown in Figure 10. These Information Items are reported separately from the GHG inventory totals per LGOP guidance. The Information Items presented in Table 12 include: R-12 refrigerants used in pre-1995 vehicle fleet air conditioning (an ozone depleting substance currently being phased out worldwide), PG&E owned and operated LS-1 designated streetlights, and solid waste from community activities - rather than municipal operations - (e.g. waste from parks and street trash cans).

Table 12: 2010 Municipal-Operations GHG Emissions Summary (Metric Tons CO_2e)

Municipal-Operations Sectors	Metric Tons CO_2e	Reporting Scope
Buildings and Facilities		
Electricity Use - Buildings	142	Scope 2
Stationary Combustion (Natural Gas) - Buildings	102	Scope 1
Electricity Use - Lighting	170	Scope 2
Electricity Use - Water and Wastewater Transport	8	Scope 2
Electricity Transmission and Distribution Losses	39	Scope 3
Total Building and Facilities	**460**	
Vehicle Fleet		
On-Road Gasoline Vehicles	355	Scope 1
On-Road Diesel Vehicles	123	Scope 1
Off-Road Equipment All Fuel	27	Scope 1
Leaked R-134a Refrigerant	29	Scope 1
Total Vehicle Fleet	**534**	
Municipal-Operations Solid Waste		
Municipal-Operations Solid Waste	7	Scope 3
Total Municipal-Operations Solid Waste	**7**	
Employee Commute		
Employee Commute Emissions	250	Scope 3
Total Employee Commute	**250**	
Total Municipal-Operations Emissions	**1,252**	
Information Items		
Ozone Depleting Substances (Vehicle Fleet R-12)	69	
LS-1 Lighting	1	
Community-Generated Solid Waste	16	

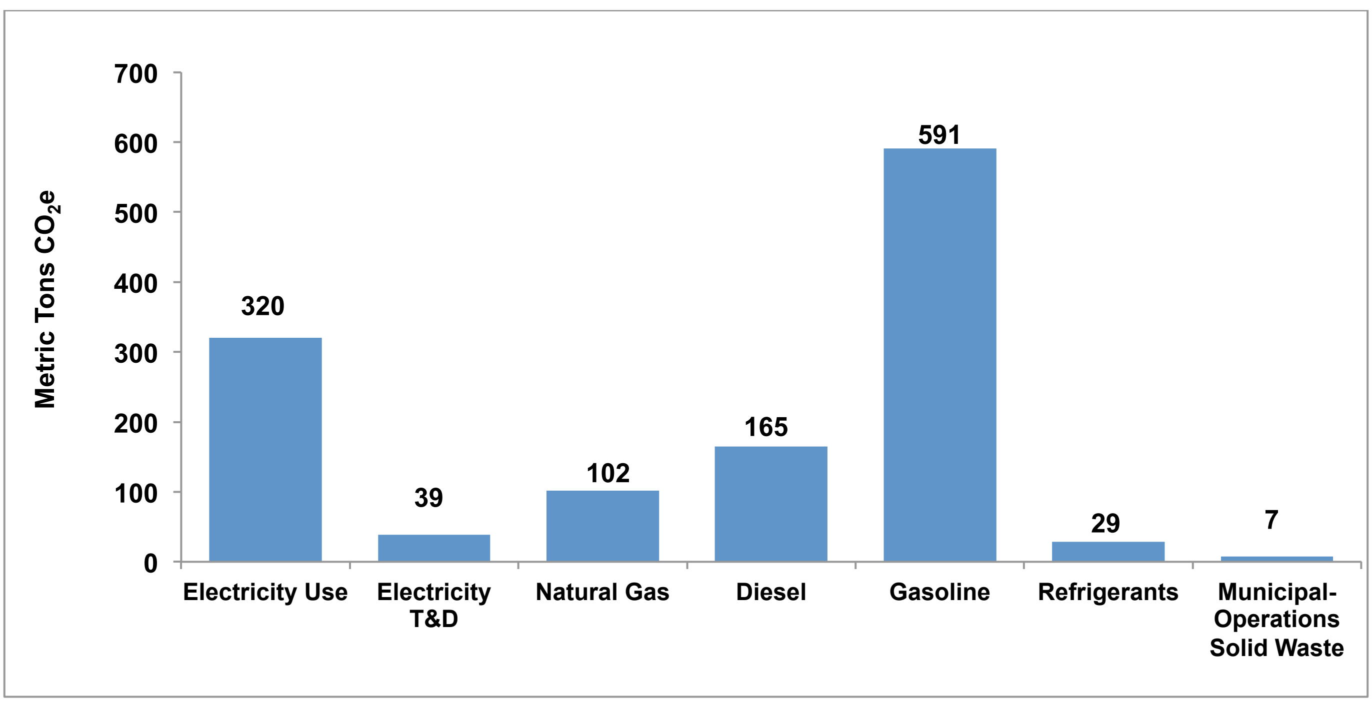
Emissions Sources and Activities

Identifying the major emissions sources and activities can help target reduction strategies that will have the greatest effect on emissions. The majority emissions are generated from gasoline use in municipal vehicles and employees' personal vehicles used to commute to work and electricity used in municipal buildings and facilities including public lighting, parks, and water and wastewater transport. Table 13 and Figure 11 present the municipal-operations emissions by source / activity.

Table 13: 2010 Municipal-Operations GHG Emissions by Source / Activity (Metric Tons CO_2e)

Source / Activity	Metric Tons CO_2e
Electricity Use	320
Electricity Transmission & Distribution Losses	39
Natural Gas	102
Diesel	165
Gasoline	591
Refrigerants	29
Municipal-Operations Solid Waste	7
Municipal-Operations Total	**1,252**

Figure 11: 2010 Municipal-Operations GHG Emissions by Source (Metric Tons CO_2e)



Buildings and Facilities

The Buildings and Facilities Sector includes electricity and stationary fuel (natural gas) consumption at the City of Oroville's buildings and other facilities, including water and wastewater transport and public lighting. The operation of Oroville's buildings and facilities produced an estimated 460 metric tons of CO_2e. The small amount of emissions that may result from the use of fire suppressants and leaking refrigerants are not included in this inventory. Refer to Appendix G for detailed activity data, emissions factors and calculation methods used in the Buildings and Facilities Sector. Table 14 lists the major City of Oroville buildings and facilities and their associated emissions.

Table 14: 2010 Buildings and Facilities Emissions Summary (Metric Tons CO_2e)

Buildings and Facilities	Metric Tons CO_2e
Police/Fire	55
Airport	43
City Hall	31
Corp Yard	23
Municipal Auditorium	20
Parks & Museums	18
Lott House	16
Chinese Temple	14
Cultural Center	12
State Theater and Minor Buildings	11
Oroville Inn placeholder	Not available at time of report.
Water and Wastewater Transport	8
Public Lighting	170
Electricity T&D Losses	39
Buildings and Facilities Total	**460**
Information Items	
LS-1 Designated Public Lighting	1

Additionally, it is helpful to identify the largest emissions sources and activities within each sector to help target reduction strategies. Table 15 presents the municipal buildings and facilities emissions by source / activity.

Table 15: 2010 Buildings and Facilities Emissions by Source / Activity (Metric Tons CO_2e)

Source / Activity	Metric Tons CO_2e
Electricity Use	320
Electricity T&D Losses	39
Natural Gas	102
Buildings and Facilities Total	**460**

Vehicle Fleet

The vehicles and mobile equipment used in the City of Oroville's daily operations burn gasoline and diesel fuel resulting in the emission of GHGs. In addition, vehicles with air conditioning use refrigerants that can leak from the vehicles during normal operation and maintenance. In 2010, the City operated a vehicle fleet with 105 vehicles; including 37 police vehicles, 26 public works vehicles, 12 fire vehicles and a host of off-road equipment including lawn mowers, sweepers, weed eaters, backhoes, a roller, a loader, and an air compressor. The fleet performed essential services, from police and fire service, to supporting public works, engineers, and sewer/water treatment. The City of Oroville's 2010 Vehicle Fleet Sector emissions are estimated to be 534 metric tons of CO_2e. Refer to Appendix H for detailed activity data, emissions factors and calculation methods used in the Vehicle Fleet Sector. Table 16 presents the City of Oroville vehicle fleet emissions by department.

Table 16: 2010 Vehicle Fleet Emissions Summary (Metric Tons CO_2e)

Department	Metric Tons CO_2e
Police Department	235
Public Works	101
Fire Department	70
Parks	44
Sewer Department	27
Other Departments	14
Housing	13
Leaked Refrigerants - All Departments	29
Vehicle Fleet Total	**534**
Information Items	
Ozone Depleting Substances (Vehicle Fleet R-12)	69

Additionally, it is helpful to identify the largest sources of emissions within each sector to help target reduction strategies. Table 17 presents the vehicle fleet emissions by source.

Table 17: 2010 Vehicle Fleet Emissions by Source (Metric Tons CO_2e)

Source	Metric Tons CO_2e
Gasoline	359
Diesel	147
Leaked Refrigerants	29
Vehicle Fleet Total	**534**

Municipal-Operations Solid Waste

Governments generate solid waste during normal operations, much of which is sent to landfills. Typical sources of waste in municipal operations include paper and food waste from offices and facilities, construction waste from public works, and plant debris from parks departments. Organic materials in the solid waste generate methane as they decompose in the anaerobic environment of a landfill. Emissions from the Municipal-Operations Solid Waste Sector are an estimate of methane generation that will result from this anaerobic decomposition of waste sent to landfills in 2010. It is important to note that although these government-generated solid-waste emissions are attributed to the inventory in the year in which the waste is generated (2010), the emissions themselves will occur over the 100+ year timeframe that the waste will decompose, and are therefore categorized as Scope 3 emissions.

Only solid waste generated by City of Oroville's municipal operations is included in this inventory. Solid waste generated by the Oroville community at large is excluded from the inventory totals because the City has little control over the waste that is deposited. The community waste that is collected as a city service and paid for by the City is reported in Table 18 under Information Items. City of Oroville's 2010 Municipal-Operations Solid Waste Sector emissions are estimated to be 7 metric tons of CO_2e. Refer to Appendix I for detailed activity data, emissions factors and calculation methods used in the Municipal-Operations Solid Waste Sector. Table 18 presents Oroville's solid waste emissions by department.

Table 18: 2010 Municipal-Operations Solid Waste Emissions Summary (Metric Tons CO_2e)

Department	Metric Tons CO_2e
Police/Fire	2
Airport	2
City Yard	2
City Hall	1
Housing Redevelopment Project	0.3
Solid Waste Total	**7**
Information Items	
Community Waste (City Trucks, Cans, Bins)	10
Community Waste (Parks and Museums)	6

Employee Commute

Although employees' personal commute choices are not under the direct operational control of the City of Oroville, there are a variety of tools and resources available to influence employees' commute patterns. For this reason, emissions are included in this inventory. A survey was administered to City of Oroville employees to collect the data needed to estimate emissions. The 2013 survey results from 43 respondents were extrapolated to the 113 employees of the City in 2010. Refer to Appendix J for detailed activity data, emissions factors and calculation methods used in the Employee Commute Sector. Employee commute emissions are categorized as Scope 3 emissions. Table 19 presents the emissions from the Employee Commute Sector, which total 250 metric tons CO_2e.

Table 19: 2010 Employee Commute Emissions Summary (Metric Tons CO_2e)

Source	Metric Tons CO_2e
Passenger Cars – Gasoline	125
Light Trucks - Gasoline	107
Light Trucks - Diesel	18
Employee Commute Total	**250**

Conclusion & Next Steps

The data presented in this report is intended to provide valuable information that the City of Oroville can use to inform future planning efforts, identify cost saving opportunities and identify climate action planning priorities. This analysis found that in the base year 2010, the community as a whole was responsible for emitting 163,288 metric tons of CO_2e, while the City of Oroville's municipal operations contributed 1,252 metric tons of CO_2e to that total. City staff should continue to update these inventories as additional data become available. Additional key findings from this analysis include:

- The sector contributing the most community-wide GHG emissions is the Community Transportation Sector (82,317 metric tons of CO_2e). The second most significant contributor is the Non-Residential Sector (52,784 metric tons of CO_2e). The third most significant contributor is the 22,259 metric tons CO_2e from residential energy use. There are significant opportunities for reducing GHG emissions and as well as energy and transportation costs in these sectors.

- The sector contributing the most municipal-operations GHG emissions is the vehicle fleet (534 metric tons of CO_2e). Significant emissions (460 metric tons of CO_2e) originate from buildings and facilities, specifically the electricity used for public lighting (170 of the 460 metric tons CO_2e). Opportunities to reduce GHG emissions may include lighting and building energy-efficiency projects, procuring renewable electricity, improvements to vehicle fleet efficiency, and reductions in commute miles.

As the City of Oroville moves forward with emissions reduction strategies and uses this data to inform planning efforts, the City should identify the emissions reduction benefits of climate and sustainability strategies that could be implemented in the future including: energy and water efficiency, renewable energy, vehicle-fuel efficiency, alternative transportation, vehicle trip reduction, land use and transit planning, waste reduction, and other strategies. Through these efforts and others Oroville can achieve benefits beyond reducing emissions, including saving money and improving the City's economic vitality and ultimately increasing the quality of life for its residents.

GHG Inventories' Role in Emissions Reduction Framework

In response to the problem of climate change, many communities in the United States are taking responsibility for addressing emissions at the local level. Since many of the major sources of GHG emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing GHG emissions within their boundaries. Through proactive measures around land use patterns, transportation demand management, energy efficiency, green building, waste diversion, and more, local governments can more effectively reduce emissions in their communities. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts.

ICLEI – Local Governments for Sustainability (ICLEI) is an association for local governments to share knowledge and successful strategies toward increasing local sustainability.[9] ICLEI provides a framework and methodology for local governments to identify and reduce GHG emissions, organized along Five Milestones (shown in Figure 13):

Figure 12: The Five Milestones of Identifying and Reducing Greenhouse Gas Emissions.

1. Conduct an inventory of local GHG emissions
2. Conduct an GHG emissions forecast and establish a reduction target
3. Develop a climate action plan for achieving the emissions reduction target
4. Implement the climate action plan
5. Monitor and report on progress

This report represents the completion of ICLEI's Climate Mitigation Milestone One and provides a foundation for future work to reduce GHG emissions in the City of Oroville.

Potential Next Steps

There are several potential next steps that SBC recommends the City of Oroville undertake to continue to efforts to reduce GHG emissions, reduce community and municipal energy and transportation costs and improve local air quality and health of community members.

- Continue to track electricity and fuel use and the associated costs so that cost-effective energy saving measures can be implemented
- Benchmark municipal buildings and facilities to help track energy use and target energy efficiency projects.
- Re-inventory GHG emissions every three to five years to track progress.
- Develop climate action or energy action plans to assist in the development of GHG reduction strategies

The City of Oroville is currently working with "The Planning Center – DC&E" and "ICF" regarding the preparation of the City's Climate Action Plan (CAP); the CAP should be reviewed and adopted by the Oroville City Council on or before March 31, 2015.

[9] ICLEI was formerly known as the International Council for Local Environmental Initiatives, but the name has been changed to ICLEI – Local Governments for Sustainability. http://www.iclei.org & http://www.icleiusa.org

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Community-Wide Inventory Appendices

Appendix A - Community Inventory Details – ICLEI Scoping Tool

Table A-1 provides a summary of the emissions sources and activities that are included in the community inventory, as well as those potential sources that are excluded.

Table A-1: Summary of Included and Excluded Community Emissions

Emissions Type		Source or Activity?	Required Activities	Included under reporting frameworks:			Excluded (IE, NA, NO, or NE)	Explanatory Notes	Emissions ($MTCO_2e$)
				SI	CA	HC			
Built Environment									
Use of fuel in residential and commercial stationary combustion equipment		Source AND Activity	X	X					38,669
Industrial stationary combustion sources		Source					IE	Included in commercial stationary combustion	
Electricity	Power generation in the community	Source					IB	Pacific Oroville Power Inc Biomass 3,439 MT CO2e: Oroville Cogen 7,951 MT CO2e	
	Use of electricity by the community	Activity	X	X					32,525
District Heating/ Cooling	District heating/cooling facilities in the community	Source					NO	No district heating/cooling	
	Use of district heating/cooling by the community	Activity					NO	No district heating/cooling	
Industrial process emissions in the community		Source					NE	Deemed insignificant.	
Refrigerant leakage in the community		Source					NE	Deemed insignificant.	

Emissions Type		Source or Activity?	Required Activities	Included under reporting frameworks: SI	CA	HC	Excluded (IE, NA, NO, or NE)	Explanatory Notes	Emissions ($MTCO_2e$)
Transportation and Other Mobile Sources									
On-road Passenger Vehicles	On-road passenger vehicles operating within the community boundary	Source					NE	Entered as Activity data	
	On-road passenger vehicle travel associated with community land uses	Activity	X	X					78,096
On-road Freight Vehicles	On-road freight and service vehicles operating within the community boundary	Source					NE	Entered as Activity data	
	On-road freight and service vehicle travel associated with community land uses	Activity	X	X			IE	Included in On-Road Passenger Vehicle Emissions	
On-road transit vehicles operating within the community boundary		Source		X			IE	Included in On-Road Passenger Vehicle Emissions	
Transit Rail	Transit rail vehicles operating within the community boundary	Source					NO	No Transit Rail	
	Use of transit rail travel by the community	Activity					NE	Deemed insignificant.	
Inter-city passenger rail vehicles operating within the community boundary		Source					NO	No Passenger Rail	
Freight rail vehicles operating within the community boundary		Source					NE	Deemed insignificant.	
Marine	Marine vessels operating within the community boundary	Source		X			IE	Pleasure Craft Included in Off-Road Emissions	
	Use of ferries by the community	Activity					NE	Deemed insignificant.	
Off-road surface vehicles and other mobile equipment operating within the community boundary		Source		X					4,221
Use of air travel by the community		Activity					NE	No Data Available	
Solid Waste									
Solid Waste	Operation of solid waste disposal facilities in the community	Source					NO	No Solid Waste Facilities	
	Generation and disposal of solid waste by the community	Activity	X	X					4,125
Collection and Transportation of community-generated solid waste				X			Information Item	549 MT CO2e	

Emissions Type		Source or Activity?	Required Activities	Included under reporting frameworks: SI	CA	HC	Excluded (IE, NA, NO, or NE)	Explanatory Notes	Emissions ($MTCO_2e$)
Water and Wastewater									
Potable Water - Energy Use	Operation of water delivery facilities in the community	Source		X			IE	Included in use of potable water by the community	
	Use of energy associated with use of potable water by the community	Activity	X	X				T&D below.	406
Use of energy associated with generation of wastewater by the community		Activity		X				T&D below.	358
Centralized Wastewater Systems - Process Emissions	Process emissions from operation of wastewater treatment facilities located in the community	Source		X					930
	Process emissions associated with generation of wastewater by the community	Activity		X			Information Item	372 MT CO2e included w/ 930.	
Use of septic systems in the community		Source AND activity		X					16
Agriculture									
Domesticated animal production		Source					NO	No Livestock Production	
Manure decomposition and treatment		Source					NO	No Livestock Production	
Upstream Impacts of Community-Wide Activities									
Upstream impacts of fuels used in stationary applications by the community		Activity					NE	Not Estimated	
Upstream and transmission and distribution (T&D) impacts of purchased electricity used by the community		Activity						3,942	
Upstream impacts of fuels used for transportation in trips associated with the community		Activity					NE	Not Estimated	
Upstream impacts of fuels used by water and wastewater facilities for water used and wastewater generated within the community boundary		Activity					NE	Not Estimated	
Upstream impacts of select materials (concrete, food, paper, carpets, etc.) used by the whole community		Activity					NE	Not Estimated	
Independent Consumption-Based Accounting									
Household Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all households in the community)		Activity					NE	See Cool California Estimates	
Government Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all governments in the community)		Activity					NE	Not Estimated	
Life cycle emissions of community businesses (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all businesses in the community)		Activity					NE	Not Estimated	

Appendix B - Residential Energy Use Sector Notes

Table B-1: Residential Activity Data Inputs

Activity / Source	Value	Units	Data Source
Electricity Consumption - PG&E	40,209,838	kWh	Pacific Gas and Electric
Natural Gas Consumption - PG&E	2,183,362	Therms	Pacific Gas and Electric
Electricity Consumption - Direct Access	50,466	kWh	California Energy Commission
Electricity Transmission & Distribution Losses	3,305,371	kWh	U.S. Environmental Protection Agency
Propane (LPG)	127,271	Gallons	Energy Information Administration and U.S. Census Bureau
Wood for Home Heating Consumption	5,220	Short Tons	Energy Information Administration and U.S. Census Bureau

Table B-2: Residential GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO_2	CH_4	N_2O	Emissions Factor Source
Electricity – PG&E	BE.2.1	445 lbs/MWh	28.94 lbs/GWh	6.17 lbs/GWh	2010 Pacific Gas and Electric (CO_2) 2009 U.S. EPA eGRID WECC California (CH_4 and N_2O)
Natural Gas – PG&E	BE.1.1	53.02 kg/MMBtu	0.005 kg/MMBtu	0.0001 kg/MMBtu	USCP Appendix C - Table B.1 Natural Gas Pipeline (US Weighted Average) and Table B.3 Natural Gas Residential
Electricity – Direct Access	BE.2.1	658.68 lbs/MWh	28.94 lbs/GWh	6.17 lbs/GWh	2009 U.S. EPA eGRID WECC California (CO_2, CH_4 and N_2O)
Electricity - T&D Losses	BE.4.1	658.68 lbs/MWh	28.94 lbs/GWh	6.17 lbs/GWh	2009 U.S. EPA eGRID WECC California (CO_2, CH_4 and N_2O)
Propane (LPG)	BE.1.2	5.79 kg/Gallon	0.001 kg/Gallon	0.0001 kg/Gallon	USCP Appendix C - Table B.1 LPG and Table B.4 Residential LPG
Wood	BE.1.2	93.80 kg/MMBtu	0.316 kg/MMBtu	0.0042 kg/MMBtu	USCP Appendix C - Table B.2 Wood and Wood Residuals and Table B.3 Biomass Fuels Solid Residential

Methods:

Utility-Derived Data

Utility-provided activity data is shown in Table B-1. Electricity and natural gas consumption data was collected from Pacific Gas and Electric Company (PG&E) for facilities within the City of Oroville. The data provided by PG&E was categorized as residential, commercial or industrial use where possible. The residential electricity and natural gas data was entered into the Climate and Energy Management Suite website where the GHG emissions were calculated using PG&E's reported grid emissions factors for electricity. Default combustion emissions factors were used for natural gas consumption. The calculation methods and emissions factors are shown in Table B-2.

Table B-3: Residential Non-Utility Home Heating Fuel Use Calculations

Parameter	Propane (LPG)	Wood	Data Source
California Fuel Use	8,273	1,628	Energy Information Administration (EIA) State Energy Data System (SEDS) 2010 California Residential Energy Use Estimates
Units	Thousand Barrels	Thousand Cords	
# of California Households	393,137	218,319	U.S. Census Bureau, 2010 American Community Survey (ACS) 1-year estimates Table B25040. California Households using Non-Utility Fuels for Home Heating
Per Household Fuel Use	883.83	13.05	
Units	Gallons	Short Tons	
Community Households	144	400	U.S. Census Bureau, 2010 American Community Survey (ACS) 5-year estimates. Table DP04. Community Households using Non-Utility Fuels for Home Heating
Estimated Fuel Use	127,271	5,220	
Units	Gallons	Short Tons	

Fuel Type	City Households per 2010 ACS	Margin of Error	City Estimates Used in Inventory
Propane (LPG)	144	+/-101	144
Kerosene	17	+/-19	0
Wood/Biomass	340	+/-132	400

Non-Utility Derived Data

Non-utility activity data is shown in Table B-1. Propane (LPG), fuel oil / kerosene and wood used for home heating were estimated using Energy Information Administration (EIA) and U.S. Census Bureau American Community Survey (ACS) data. The EIA State Energy Data System 2010 California residential energy use estimates and the U.S. Census Bureau 2010 ACS 1-year estimates of California households using non-utility fuels for home heating was used to calculate California per household fuel use in 2010. This per household fuel use factor was applied to U.S. Census Bureau 2010 ACS 5-year estimates of Oroville households using non-utility fuels for home heating. Due to the high level of uncertainty in the 2010 ACS 5-year estimates for Oroville, City staff were consulted to determine more accurate estimates within the margin of error of the ACS 5-year estimates. Table B-3 above shows the data used in these calculations. Activity data was then entered into the Climate and Energy Management Suite using the calculation methods and emissions factors shown in Table B-2.

Table B-4: Direct Access Electricity Usage

Direct Access Calculator							
County	Sector	Year	Utility		Direct Access		Total
			Million kWh	%	Million kWh	%	
Butte County	Residential	2010	716.64	53.39	0.90	1.97	717.54
Butte County	Non-Residential	2010	625.66	46.61	44.87	98.03	670.52
Total (Million kWh)			1,342		46		1,388
Total %			96.70%		3.30%		100.00%

Direct Access Estimate by Local Government					
Sector	PG&E Total kWh	% DA Usage	DA kWh	Calculations to Estimate Proportion	
Residential	40,209,838	0.13%	50,466	0.13%	99.87%
Non-Residential	111,793,954	7.17%	8,017,191	6.69%	93.31%

Direct Access Electricity Data

Direct access activity data is shown in Table B-1. Direct access electricity is energy supplied by a competitive energy service provider other than a utility, but uses a utility's transmission lines to distribute the energy. Direct access electricity was either provided by PG&E or, when confidentiality laws would not allow data release, was estimated from county-level direct access electricity data provided by the California Energy Commission (CEC). The direct access calculator provided by ICLEI, Table B-4, was used to estimate direct access electricity usage within the City of Oroville. The total direct access electricity consumption for Butte County was used to determine the ratio of direct-access electricity use to utility-provided electricity use for Residential and Non-Residential Sectors. This ratio was applied to the utility-provided electricity use within the City to determine an estimate of the direct-access electricity consumed within Oroville. The calculated direct access totals were entered into the Climate and Energy Management Suite where the GHG emissions were calculated using the U.S. Environmental Protection Agency's (EPA) Emissions & Generation Resource Integrated Database (eGRID) 2009 Western Electricity Coordinating Council (WECC) California sub region grid average emissions factors. Direct access natural gas use was included in the PG&E totals.

Electricity Transmission and Distribution Losses Data

Electricity transmission and distribution (T&D) losses activity data is shown in Table B-1. T&D Losses were calculated for the combined residential electricity total, PG&E and direct access electricity combined, using the EPA eGRID 2009 Western region grid loss factor of 8.21%. The calculated T&D losses were entered into the Climate and Energy Management Suite where the GHG emissions were calculated using the EPA eGRID 2009 WECC California sub region grid average emissions factors.

Appendix C - Non-Residential Sector Notes

Table C-1: Non-Residential Activity Data Inputs

Activity / Source	Value	Units	Data Source
Electricity Consumption - PG&E (includes water and wastewater facility use)	111,793,954	kWh	Pacific Gas and Electric
Natural Gas Consumption - PG&E	4,810,381	Therms	Pacific Gas and Electric
Electricity Consumption - Direct Access	8,017,191	kWh	California Energy Commission
Electricity Transmission & Distribution Losses (includes water and wastewater facility use losses)	9,836,495	kWh	U.S. Environmental Protection Agency
Power Generation - Natural Gas Consumption	150,104	MMBtu	Energy Information Administration
Power Generation - Wood and Wood Residuals Consumption	1,676,452	MMBtu	Energy Information Administration

Table C-2: Non-Residential GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO_2	CH_4	N_2O	Emissions Factor Source
Electricity - PG&E	BE.2.1	445 lbs/MWh	28.94 lbs/GWh	6.17 lbs/GWh	2010 Pacific Gas and Electric (CO_2) and 2009 EPA eGRID WECC California (CH_4 and N_2O)
Natural Gas - PG&E	BE.1.1	53.02 kg/MMBtu	0.005 kg/MMBtu	0.0001 kg/MMBtu	USCP Appendix C - Table B.1 Natural Gas Pipeline (US Weighted Average) and Table B.3 Natural Gas Commercial
Electricity - Direct Access	BE.2.1	658.68 lbs/MWh	28.94 lbs/GWh	6.17 lbs/GWh	2009 EPA eGRID WECC California (CO_2, CH_4 and N_2O)
Electricity - T&D Losses	BE.4.1	658.68 lbs/MWh	28.94 lbs/GWh	6.17 lbs/GWh	2009 EPA eGRID WECC California (CO_2, CH_4 and N_2O)
Diesel	BE.1.1	10.21 kg/gallon	0.0004 kg/MMBtu	0.0001 kg/MMBtu	USCP Appendix C - Table B.1 Distillate Fuel Oil No. 2 and Table B.4 Distillate Fuel Oil No. 2 Industrial
Natural Gas - Power Generation	BE.6.1	52.91 kg/MMBtu	0.001 kg/MMBtu	0.0001 kg/MMBtu	California Air Resources Board and USCP Appendix C - Table B.3 Natural Gas Energy Industry
Wood and Wood Residuals - Power Generation	BE.6.1	75.92 kg/MMBtu	0.032 kg/MMBtu	0.0042 kg/MMBtu	California Air Resources Board and USCP Appendix C - Table B.3 Biomass Fuels Solid Energy Industry

Methods:

Utility-Derived Data

Utility-provided activity data is shown in Table C-1. Electricity and natural gas consumption data was collected from Pacific Gas and Electric Company (PG&E) for all facilities within Oroville. The data provided by PG&E is categorized as residential, commercial or industrial where possible. Activity data, shown in Table C-1, was entered into the Climate and Energy Management Suite where the GHG emissions were calculated using PG&E's reported grid emissions factors for electricity and default combustion emissions factors for natural gas. The calculation methods and emissions factors are shown in Table C-2. Wastewater treatment and potable water infrastructure that lies within the City limits uses electricity that is included in the PG&E non-residential electricity data. Because of this overlap, those wastewater treatment and potable water GHG emissions are subtracted from the non-residential emissions total to prevent double-counting.

It should be noted that as a result of PG&E's 15/15 Confidentiality Rule, electricity and natural gas consumption associated with industrial land uses within Oroville has been aggregated into the commercial energy totals. According to PG&E's 15/15 Rule, any aggregated information provided by the utilities must be made up of at least 15 customers and a single customer's load must be less than 15 percent of an assigned category. If the number of customers in the compiled data is below 15, or if a single customer's load is more than 15 percent of the total data, categories must be combined before the information is released for customer confidentiality purposes.

Table C-3: Direct Access Electricity Usage

Direct Access Calculator							
County	Sector	Year	Utility		Direct Access		Total
			Million kWh	%	Million kWh	%	
Butte County	Residential	2010	716.64	53.39	0.90	1.97	717.54
Butte County	Non-Residential	2010	625.66	46.61	44.87	98.03	670.52
Total (Million kWh)			1,342		46		1,388
Total %			96.70%		3.30%		100.00%

Direct Access Estimate by Local Government					
Sector	PG&E Total kWh	% DA Usage	DA kWh	Calculations to Estimate Proportion	
Residential	40,209,838	0.13%	50,466	0.13%	99.87%
Non-Residential	111,793,954	7.17%	8,017,191	6.69%	93.31%

Direct Access Electricity Data

Direct access activity data is shown in Table C-1. Direct access electricity is energy supplied by a competitive energy service provider other than a utility, but uses a utility's transmission lines to distribute the energy. Direct access electricity data was either provided by PG&E or, when confidentiality laws would not allow data release, was estimated from county-level direct access electricity data provided by the California Energy Commission (CEC). The direct access calculator provided by ICLEI, Table C-3, was used to estimate direct access electricity usage within Oroville. The direct access electricity consumption for Butte County was used to determine the ratio of direct-access electricity use to utility-provided electricity use for Residential and Non-Residential Sectors. This ratio was applied to utility-provided electricity use within Oroville to estimate the City's direct-access electricity use. The direct access estimates were entered into the Climate and Energy Management Suite where the GHG emissions were calculated using the EPA eGRID WECC California grid average emissions factors. Direct access natural gas use was included in the PG&E totals.

Electricity Transmission and Distribution Losses Data

Electricity transmission and distribution (T&D) losses activity data is shown in Table C-1. T&D losses were calculated for the total non-residential electricity total, PG&E and direct access electricity combined, using the EPA eGRID 2009 Western region grid loss factor of 8.21%. The calculated T&D losses were entered into the Climate and Energy Management Suite where the GHG emissions were calculated using the EPA eGRID 2009 WECC California sub region grid average emissions factors.

Power Generation Data

Power generation activity data is shown in Table C-1. Power plant fuel usage data was collected from the Energy Information Administration (EIA) 2010: EIA-923 data set for power plants within the City of Oroville. The natural gas usage was not subtracted from PG&E reported natural gas usage totals because natural gas used for electricity generation is not included in the PG&E Community (non-residential) natural gas use reports. Since the emissions from the fuel used for electricity generation are typically accounted for by communities' electricity use, the power generation emissions within Oroville are not reported within the non-residential total. It is important to note that double counting would happen if the power generation emissions were added to the emissions from community electricity use. Power generation emissions are reported here due to their policy relevance and effect on local air quality. However, it is important to note that not all of the electricity produced at these facilities is necessarily consumed within the City. This data was entered into the Climate and Energy Management Suite to calculate the associated GHG emissions using the emissions factors used in California Air Resources Board (ARB) mandatory greenhouse gas reporting.

Table C-4: Community Potable Water Electricity Use Activity Data

Water System	Process	Electricity Use (kWh)	Water Production (MG)	Energy Intensity (kWh/MG)	Population Served	Gallons per Capita per day	Data Source
CA Water Agency	Conveyance	38,602	747.2	52	7,251	282	CA Water Agency (conveyance not included in PG&E non-res data)
	Extraction	228,610	236.9	965	2,299	282	
	Distribution and Treatment	1,287,111	984.1	1,308	9,550	282	
Thermalito Water and Sewer	Extraction	29,020	332.1	87	5,233	174	Thermalito Water and Sewer
	Treatment	376,859	332.1	1,135	5,233	174	
South Feather Water and Power	Treatment	8,808	48.3	182.2	602	220	South Feather Water and Power (conveyance not included in PG&E non-res data)
	Conveyance	5,317	48.3	110	602	220	
	Water Distribution	26,104	48.3	540	602	220	
Total Electricity Transmission & Distribution Losses (T&D)	8.21% of kWh	164,235	N/A	N/A	N/A	N/A	eGRID Regional T&D Factors (Western = 8.21%).

Blue numbers are supplied data, **black numbers are calculated,** and red numbers are USCP defaults.

Community Potable Water Electricity Use

Electricity used for Oroville's potable water supply is shown in Table C-4. Data on the electricity use, water production and population served was collected from water agencies serving the City's residents and businesses. The electricity use was entered into the Climate and Energy Management Suite where the GHG emissions were calculated using PG&E's reported grid emissions factors for electricity. T&D losses were calculated by applying the EPA eGRID Western region grid loss factor of 8.21% to the total electricity use and then entered into the Climate and Energy Management Suite where the GHG emissions were calculated using the EPA eGRID WECC California sub region grid average emissions factors. Emissions factors and calculation methods are shown in Table C-2.

Table C-5: Community Wastewater Electricity Use Activity Data

Wastewater System	Process	Electricity Use (kWh)	Wastewater Treated (MG)	Energy Intensity (kWh/MG)	Population Served	Gallons per Capita per day	Data Source
SC-OR Wastewater Treatment	Total SC-OR	1,727,040	1,144.5	1,509	38,399	82	SC-OR
	Diesel	159	Gallons / Year				
	T&D Losses 8.21%	141,790					
	Oroville-Only	967,385	641.1	1,509	15,385	114	
	Diesel	89.1	Gallons / Year				
	T&D Losses 8.21%	79,422					
Oroville City-owned sewer lift stations and flow meters	City Equipment	35,202	641.1	55	15,385	114	PG&E records, SC-OR
	T&D Losses 8.21%	2,890					

Community Wastewater Electricity Use

Community-generated wastewater electricity use activity data is shown in Table C-5. Data on electricity use, volume of wastewater treated and population served is from the City's PG&E data and from SC-OR. Wastewater treatment that occurs within the City limits uses electricity that is included in the PG&E non-residential electricity data. Because of this overlap, those wastewater treatment GHG emissions are subtracted from the non-residential emissions total to prevent double-counting.

The electricity use was entered into the Climate and Energy Management Suite where the GHG emissions were calculated using PG&E's reported grid emissions factors for electricity. T&D losses were calculated by applying the EPA eGRID Western region grid loss factor of 8.21% to the total electricity use and then entered into the Climate and Energy Management Suite where the GHG emissions were calculated using the EPA eGRID WECC California sub region grid average emissions factors. Emissions factors and calculation methods are shown in Table C-2.

Appendix D - Transportation Sector Notes

Table D-1: Transportation Activity Data Inputs

Activity / Source	Type	Value	Units	Data Source
On-Road Vehicles Oroville Share	Internal – Internal Trips (I-I)	29,362,446	Miles / Year	Fehr and Peers & Butte County Association of Governments
	Internal – External Trips (I-X)	58,705,113	Miles / Year	
	External – Internal Trips (X-I)	59,773,526	Miles / Year	
Butte County Vehicle Breakdown	Cars and Motorcycles	40.8	Percent	ICF International & California ARB EMFAC2011
	Light Trucks	43.7	Percent	
	Heavy Trucks and Buses	15.3	Percent	
	Urban Transit Buses	0.1	Percent	
Oroville Share of VMT using Butte County Vehicle Breakdown	Cars and Motorcycles	60,356,560	Miles / Year	ICF International & California ARB EMFAC2011
	Light Trucks	64,672,792	Miles / Year	
	Heavy Trucks and Buses	22,616,198	Miles / Year	
	Urban Transit Buses	195,535	Miles / Year	
Off-Road Equipment Emissions	CO_2	4,184	Metric Tons	ICF International & California ARB OFFROAD2007 and OFFROAD2011
	CH_4	0.24	Metric Tons	
	N_2O	0.11	Metric Tons	

Table D-2: Transportation GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO_2	CH_4	N_2O	Emissions Factor Source
On-Road Cars and Motorcycles - Average	TR.1.A	346.75 g/mile	0.030 g/mile	0.016 g/mile	Fehr and Peers, ICF International & California ARB EMFAC2011
On-Road Light Trucks - Average	TR.1.A	518.65 g/mile	0.043 g/mile	0.035 g/mile	
On-Road Heavy Trucks and Buses - Average	TR.1.A	960.27 g/mile	0.253 g/mile	0.043 g/mile	
On-Road Urban Transit Buses - Average	TR.1.A	2,000.50 g/mile	0.028 g/mile	0.112 g/mile	
Off-Road Agriculture Equipment Gasoline	TR.8	8.78 kg/gallon	1.26 g/gallon	0.22 g/gallon	Climate Registry 2013 Emissions Factors - Table 13.1 and 13.7
Off-Road Agriculture Equipment Diesel	TR.8	10.21 kg/gallon	1.44 g/gallon	0.26 g/gallon	Climate Registry 2013 Emissions Factors - Table 13.1 and 13.7
Off-Road Equipment Gasoline	TR.8	8.78 kg/gallon	0.50 g/gallon	0.22 g/gallon	Climate Registry 2013 Emissions Factors - Table 13.1 and 13.7
Off-Road Equipment Diesel	TR.8	10.21 kg/gallon	0.58 g/gallon	0.26 g/gallon	Climate Registry 2013 Emissions Factors - Table 13.1 and 13.7
Off-Road Equipment LPG	TR.8	5.79 kg/gallon	0.50 g/gallon	0.22 g/gallon	Climate Registry 2013 Emissions Factors - Table 13.1 and ICLEI USCP Table TR.6.C.1

Methods:

On-Road Vehicles

On-road transportation emissions for Oroville were estimated by Fehr and Peers and ICF International. Since the actual fuel consumption data is not available at the city level, the emissions were calculated using vehicle-miles traveled (VMT) estimates coupled with county-level vehicle-type/fuel-type percentages by 5-mile-per-hour speed bin. On-road transportation activity data is shown in Table D-1. Final emissions totals were provided by ICF International and entered into the Climate and Energy Management Suite as pre-calculated emissions. The methods and emissions sources are shown in Table D-2. The methodology used by Fehr and Peers for collecting and conditioning this data is as follows:

Vehicle Miles Travelled Estimates

Fehr and Peers ran the Butte County Association of Governments regional Origin-Destination Transportation Model and provided 2010 daily VMT estimates attributed to Oroville. Trips and the subsequent VMT were broken into three categories: Internal-Internal (trips beginning and ending within the community), Internal-External (trips beginning within the community and ending somewhere within the region) and External-Internal (trips beginning somewhere else within the region and ending within the community). The transportation model provides an estimate of daily VMT. Since daily VMT is not representative of annual-average daily VMT a global adjustment factor of 347, developed by Fehr and Peers for model validation, was multiplied by the daily VMT to convert to annual VMT.

Fuel / Vehicle Type Breakdown and Emissions Calculations

Since the regional transportation model does not provide VMT by fuel and vehicle type, local fuel and vehicle type percentages were extracted from the California ARB's EMFAC2011 model, which provides this information by county. ICF International used the EMFAC2011 model outputs for Butte County to calculate local CO_2, CH_4 and N_2O emissions factors by vehicle type, fuel type and 5 mile per hour speed bins. The EMFAC2011 reports CO_2, CH_4 and N_2O emissions factors for 51 different vehicle type and fuel combinations for every County in California, informed by California Department of Motor Vehicles registrations, the Smog Check program and many other data sources. CO_2 emissions factors were obtained directly from the EMFAC2011 Web Based Emissions Inventory. CH_4 emissions for Passenger Cars, Light Trucks and Motorcycles were calculated from County EMFAC2011 - LDV Module reported methane total exhaust (CH_4_Totex). CH_4 emissions for Heavy Trucks were calculated from County EMFAC2011 - HD Module reported total organic gases total exhaust (TOG_Totex) multiplied by 0.0408, the estimated average fraction of TOG that is comprised of CH_4, based on guidance from ARB. N_2O emissions for gasoline-fueled vehicles were calculated from County EMFAC2011 Web Based Emissions Inventory reported nitrogen oxides total exhaust (NOx_Totex) multiplied by 0.0416, the average fraction of NOx emissions that are, or react into, N_2O, based on guidance from ARB. N_2O emissions for diesel fueled vehicles were calculated from County EMFAC2011 Web Based Emissions Inventory reported Fuel Use multiplied by 0.3316 grams per gallon, based on guidance from ARB.

Off-Road Emissions

ICF International estimated off-road emissions with methods recommended by ARB staff using California ARB's OFFROAD2007 and OFFROAD2011 modeling programs. OFFROAD2007 and OFFROAD2011 report fuel use for various off-road, fuel-consuming machines at the county level. Logging and Oil Drilling were excluded because these activities do not occur within the city limits. Population, employment, and other relevant statistics were used to apportion the Butte County fuel consumption to the City. Table D-3 shows the scaling factors applied to each off-road equipment category and the rational employed. Fuel consumed by equipment operating within Oroville was converted to CO_2, CH_4, and N_2O using the standard emissions factors summarized in Table D-2. The final data was entered into the Climate and Energy Management Suite as annual emissions of CO_2, CH_4, and N_2O, in metric tons.

Table D-3: Off-Road Proportions by Category

Off Road Equipment Type Category	Scaling Factor	Oroville Allocation	Rational
Agricultural	Agricultural Acreage	0.01%	Equipment use assumed to be correlated with the area of agricultural land in the City and county.
Airport Ground Support	Airport Operations	43.00%	Equipment use assumed to be correlated with airport operations. The scaling factor considers activities at the Chico and Oroville Municipal airports.
Construction	Population	7.00%	Equipment use assumed to be correlated with population.
Entertainment	Population	7.00%	Equipment assumed to be owned and operated by the community.
Industrial	Employment	6.29%	Equipment use assumed to operate at manufacturing businesses.
Lawn and garden	Households	6.41%	Equipment assumed to primarily operate on residential landscapes.
Light Commercial	Employment	6.29%	Equipment use assumed to operate at manufacturing businesses.
Pleasure craft	Population	7.00%	Equipment assumed to be owned by owned and operated by the community.
Rail yards	Population	7.00%	Equipment use and rail yard activity assumed to be driven by population demand.
Recreational	Population	7.00%	Equipment assumed to be owned by owned and operated by the community.
Transportation refrigeration units	Employment	6.29%	Equipment use assumed to operate at trade-related businesses.

Appendix E - Solid Waste Sector Notes

Table E-1: Solid Waste Activity Data Inputs

Landfill	2010 Tons Waste Deposited	CH4 Capture?	Distance to Facility (Miles)	Transport Fuel	Data Source
Azusa Land Reclamation Co. Landfill	9	Yes	466.0	Diesel	CalRecycle Website. Google maps for mileage.
Forward Landfill, Inc. (ash from POPI)	8,851	Yes	97.7	Diesel	
Neal Road Recycling and Waste Facility	1,819	Yes	16.8	Diesel	
Recology Hay Road - Vacaville	38	Yes	97.1	Diesel	
Recology Ostrom Road LF Inc.	14,896	Yes	42.2	Diesel	
Total Tonnage Landfilled	16,753	Yes			(Excludes Azusa and POPI/Forward)
Total Tonnage Collected	16,762				(Excludes POPI/Forward)
Total Tonnage Transported	16,762		39.8	Diesel	(Excludes POPI/Forward):
Total Tonnage Transported by POPI to Forward (ash):	8,851		97.7	Diesel	
Azusa is an "inert" landfill (inert, asbestos, tires etc). Emissions for collection and transportation entered into CEMS, not emissions for waste disposal.					
Forward is listed as a hazardous waste site. Composition is ash, so does not need to be accounted for in SW disposed emissions, just for transport. No collection because waste is from POPI and they transport to LF.					
Neal Road, Hay Road and Ostrom Road receive municipal solid waste, and collection, transportation and disposal emissions are included.					

Table E-2: Solid Waste Characterization and GHG Emissions Factors

Activity / Source	Method	Type	Percent by Weight	Emissions Factor (Metric Tons CH_4 / wet short ton waste)	Emissions Factor Source
Community-Generated Solid Waste	SW.4.1	Newspaper	1.40%	0.043	CalRecycle *California 2008 Statewide Waste Characterization Study, USCP Appendix E (Page 34) & U.S. EPA Waste Reduction Model (WARM)*
		Office Paper	4.90%	0.203	
		Corrugated Cardboard	5.20%	0.120	
		Magazines/Third Class Mail	5.90%	0.049	
		Food Scraps	15.50%	0.078	
		Grass	1.90%	0.038	
		Leaves	1.90%	0.013	
		Branches	3.30%	0.062	
		Dimensional Lumber	14.50%	0.062	
		All other (Non-Organic)	45.5%	0	
Collection and Transportation of Solid Waste	SW.6	Collection (diesel)	N/A	0.020 MT / wet short ton SW	USCP Appendix E (page 29)
		Transportation (diesel)	N/A	0.00014 MT / wet short ton SW / mile	

Methods:

Community-Generated Solid Waste

Solid waste generated within the City in 2010 and transferred to landfills for disposal has associated emissions that are included in the inventory. Emissions occur at the landfill site(s) over the entire period of waste decomposition, estimated to be 100 years. Data on the tonnage of waste generated by Oroville's residents and businesses and then landfilled was collected from the California Integrated Waste Management Board (CalRecycle). Waste characterization percentages from the CalRecycle *California 2008 Statewide Waste Characterization Study* were applied to the tonnage of community-generated waste landfilled in 2010. The community waste tonnage and waste characterization, shown in Tables E-1 and E-2, were entered into the Climate and Energy Management Suite where GHG emissions were calculated based on standard factors for organic content and methane generating potential for each waste type. Emissions were adjusted based on the presence or absence of landfill gas capture systems. Emissions factor and calculation methods are shown in Table E-2.

Solid Waste Collection and Transportation

Emissions associated with solid waste management services result from collection, transportation, processing, and storage of the municipal solid waste. Collection and transportation emissions are included in Transportation Sector emissions, and are also reported as an Information Item in Solid Waste Sector to provide context. Process emissions from landfill equipment are not included in this inventory.

It is important to acknowledge the benefits of recycling and composting programs that lower waste volumes and reduce emissions. When incoming organic waste is diverted, landfill emissions are reduced. Upstream emissions from materials manufacturing are reduced when recycled materials displace virgin materials.

Solid waste collection and transportation emissions are included, from the trucks that collected municipal solid waste within the community and trucks that transported the waste to the landfills serving Oroville. The tonnage of waste collected and the distance to the receiving landfills, shown in Table E-1, were entered into the Climate and Energy Management Suite to calculate GHG emissions using methods and emissions factors listed in Table E-2.

Appendix F - Wastewater Sector Notes

Table F-1: Wastewater Treatment Activity Data Inputs

Wastewater Facility	Population Served	Wastewater Treated (MG/Yr)	Nit/Denit Process (Yes / No)	Industrial Discharges (Yes / No)	Nitrogen Load (kg/day)	Aerobic or Anaerobic	Data Source
SC-OR Total	38,399	1,144.5	No	Yes	73.9	Aerobic	SC-OR
Oroville-Generated	15,385	641.1	No	Yes	41.4	Aerobic	
Oroville Septic	144	N/A	N/A	N/A	N/A	N/A	Remaining Oroville population not served by SC-OR

Table F-2: Wastewater Treatment GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CH_4	N_2O	Emissions Factor Source
Septic Systems (population based)	WW.11(alt)	0.6 kg CH_4 / kg BOD_5	N/A	USCP App F page 52.
Central Plants - no nitrification / denitrification process (population based)	WW.8	N/A	3.2 g N_2O / person / year	USCP App F page 43
Effluent (population based)	WW.12(alt)	N/A	0.026 kg N / person / day	USCP App F page 56

Table F-3: Wastewater Treatment GHG Emissions Calculation Formulas

Method	Emissions Calculation Formula
WW.8	Metric Tons N_2O = Population X EF (3.2 g N_2O / person / year) x 10^{-6} x 1.25 industrial factor
WW.11(alt)	Metric Tons CH_4 = Population x BOD_5 load (0.09 kg / person / day) x Bo (0.6 kg CH_4 / kg BOD_5) x MCF_s (0.22 Methane Correction Factor) x 365.25 days / year x 10^{-3}
WW.12(alt)	Metric Tons N_2O = Population x $F_{ind-com}$ (Industrial Discharge Factor) x [N load (0.026 kg N / person / day - (kg N / kg BOD_5 (0.05 for aerobic systems or 0.005 for anaerobic or lagoon systems) x 0.09 kg BOD_5 / person / day)] x $EF_{effluent}$ (0.005 kg N discharged to river / stream) x 365.25 days / year x 44/28 (N_2O / N) x 10^{-3}

Methods:

Wastewater Treatment Facility Process and Fugitive Emissions

Wastewater treatment process emissions account for a small part of total community-based GHG emissions. Wastewater can be treated using either conventional plants (with or without a nitrification/denitrification process and with or without anaerobic digesters), lagoons, or septic systems. There are two emissions associated with these processes: methane (CH_4) and nitrous oxide (N_2O). Calculating the makeup and amount of emissions depends on the processes involved and the management practices employed.

In 2010, Oroville's wastewater was treated by the "Sewerage Commission - Oroville Region" (SC-OR), located within the City. SC-OR treats wastewater from Oroville as well as surrounding areas. This inventory reports the SC-OR total emissions, as source emissions from a facility located within the community. The emissions from Oroville-generated wastewater are reported as an Information Item for context. Electricity and diesel fuel used in the treatment process is accounted for in the Buildings and Facilities appendix.

SC-OR's wastewater treatment plant uses an aerobic treatment process, without nitrification/denitrification. There is some industrial discharge that is accounted for. Wastewater effluent emissions were calculated using the population based alternative method because SC-OR is only required to measure nitrogen load as ammonia. SC-OR anticipates that they will be required to begin measuring nitrogen in its other forms in the near future. Therefore the population-based method was used in the attempt to capture emissions from nitrogen discharged in forms other than ammonia. Once more accurate nitrogen load measurements become standard, it is recommended to use the nitrogen load based calculation method to improve accuracy. There are in addition, private septic systems. The wastewater treatment plant (WWTP) characteristics shown in Table F-1 were collected from wastewater agency and county staff. The wastewater treatment activity data was entered into the Climate and Energy Management Suite where GHG emissions were calculated using the standard methods and emissions factors from the USCP shown in Table F-2 and formulas shown in Table F-3.

Uncertainties

According to the latest EPA national inventory of greenhouse gas emissions considerable uncertainty exists within any of the EPA/IPCC-based methodologies used to estimate wastewater process and fugitive emissions. EPA states that population-based methane emissions could be underestimated by 37% or over estimated by 47% while nitrous oxide emissions could be under estimated by 76% or over estimated by 93%. Emissions estimates based on direct source measurements can possibly have higher accuracy and less uncertainty. This extreme degree of uncertainty exists because these methodologies were originally developed for international countrywide inventories that were mainly population-based. By necessity, these methodologies were generalized "top-down" approaches that sought to provide emissions estimates for countries where detailed information would be impractical to obtain. Although these methodologies had the advantage of being relatively simple to calculate, the trade-off was a compromised level of accuracy. Nevertheless, the methodologies in this Appendix reflect the evolution of knowledge since the development of the LGOP.

In some cases, especially where the emissions are based on population and default inputs, communities should exercise caution in drawing conclusions or establishing policy. Methods are evolving but caution should be used drawing conclusions and establishing policies based on these calculations.

Municipal-Operations Inventory Appendices

Appendix G - Buildings and Facilities Sector Notes

Table G-1: Buildings and Facilities Activity Data Inputs

Facility Name	Electricity Use PG&E (kWh / Year)	Natural Gas Use PG&E (therms / Year)	Data Source
Police/Fire	185,956	3,209	Pacific Gas and Electric
City Hall	62,382	3,439	Pacific Gas and Electric
Municipal Auditorium	85,760	586	Feather River Recreation and Park District (PG&E)
Corporate Yard	13,440	3,777	Pacific Gas and Electric
Airport Lighting & Hangers	183,560	0	Pacific Gas and Electric
Airport Facilities and Gas Tank	26,753	52	Pacific Gas and Electric
Oroville Inn Placeholder	NA	NA	Not Available
Residential Redevelopment and Minor Bldgs	6,204	415	Pacific Gas and Electric
State Theater	36,997	51	Pacific Gas and Electric
Chinese Temple	20,575	1,801	Pacific Gas and Electric
Bolt Museum	13,641	1,105	Pacific Gas and Electric
Cultural Center - Arlin Rhine	22,520	1,335	Pacific Gas and Electric
Lott House	13,982	2,516	Pacific Gas and Electric
Other Parks/Museums	21,932	977	Pacific Gas and Electric
Transmission and Distribution Losses on all Electricity Use	129,028	NA	EPA eGRID 2009 Western region grid loss factor of 8.21%

Table G-2: Buildings and Facilities GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO_2	CH_4	N_2O	Emissions Factor Source
Electricity – PG&E	6.1.1	445 lbs/MWh	28.94 lbs/GWh	6.17 lbs/GWh	2010 Pacific Gas and Electric (CO_2) and 2009 EPA eGRID WECC California (CH_4 and N_2O)
Natural Gas – PG&E	6.2.1	53.02 kg/MMBtu	0.005 kg/MMBtu	0.0001 kg/MMBtu	LGOP Appendix G - Table G.1 (CO_2) and Table G.3 (CH_4 and N_2O)
Electricity - T&D Losses	6.2.6	658.68 lbs/MWh	28.94 lbs/GWh	6.17 lbs/GWh	2009 EPA eGRID WECC California (CO_2, CH_4 and N_2O)

Methods:

2010 buildings and facilities electricity and natural gas consumption data, shown in Table G-1, was collected from Pacific Gas and Electric Company (PG&E). The PG&E data for the Municipal Auditorium was supplied by Feather River Recreation and Parks District, since the Municipal Auditorium is owned by the City though managed by Feather River Recreation and Parks District in 2010. The activity data was entered into the Climate and Energy Management Suite where GHG emissions were calculated using the calculation methods and emissions factors shown in Table G-2.

Fire suppression agents, and air conditioning and refrigeration equipment used in buildings can emit hydrofluorocarbons (HFCs) and other GHGs when these systems leak. Refrigerants used in Oroville's building HVAC and refrigeration equipment are assumed to have been R-22 and therefore not estimated. R-22 is controlled under the Montreal Accord. It is currently being phased out as an ozone-depleting substance, and is therefore not included in GHG inventories based on LGOP guidance.

Table G-3: Public Lighting Activity Data Inputs

Lighting Use	Electricity Use – PG&E (kWh / Year)	Data Source
Traffic Signals / Controllers	67,822	Pacific Gas and Electric Co.
Streetlights	754,901	Pacific Gas and Electric Co.
Park Lighting	15,459	Pacific Gas and Electric Co.
Other Outdoor Lighting	706	Pacific Gas and Electric Co.
LS-1 Information Item	6,417	Pacific Gas and Electric Co.

Public lighting electricity usage data, shown in Table G-3, was collected from PG&E. Activity data was entered into the Climate and Energy Management Suite where GHG emissions were calculated using the calculation methods and emissions factors shown in Table G-2. PG&E designated LS-1 lighting was included as an Information Item. LS-1 designated streetlights are owned, operated, maintained and directly paid for by PG&E, but are indirectly paid for by the City of Oroville through their general rate case with PG&E.

Table G-4: Water Delivery Activity Data Inputs

Potable Water Supply Use	Electricity Use – PG&E (kWh / Year)	Data Source
Sprinklers / Irrigation Control	512	Pacific Gas and Electric Co.
Storm Water Management	3,286	Pacific Gas and Electric Co.

Water delivery electricity usage data, shown in Table G-4, was collected from PG&E. The data was entered into the Climate and Energy Management Suite where GHG emissions were calculated using the calculation methods and emissions factors show in Table G-2.

Table G-5: Wastewater Transport Facilities Activity Data Inputs

Wastewater Treatment Use	Electricity Use – PG&E (kWh/Yr)	Data Source
Lift Stations and Flow Meters	35,202	Pacific Gas and Electric

Wastewater transport facilities electricity use data, shown in Table G-5, was collected from PG&E. Activity data was entered into the Climate and Energy Management Suite where GHG emissions were calculated using the calculation methods and emissions factors show in Table G-2.

Appendix H - Vehicle Fleet and Mobile Equipment Sector Notes

Table H-1: Vehicle Fleet and Mobile Equipment Activity Data Inputs

Department / Fuel		Gallons / Year	Vehicle Miles Traveled (VMT) Miles / Year	% Vehicle Miles Travelled			Data Source
				Passenger Vehicle	Light Truck	Heavy Truck	
Fire Department	On-Road Gas	3,003.3	42,468	2.2	97.8		City Staff
	On-Road Diesel	4,247.4	19,671			100	
	Off-Road Gas	52					
	Off-Road Diesel	1.2					
Housing	On-Road Gas	1,466.9	24,124	62.0	38.0		
	Off-Road Gas	12.1					
Parks	On-Road Gas	3,282.3	21,968		100		
	On-Road Diesel	807.2	3,600			100	
	Off-Road Gas	223.2					
	Off-Road Diesel	465.6					
Police Department	On-Road Gas	26,436.5	339,897	90.0	10.0		
	Off-Road Gas	3.4					
Other	On-Road Gas	1,516.3	18,758	27.1	72.9		
Public Works	On-Road Gas	3,123.4	18,129		99.5	0.5	
	On-Road Diesel	5,304.5	15,428			100	
	Off-Road Gas	110.3					
	Off-Road Diesel	1,711.3					
Sewer	On-Road Gas	985.4	7,127		100		
	On-Road Diesel	1,728.3	4,314		44.5	55.5	
	Off-Road Gas	16.5					
	Off-Road Diesel	48.3					
Other Departments: Buildings, Engineering, Planning and Admin	On-Road Gas	1,516.3	18,758	27.1	72.9		
Leaked Refrigerants	Metric Tons R-134a	0.02010					
	Metric Tons R-12	0.0063					

Table H-2: Vehicle Fleet and Mobile Equipment GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO_2	CH_4	N_2O	Emissions Factor Source
On-Road Passenger Vehicles - Gasoline	7.1.1.1 and 7.1.3.3	8.78 kg / gallon	0.02780 g / mile	0.02940 g / mile	LGOP Appendix G - Table G.11 (CO_2) and Table G.15 (CH_4 and N_2O)
On-Road Light Trucks - Gasoline	7.1.1.1 and 7.1.3.3	8.78 kg / gallon	0.03146 g / mile	0.04331 g / mile	LGOP Appendix G - Table G.11 (CO_2) and Table G.15 (CH_4 and N_2O)
On-Road Heavy Duty Trucks - Gasoline	7.1.1.1 and 7.1.3.3	8.78 kg / gallon	0.12351 g / mile	0.10310 g / mile	LGOP Appendix G - Table G.11 (CO_2) and Table G.15 (CH_4 and N_2O)
On-Road Passenger Vehicles - Diesel	7.1.1.1 and 7.1.3.3	10.21 kg / gallon	0.0005 g / mile	0.0010 g / mile	LGOP Appendix G - Table G.11 (CO_2) and Table G.15 (CH_4 and N_2O)
On-Road Light Trucks - Diesel	7.1.1.1 and 7.1.3.3	10.21 kg / gallon	0.00099 g / mile	0.00149 g / mile	LGOP Appendix G - Table G.11 (CO_2) and Table G.15 (CH_4 and N_2O)
On-Road Heavy Duty Trucks - Diesel	7.1.1.1 and 7.1.3.3	10.21 kg / gallon	0.0051 g / mile	0.0048 g / mile	LGOP Appendix G - Table G.11 (CO_2) and Table G.15 (CH_4 and N_2O)
Off-Road Equipment - Gasoline	7.2	8.78 kg / gallon	0.22 g / gallon	0.50 g / gallon	LGOP Appendix G - Table G.11 (CO_2) and Table G.14 (CH_4 and N_2O)
Off-Road Equipment - Diesel	7.2	10.21 kg / gallon	0.26 g / gallon	0.58 g / gallon	LGOP Appendix G - Table G.11 (CO_2) and Table G.14 (CH_4 and N_2O)
Refrigerants	7.4	N/A	N/A	N/A	LGOP

Methods:

Detailed vehicle fleet information was collected from City of Oroville staff. While the City generally had very good data on Vehicle Miles Travelled (VMT) and fuel consumption for all their vehicles, some data points were estimated using interpolation or extrapolation, or by conversation with staff pertaining to which vehicles were in use in 2010. Cost data is not included. Activity data, shown in Table H-1, was entered into the Climate and Energy Management Suite where GHG emissions were calculated using the standard methods and emissions factors outlined in the LGOP and shown in Table H-2.

The fugitive emissions from vehicle air conditioning refrigerants were estimated using the LGOP's alternate method, which likely overestimates emissions. Vehicle refrigerant is assumed to be R-134a if a vehicle is a 1995 model or newer, which all were. The majority of automakers changed from R-12 to R-134a as the refrigerant of choice in their cars in that year. The full-charge volume of refrigerant estimated by the alternate method is the maximum value for the equipment type. This approach maximizes the estimated refrigerant leakage for normal use and maintenance and likely higher than if refrigerant use was measured. Total emissions are still very small.

Appendix I - Municipal-Operations Solid Waste Sector Notes

Table I-1: Municipal-Operations Solid Waste Activity Data

Facility Name	Activity / Source	Wet Short Tons / Year	Information Item?	Data Source
Police/Fire	Municipal Solid Waste	7.530	No	Recology
City Yard	Municipal Solid Waste	6.407	No	Recology
City Hall	Municipal Solid Waste	2.666	No	Recology
2712 Spencer - Housing	Municipal Solid Waste	0.889	No	Recology
Airport	Municipal Solid Waste	6.442	No	Recology
Parks/Museums	Community Solid Waste	23.547	Yes	Recology
6 & 40 Yard Bins	Community Solid Waste	16.000	Yes	Recology
City Cans	Community Solid Waste	15.846	Yes	Recology
City Trucks	Community Solid Waste	9.646	Yes	Recology

Table I-2: Municipal-Operations Solid Waste GHG Calculation Methods and Emissions Factors

Activity / Source	Method	Waste Component	Percent by Volume	Emissions Factor (MT CH4 / wet short ton waste)	Emissions Factor Source
Municipal Waste Characterization	12.2.2	Newspaper	5.7%	0.043	CalRecycle *California 1999 Statewide Public Administration Waste Characterization Study;* *USCP Appendix E (Page 34) & U.S. EPA Waste Reduction Model (WARM)*
		Office Paper	13.2%	0.203	
		Corrugated Cardboard	5.1%	0.120	
		Magazines / Third Class Mail	15.4%	0.049	
		Food Scraps	9.8%	0.078	
		Grass	8.1%	0.038	
		Leaves	8.1%	0.013	
		Branches	0.1%	0.062	
		Dimensional Lumber	5.0%	0.062	
		All other (Non-Organic)	29.6%	0	
Community Waste Characterization	12.2.2	Newspaper	1.40%	0.043	CalRecycle *California 2008 Statewide Waste Characterization Study,* *USCP Appendix E (Page 34) & U.S. EPA Waste Reduction Model (WARM)*
		Office Paper	4.90%	0.203	
		Corrugated Cardboard	5.20%	0.120	
		Magazines/Third Class Mail	5.90%	0.049	
		Food Scraps	15.50%	0.078	
		Grass	1.90%	0.038	
		Leaves	1.90%	0.013	
		Branches	3.30%	0.062	
		Dimensional Lumber	14.50%	0.062	
		All other (Non-Organic)	45.5%	0	

Methods:

Table I-1 shows the municipal-operations solid waste activity data, which was collected from Recology, primarily as volume of waste in the form of the number, size and collection schedule of bins and debris boxes collected in 2010. Bins were assumed to be 80% full, as estimated by the waste hauler, and is different from the LGOP assumption that bins are 100% full. When volume data was collected, the tonnage of mixed solid waste was calculated using a conversion factor of 89 lbs per cubic yard, provided by the California Integrated Waste Management Board (CalRecycle) and specifically tailored to public administration waste. Some data was reported by weight. Emissions from community-generated waste collected at parks and from city trucks, bins and cans is reported as an Information Item, since it is not directly tied to municipal operations and the City cannot control the generation of this waste. The waste characterization for the community waste is from the CalRecycle 2008 Statewide Waste Study. All 2010-generated solid waste reported in this inventory was transferred to the landfill for disposal. The emissions associated with this waste are defined as Scope 3 since they occur at the landfill sites over the entire period of decomposition (estimated to be about 100 years).

The solid waste activity data was entered into the Climate and Energy Management Suite where GHG emissions were calculated using CalRecycle's 1999 public administration specific waste characterization coupled with standard emissions factors adopted by the California Air Resources Board, the California Climate Action Registry, ICLEI - Local Governments for Sustainability and The Climate Registry, shown in Table I-2. The community-generated waste emissions were calculated using CalRecycle's 2008 Statewide Waste Study, and the same emissions factors, detailed in Table I-2.

Appendix J - Employee Commute Sector Notes

Table J-1: Employee Commute Activity Data Inputs

Vehicle Type	Fuel Type	Vehicle Miles Travelled	Average Miles Per Gallon	Data Source
Passenger Vehicles	Gasoline	353,257	25.5510	Employee Commute Survey
Light Trucks	Gasoline	190,692	16.0212	Employee Commute Survey
	Diesel	30,799	17.1635	Employee Commute Survey

Table J-2: Employee Commute GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO_2	CH_4	N_2O	Emissions Factor Source
Passenger Vehicles - Gasoline	12.2.1	8.78 kg / gallon	0.02780 g / mile	0.02940 g / mile	LGOP Appendix G - Table G.11 (CO_2) and Table G.15 (CH_4 and N_2O)
Light Trucks - Gasoline	12.2.1	8.78 kg / gallon	0.03146 g / mile	0.04331 g / mile	LGOP Appendix G - Table G.11 (CO_2) and Table G.15 (CH_4 and N_2O)
Light Trucks - Diesel	12.2.1	10.21 kg / gallon	0.00099 g / mile	0.00149 g / mile	LGOP Appendix G - Table G.11 (CO_2) and Table G.15 (CH_4 and N_2O)

Methods:

Employee commute emissions were calculated by first conducting a survey of current (2013) employees regarding commute distance, and mode and frequency of travel. Vehicle miles traveled (VMT) and average miles per gallon (MPG) were estimated from the survey data and extrapolated to the number of employees in 2010. The VMT activity data, shown in Table J-1, was then entered into the Climate and Energy Management Suite where GHG emissions were calculated using the methods and emissions factors shown in Table J-2. The calculated average MPG for each vehicle and fuel type was used to convert VMT to gallons of fuel used for the CO_2 emissions calculations.

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Appendix C
Forecast Details

Introduction

This appendix presents the methodology used to develop the 2020 business-as-usual (BAU) community greenhouse gas (GHG) emissions forecast (2020 BAU Forecast) for the City of Oroville (City). The forecast was developed based on the 2010 community GHG emissions inventory (2010 Inventory), which is described in Appendix B. The forecasting methods are consistent with the most recent government and non-government agency guidance.

Data and Methods Summary

The 2020 BAU Forecast is a prediction of how community emissions may change by 2020, absent any federal, State, or local reduction measures designed to reduce GHG emissions. The 2020 BAU Forecast is therefore an estimate of future emissions based on existing energy and carbon-intensity factors. This approach is consistent with the California Air Resources Board's (ARB's) definition of the statewide 2020 emissions forecast, as outlined in the Assembly Bill 32 scoping plan (California Air Resources Board 2008).

The 2020 BAU Forecast uses socioeconomic data to project 2010 emissions (see Appendix B) to 2020. For example, to estimate emissions generated by residential building energy consumption in 2020, GHG emissions produced in 2010 were multiplied by the expected growth in households between 2010 and 2020. The socioeconomic data used in the analysis is presented in Table C-1 and is consistent with the City's General Plan.

Table C-1. 2010 and 2020 Socioeconomic Data: Population, Households, and Employment

	Value		
Parameter	2010	2020	Growth Rate (2010–2020)
Population	15,529	19,125	1.23
Housing	6,198	7,376	1.19
Employment	4,500	5,605	1.25

Table C-2 summarizes the general approach for forecast emissions by sector. The table also identifies the major assumptions associated with the forecast methodology and the implications of those assumptions on the forecast with regards to uncertainty, level of detail, or other factors.

Table C-2. Summary of Methods for the Oroville 2020 BAU Forecast

Sector	Summary of Methods for Estimating Emissions	Methods Assumptions and Implications
Building Energy Use	<u>Residential</u> Growth in households (Table C-1) applied to 2010 emissions from residential electricity use and natural gas and propane combustion <u>Commercial and Industrial</u> Growth in employment (Table C-1) applied to 2010 emissions from commercial and industrial electricity use and natural gas combustion	Energy-related emissions are directly proportional to households and employment. It is likely that with future improvements in energy efficiency and consumer education, energy consumption will grow slightly more slowly than actual household or employment growth.
Onroad Transportation	2020 vehicle miles traveled (VMT) provided by Fehr & Peers multiplied by EMFAC2011 vehicle emission factors for 2020	Assumptions are embodied in EMFAC2011 model. VMT projections are based on future predictions of land use characteristics, as opposed to actual activity data.
Offroad Vehicles and Equipment	Emissions obtained from OFFROAD2007 and OFFROAD2010 model outputs for 2020	Assumptions are embodied in OFFROAD2007 and OFFROAD 2011 models.
Solid Waste Management	Growth in population (Table C-1) multiplied by per capita solid waste emissions for 2010	Solid waste generation is directly proportional to population.
Water Management	Urban Water Management Plans (UWMP) forecasts of per-capita water use rates multiplied by the growth in population (Table C-1)	The energy required to convey, distribute, supply, and treat water remains constant in all future years.
Wastewater Management	Growth in population (Table C-1) multiplied by per capita wastewater treatment emissions for 2010	Wastewater generation is directly proportional to population.

Detailed Methods and Supporting Information

This section includes detailed methods and supporting information for the 2020 BAU Forecast by emissions sector.

Building Energy

Electricity, natural gas, and propane emissions were forecasted using household and employment data summarized in Table C-1. Residential energy use was forecast based on the growth in households between 2010 and 2020, whereas nonresidential energy use (commercial and industrial) was forecast based on the growth in employment. All utility emission factors were held constant from 2010 to 2020. Changing rates of electricity and fuel use on a per job and per capita basis were not included in the forecasts. This is consistent with a BAU projection, although it is likely that with future improvements in energy efficiency and consumer education, electricity and fuel consumption will grow slightly slower than actual household or employment growth.

Onroad Transportation

Emissions estimates for onroad transportation in 2020 were developed using a similar methodology as described for the 2010 Inventory (see Appendix B). The ARB's EMFAC2011 model was used to develop emission factors for 2020 for Butte County. These emission factors account for expected improvements in engine technology and vehicle efficiency, but do not assume implementation of statewide mandates to reduce GHG emissions from transportation (e.g., Pavley).

The VMT data developed by Fehr & Peers for 2020 were multiplied by the Butte County emission factors from EMFAC 2011 to determine carbon dioxide (CO_2) emissions by vehicle class. Emission factors for methane (CH_4) and nitrous oxide (N_2O) were calculated using the ARB's (2013) recommended methodology, which is described in Appendix B. The calculated emission factors were multiplied by the 2020 VMT to obtain total CH_4 and N_2O emissions.

Offroad Equipment and Vehicles

Butte County emissions from offroad equipment and vehicles were forecast using the OFFROAD model. Countywide model outputs for 2020 were allocated to the city using the same methodology as the 2010 Inventory (see Appendix B). The allocation factors used for the forecast are provided in Table C-3.

Table C-3. Offroad Equipment and Vehicles 2020 Allocation Factors

Parameter	City of Oroville	Butte County	City Allocation Factor
Population (persons)	19,125	272,800	7.0%
Housing (households)	7,376	111,120	6.6%
Employment (jobs)	5,605	84,451	6.6%
Agricultural Area (acres)[a]	65	599,040	0.0%
Airport Activity (days)[a]	19,125	272,800	7.0%

[a] Conservatively held constant from 2010.

Solid Waste Management

Solid waste emissions were forecasted using the expected growth in population (see Table C-1). Per capita waste generation was assumed to grow linearly from 2010 to 2020, and landfill characteristics were assumed to remain constant in the future. For example, it was assumed that existing methane-capture systems would continue to capture methane at the same rate in 2020. This is consistent with a BAU approach to forecasting waste emissions.

Water Management

Water emissions were forecasted using future per capita water use rates published by the local water service agencies (see Table C-4). The per-capita rates were multiplied by the projected population in 2020 to obtain water consumption for the city. Communitywide water usage was multiplied by the same regional energy intensity factors as the 2010 Inventory for water treatment, supply, distribution, and conveyance. The resulting electricity use was multiplied by the appropriate utility emission factors, consistent with the 2010 Inventory.

Table C-4. Per Capita Water Use Rates (gallons per capita per day)

Water Service Agency	2010 Rate	2020 Rate	Growth (2010–2020)
California Water Service Company	260.5	268.0	1.03
South Feather River Water and Power	237.5	232.4	0.98
Thermalito Water and Sewer[a]	237.5	232.4	0.98

[a] Values reported for South Feather River Water and Power Agency were used as no water consumption data were available for the Thermalito Water and Sewer District.

Sources: California Water Service Company 2011; South Feather Water and Power Agency 2012

Wastewater Management

Wastewater emissions were forecasted using the 2010 per capita wastewater generation rates and the 2020 population (see Table C-1). This method assumes that the rate of wastewater generation stays constant in all future years. Future emissions were based on the same wastewater treatment processes occurring in 2010. In other words, the rate of wastewater treatment emissions on a per capita basis was held constant between 2010 and 2020.

References

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California Water Service Company. 2011. *2010 Urban Water Management Plan Oroville District*. Adopted June 2011.

South Feather Water and Power Agency. 2012. *2010 Urban Water Management Plan*. Adopted May 2012.

Appendix D
Reduction Strategy Details and Analysis Methods

Introduction

This appendix summarizes the calculations and assumptions used to quantify greenhouse gas (GHG) reductions and monetary costs and savings for the local and State strategies included in the City of Oroville's (City's) Climate Action Plan (CAP). The primary objective for each strategy is also provided. The appendix begins with a general overview of the GHG and economic analysis, followed by specific details regarding each of the local and State emissions reduction strategies.

Overview of Analysis Methods

Emissions reductions achieved by local and State strategies were quantified using guidance provided by the California Air Resources Board (ARB), California Air Pollution Control Officers Association (CAPCOA), California Energy Commission (CEC), and professional experience obtained from preparing CAPs for other jurisdictions in California. The majority of calculations were performed using standard factors and references, rather than through a specific analysis of individual technologies. GHG savings attributed to the individual strategies exclude emissions reductions achieved by other overlapping actions. This avoids double counting emissions benefits and enables a cumulative assessment of emissions reductions achieved by the CAP. All reductions were quantified in terms of metric tons of carbon dioxide equivalent ($MTCO_2e$) and represent the annual emissions saving in 2020.

Monetary costs and savings were estimated using information specific to the City, when available, or for similar cities in the region, California, or United States, prioritized in that order. The majority of data was from public sources, including the California Public Utilities Commission (CPUC), Pacific Gas & Electric (PG&E), United States Department of Energy (DOE), CEC, and EPA. Some cost data were also based on price quotes provided from suppliers serving the northern California region. Costs estimated include initial capital cost and programmatic costs, whereas savings include reduced costs associated with electricity, natural gas, fuel usage, and required maintenance. Ranges were provided for most strategies due to the uncertainties and variability associated with estimating project costs. In general, ranges reflect differences in price estimates for technologies, based on the use of multiple data sources.

Presentation Framework and Common Assumptions

The following sections present a detailed overview of the emissions reduction strategies and analysis procedures. Local strategies are summarized by the five action areas discussed in Chapter 3. Figure D-1 identifies the information that is provided for all strategies, as available.

Strategy Description	Objective: Describes the intent and overall goal for each strategy. Summary Metrics: Summarizes the GHG reductions, costs, savings, and/or other quantified metrics.
GHG Reduction and Economic Analysis	Assumptions: Identifies assumptions used in calculating emissions reductions and costs. Table D-1 includes a master list of assumptions for reference. Analysis Method. Provides an overview of the methods for calculating GHG reductions and costs. A reasonable amount of detail is presented to provide a basic overview of the approach, as opposed to an exhaustive list of all calculations and steps.

Figure D-1. Presentation Framework

As noted in Table D-1, many of the same assumptions are used to evaluate emissions reductions and costs for multiple strategies. Table D-1 provides a master list of common assumptions.

Table D-1. Master List of Quantification Assumptions for the Oroville CAP

Parameter	Value	Unit	Source
GWPs			
CO_2	1	-	IPCC 2007
CH_4	25	-	IPCC 2007
N_2O	298	-	IPCC 2007
CONVERSIONS			
Days per year	365	days/year	NA
Pounds per MT	2,204.62	pounds/MT	NA
Kilograms per MT	1,000	kilograms/MT	NA
Grams per MT	1,000,000	grams/MT	NA
Grams per kilogram	1,000	grams/kilograms	NA
Therms per million British thermal units (MMBtu)	10	therms/MMBtu	NA
Single: Multi-family housing—Electricity	1.97	-	EIA 2009
Single: Multi-family housing—Natural gas	2.27	-	EIA 2009
Kilowatt-hour (kWh) per megawatt-hour (MWh)	1,000.00	kWh/MWh	NA
Minutes per hour	60.00	minutes/hour	NA
MT per ton	0.91	MT/ton	NA
Million gallons per gallon	0.0000010	million gallons/gallon	NA
Days per year (onroad transportation analysis only)	347	days/year	Robinson pers. comm.
ENERGY			
2010 Electricity			
Residential (PG&E delivered)	40,209,838	Kilowatt-hours	Ahrns pers. comm.
Single-family	31,879,765	Kilowatt-hours	Calculated by ICF
Multi-family	8,330,073	Kilowatt-hours	Calculated by ICF
Residential (ESP delivered)	50,466	Kilowatt-hours	Ahrns pers. comm.
Single-family	40,011	Kilowatt-hours	Calculated by ICF
Multi-family	10,455	Kilowatt-hours	Calculated by ICF
Residential (transmission losses)	3,305,371	Kilowatt-hours	Ahrns pers. comm.
Nonresidential (PG&E delivered)	108,075,200	Kilowatt-hours	Ahrns pers. comm.

Parameter	Value	Unit	Source
Nonresidential (ESP delivered)	8,017,191	Kilowatt-hours	Ahrns pers. comm.
Nonresidential (transmission losses)	9,531,185	Kilowatt-hours	Ahrns pers. comm.
Municipal (PG&E delivered)	1,482,209	Kilowatt-hours	Ahrns pers. comm.
Water (PG&E delivered)	2,000,431	Kilowatt-hours	Ahrns pers. comm.
Water (transmission losses)	164,236	Kilowatt-hours	Ahrns pers. comm.
Wastewater Treatment (PG&E delivered)	1,762,242	Kilowatt-hours	Ahrns pers. comm.
Wastewater Treatment (transmission losses)	144,680	Kilowatt-hours	Ahrns pers. comm.
Total PG&E delivered	*152,047,711*	*Kilowatt*	Ahrns pers. comm.
Total EPS delivered	*21,213,129*	*Kilowatt*	Ahrns pers. comm.
2010 Natural Gas			
Residential	218,336	MMBtu	Ahrns pers. comm.
Single-family	177,999	MMBtu	Calculated by ICF
Multi-family	40,337	MMBtu	Calculated by ICF
Nonresidential	481,038	MMBtu	Ahrns pers. comm.
2020 Electricity			
Residential (PG&E delivered)	47,849,707	Kilowatt-hours	Calculated by ICF
Single-family	37,936,921	Kilowatt-hours	Calculated by ICF
Multi-family	9,912,787	Kilowatt-hours	Calculated by ICF
Residential (ESP delivered)	60,055	Kilowatt-hours	Calculated by ICF
Single-family	47,613	Kilowatt-hours	Calculated by ICF
Multi-family	12,441	Kilowatt-hours	Calculated by ICF
Residential (transmission losses)	3,933,391	Kilowatt-hours	Calculated by ICF
Nonresidential (PG&E delivered)	134,624,982	Kilowatt-hours	Calculated by ICF
Nonresidential (ESP delivered)	9,986,696	Kilowatt-hours	Calculated by ICF
Nonresidential (transmission losses)	11,872,618	Kilowatt-hours	Calculated by ICF
Municipal (PG&E delivered)	1,846,329	Kilowatt-hours	Calculated by ICF
Water (PG&E delivered)	2,500,232	Kilowatt-hours	Calculated by ICF
Water (transmission losses)	205,270	Kilowatt-hours	Calculated by ICF
Wastewater Treatment (PG&E delivered)	2,170,317	Kilowatt-hours	Calculated by ICF
Wastewater Treatment (transmission losses)	178,183	Kilowatt-hours	Calculated by ICF

Parameter	Value	Unit	Source
Total PG&E delivered	*187,145,239*	*Kilowatt-hours*	Calculated by ICF
Total EPS delivered	*26,236,213*	*Kilowatt-hours*	Calculated by ICF
2020 Natural Gas			
Residential	259,820	MMBtu	Calculated by ICF
Single-family	211,819	MMBtu	Calculated by ICF
Multi-family	48,001	MMBtu	Calculated by ICF
Nonresidential	599,210	MMBtu	Calculated by ICF
WASTE			
Waste disposal in 2010	16,762	tons	Ahrns pers. comm.
Waste disposal in 2020	20,644	tons	Calculated by ICF
WATER			
2010 water use	3,738,356	gallons/day	Ahrns pers. comm.
2020 water use	4,672,372	gallons/day	Calculated by ICF
Percentage of water from California Water Service Company	72%	-	Ahrns pers. comm.
Percentage of water from South Feather Water and Power Agency	4%	-	Ahrns pers. comm.
Percentage of water from Thermolito Water and Sewer District	24%	-	Ahrns pers. comm.
Percentage of residential water use (outdoor)	57%	-	ConSol 2010
Percentage of residential water use (indoor)	43%	-	ConSol 2010
Percentage of commercial water use (outdoor)	35%	-	Yudelson 2010
Percentage of commercial indoor water use (indoor)	65%	-	Yudelson 2010
Percentage of water heated (indoor residential)	30%	-	DeOreo & Mayer 2014
Percentage of water heated (indoor nonresidential)	22%	-	Yudelson 2010 and DeOreo & Mayer 2014
Electricity use to heat gallon of hot water	0.18	Kilowatt-hours/gallon	EPA 2010
Percentage of homes with electric water heaters	21%	-	EIA 2009
Percentage of homes with natural gas water heaters	74%	-	EIA 2009
Percentage of commercial buildings with electric water heaters	40%	-	EIA 2003
Percentage of homes with natural gas water heaters	74%	-	EIA 2009
Natural gas use to heat gallon of hot water	0.009	therm/gallon	EPA 2010
Percentage of commercial buildings with natural gas water heaters	60%	-	EIA 2003

Parameter	Value	Unit	Source
EMISSION FACTORS			
2010 Energy			
CO_2e (PG&E)	0.445	Pounds/kilowatt-hour	Ahrns pers. comm.
CO_2 (ESP)	0.659	Pounds/kilowatt-hour	Ahrns pers. comm.
CH_4 (ESP)	0.0000289	Pounds/kilowatt-hour	Ahrns pers. comm.
N_2O (ESP)	0.0000062	Pounds/kilowatt-hour	Ahrns pers. comm.
CO_2 (natural gas)	117	Pounds/MMBtu	Ahrns pers. comm.
CH_4 (natural gas)	0.005	Kilograms/MMBtu	Ahrns pers. comm.
N_2O (natural gas)	0.0001	Kilograms/MMBtu	Ahrns pers. comm.
2020 Energy			
CO_2 (PG&E RPS-adjusted)	0.290	Pounds/kilowatt-hour	PG&E 2013
CO_2 (ESP RPS-adjusted)	0.455	Pounds/kilowatt-hour	Calculated by ICF
CH_4 (PG&E and ESP RPS-adjusted)	0.000020	Pounds/kilowatt-hour	Calculated by ICF
N_2O (PG&E and ESP RPS-adjusted)	0.0000043	Pounds/kilowatt-hour	Calculated by ICF
T&D losses	8.21%	per kilowatt-hour	Ahrns pers. comm.
OFFROAD			
CO_2 (gasoline)	8.78	Kilograms/gallons	Climate Registry 2013
CO_2 (diesel)	10.21	Kilograms/gallons	Climate Registry 2013
CO_2 (LPG)	5.79	Kilograms/gallons	Climate Registry 2013
CH_4 (agricultural gasoline)	1.26	grams/gallon	Climate Registry 2013
CH_4 (agricultural diesel)	1.44	grams/gallon	Climate Registry 2013
CH_4 (gasoline)	0.50	grams/gallon	Climate Registry 2013
CH_4 (diesel)	0.58	grams/gallon	Climate Registry 2013
N_2O (gasoline)	0.22	grams/gallon	Climate Registry 2013
N_2O (diesel)	0.26	grams/gallon	Climate Registry 2013
CH_4 (LPG)	0.50	grams/gallon	ICLEI 2012
N_2O (LPG)	0.22	grams/gallon	ICLEI 2012
SOCIOECONOMIC DATA			
Population			
2010 Oroville	15,529	persons	DOF 2012

Parameter	Value	Unit	Source
2010 Butte County	221,768	persons	DOF 2012
2020 Oroville	19,125	persons	Sundberg pers. comm.
2020 Butte County	272,800	persons	Sundberg pers. comm.
Households			
2010 Oroville	6,198	dwellings	DOF 2012
2010 Butte County	96,623	dwellings	DOF 2012
2020 Oroville	7,376	dwellings	Sundberg pers. comm.
2020 Butte County	111,120	dwellings	Sundberg pers. comm.
Employment			
2010 Oroville	4,500	jobs	EDD 2012
2010 Butte County	71,501	jobs	EDD 2012
2020 Oroville	5,605	jobs	Sundberg pers. comm.
2020 Butte County	84,451	jobs	Sundberg pers. comm.
OTHER			
Percentage GHG reduction from electrified G4 equipment by horsepower			
Less than 25	64.10%	-	CAPCOA 2010
25–50	80.30%	-	CAPCOA 2010
50–120	80.10%	-	CAPCOA 2010
120–175	79.50%	-	CAPCOA 2010
Greater than 175	78.90%	-	CAPCOA 2010
PG&E average bundled residential electricity rate	$0.1667	$ per kWh in 2016	CEC 2014
PG&E average bundled commercial electricity rate	$0.1460	$ per kWh in 2016	CEC 2014
PG&E average bundled residential natural gas rate	$1.0907	$ per therm in 2016	CEC 2014
PG&E average bundled commercial natural gas rate	$1.1056	$ per therm in 2016	CEC 2014
Potable water rate	$0.003	$ per gallon	California Water Service Company 2011

Notes:
CAPCOA = California Air Pollution Control Officers; CEC = California Energy Commission; DOF = California Department of Finance; EDD = California Employment Development Division; EIA = Energy Information Administration; EPA = U.S. Environmental Protection Agency; IPCC = Intergovernmental Panel on Climate Change; PG&E = Pacific Gas and Electric.

State Emissions Reduction Strategies

S-1. Renewables Portfolio Standard

Objective: The Renewables Portfolio Standard (RPS) obligates investor-owned utilities (IOUs), energy service providers (ESPs), and Community Choice Aggregators (CCAs) to procure an increasing amount of their electricity from eligible renewable sources. Senate Bill X1-2 was signed by Governor Brown in April 2011 and requires regulated entities to meet RPS goals of 20% of retail sales from renewables by the end of 2013, 25% by the end of 2016, and the 33% by the end of 2020.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
15,661	26.0%	30.4%	-[c]	-[c]	-[c]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Cost analysis not prepared for State-level strategies.

Assumptions: All assumptions utilized for the analysis of this strategy are identified in Table D-1.

Analysis Method:

Both PG&E and ESPs provide electricity to Oroville residents. GHG emissions generated by PG&E-delivered electricity in the Oroville 2020 business-as-usual (BAU) community emissions forecast (2020 BAU Forecast) were quantified using the utility's BAU CO_2e intensity, whereas GHG emissions generated by ESP-delivered electricity in the 2020 BAU Forecast were quantified using the statewide average emissions intensities. Achievement of the RPS will reduce PG&E's and statewide average BAU carbon intensities. GHG emissions that would be generated by community-wide electricity consumption in 2020 will therefore be lower as a result of the RPS-adjusted emission factors. These reductions were calculated by multiplying the forecasted 2020 community-wide electricity consumption by the RPS-adjusted emissions factors for PG&E and ESPs. The difference in emissions between the 2020 BAU and 2020 RPS scenarios represents the emissions reductions achieved by this State action.

S-2. Title 24 Standards for Commercial and Residential Buildings

Objective: Title 24 requires that building shells and building components be designed to conserve energy and water. CALGREEN mandatory and voluntary measures became effective on January 1, 2011, and the guidelines will be periodically updated. The current energy efficiency standards in Title 24 were last adopted in 2013 and took effect on January 1, 2014. The standards are planned to be updated periodically in the future.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
2,673	4.4%	5.2%	-[c]	-[c]	-[c]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Cost analysis not prepared for State-level strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- State action would apply to buildings constructed between 2010 and 2020.
- Stringency of the single-family and multi-family residential 2013 Title 24 Standards (effective 2014) increased by 25% and 18%, respectively, relative to the 2008 Standard (California Energy Commission 2012). Stringency of the residential standards is assumed to increase by 17% every three years after 2014.
- Stringency of the nonresidential 2013 Title 24 Standard (effective 2014) increased by 30%, relative to the 2008 Standard (California Energy Commission 2012). Stringency of the nonresidential standards is assumed to increase by 7% every three years after 2014.

Analysis Method:

Revisions to the single-family, multi-family, and nonresidential Title 24 standards in 2013 increased the stringency by 25%, 14%, and 30%, respectively, relative to the 2008 standards, which were in place at the time of the Oroville 2010 community emissions inventory (2010 Inventory). It was assumed that Title 24 will be revised again in 2017[1] to include a 17% and 7% stringency increase in the residential and nonresidential standards, respectively, relative to the 2013 standard. Community-wide energy reductions in 2020 were calculated based on the assumed stringency increases in the Title 24 standards and the annual fraction of electricity subject to each code revision. Emissions reductions achieved by the strategy were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

S-3. Lighting Efficiency and Toxics Reduction Act

Objective: Assembly Bill 1109 (AB 1109), Lighting Efficiency and Toxics Reduction Act, is structured to reduce statewide electricity consumption by at least 50% from 2007 levels for indoor residential lighting, and by at least 25% from 2007 levels for indoor commercial and outdoor lighting, by 2018.

[1] The Title 24 standards will likely be revised again in 2020, but the code revision will not take effect until 2021. Accordingly, energy and emissions benefits achieved by the 2020 code update have not been included in the 2020 reduction calculation.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
2,380	4.0%	4.6%	-[c]	-[c]	-[c]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Cost analysis not prepared for State-level strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- State action would apply to buildings constructed before 2010.
- 5.20% of nonresidential electricity is used for outdoor lighting (California Energy Commission 2006).
- 28.9% of nonresidential electricity is used for indoor lighting (California Energy Commission 2006).
- 13.0% of residential electricity is used for indoor lighting (Energy Information Administration 2009).

Analysis Method:

Electricity usage from lighting in existing residential and nonresidential developments was estimated by multiplying energy use in 2010 by the fraction of energy that is used for outdoor and indoor lighting. Energy reductions achieved by AB 1109 were calculated by multiplying the estimated lighting consumption by the State goals for residential and nonresidential developments. GHG emissions reductions achieved by the strategy were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

S-4. Residential Solar Water Heaters

Objective: The Residential Solar Water Heater Program (AB 1470) creates a $25 million per year, 10-year incentive program to encourage the installation of solar water heating systems that offset natural gas and electricity use in homes and businesses throughout the state.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
54	0.1%	0.1%	-[c]	-[c]	-[c]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Cost analysis not prepared for State-level strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- State action would apply to buildings constructed before 2020.
- Natural gas solar water heaters reduce natural gas use by 130 therms (California Air Resources Board 2008).
- Electric solar water heaters reduce electricity use by 2,195 kilowatt-hours (kWh) (U.S. Department of Energy 2012a).

- An average of 0.013 water heaters per home will be replaced as a result of the strategy in 2020 (California Air Resources Board 2008).

Analysis Method:

The ARB estimates that implementation of AB 1470 would result in the installation of 200,000 solar water heaters by 2020. The solar water heaters will reduce either natural gas use by 130 therms or electricity use by 2,195 kWh, depending on the type of auxiliary tank system. Natural gas and electricity reductions were calculated by multiplying the expected energy reductions by the percentage of homes with each system type and estimated number of water heaters in Oroville. GHG emissions reductions achieved by the strategy were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

S-5. Pavley Emissions Standards for Passenger Vehicles, Advanced Clean Cars, and Low Carbon Fuel Standard

Objective: Pavley will reduce GHG emissions from automobiles and light-duty trucks (2009 model years and newer) by 30% from 2002 levels by the year 2016. The Advanced Clean Car (ACC) rule will further reduce GHG emissions from automobiles and light-duty trucks for 2017–2025 vehicle model years. The State's vehicle efficiency standards have been harmonized with federal vehicle efficiency standards. The low carbon fuel standard (LCFS) would reduce GHG emissions by requiring a low carbon intensity of transportation fuels sold in California by at least 10% by the year 2020.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
30,300	50.3%	58.9%	-[c]	-[c]	-[c]

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Cost analysis not prepared for State-level strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- The ACC rule will reduce statewide emissions from passenger vehicles by 3.8 million $MTCO_2e$ in 2020 (California Air Resources Board 2013).

Analysis Method:

The ARB's EMFAC2011 model provides GHG emission factors that account for the statewide impact of Pavley and LCFS. The 2020 VMT forecast for the City were multiplied by the EMFAC2011 emission factors to obtain GHG emissions assuming implementation of the State actions. Local GHG emissions reductions achieved by Pavley and LCFS were calculated by subtracting the Pavley and LCFS adjusted emissions from the 2020 BAU emissions for the transportation sector.

The EMFAC2011 model does not include emissions benefits from the ACC rule. Local reductions achieved by the ACC rule were therefore obtained by apportioning expected statewide reductions to the City level. The ARB estimates that implementation of the ACC rule will reduce statewide emissions from light-duty vehicles by 3.8 million $MTCO_2e$ in 2020, or by approximately 2.5% (California Air Resources Board 2013). Emissions reductions achieved by the ACC rule within Oroville were therefore quantified by multiplying GHG emissions from light-duty vehicles by 0.025. Reductions achieved by Pavley and LCFS were removed from the light-duty emissions forecast to avoid double counting.

S-6. Assembly Bill 32 Vehicle Efficiency Measures

Objective: The AB 32 scoping plan includes several vehicle efficiency measures that focus on maintenance practices. The Tire Pressure Program will increase vehicle efficiency by assuring properly inflated automobile tires to reduce rolling resistance. The Heavy-Duty Vehicle Aerodynamic Efficiency Program will increase heavy-duty vehicle (long-haul trucks) efficiency by requiring installation of best available technology and/or ARB approved technology to reduce aerodynamic drag and rolling resistance. Finally, the Heavy-Duty Vehicle Hybridization Program will reduce GHG emissions through the use of hybrid and zero-emission technology.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
397	0.7%	0.8%	-[c]	-[c]	-[c]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Cost analysis not prepared for State-level strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- The Tire Pressure Program will reduce statewide emissions from passenger vehicles by 0.6 million $MTCO_2e$ (California Air Resources Board 2013).
- The Heavy-Duty Vehicle Aerodynamic Efficiency Program will reduce statewide emissions from heavy-duty vehicles by 0.7 million $MTCO_2e$ (California Air Resources Board 2013).
- The Heavy-Duty Vehicle Hybridization Program will reduce statewide emissions from heavy-duty vehicles by 0.1 million $MTCO_2e$ (California Air Resources Board 2013).

Analysis Method:

The ARB estimates that implementation of the Tire Pressure Program will reduce statewide emissions from light-duty vehicles by 0.6 million $MTCO_2e$, or by approximately 0.39%. Implementation of the Heavy-Duty Vehicle Programs (Aerodynamic Efficiency and Hybridization) will reduce statewide emissions from heavy-duty vehicles by 0.8 million $MTCO_2e$, or by approximately 1.9%. Emissions reductions achieved by the Tire Pressure and Heavy-Duty Vehicle Programs were therefore quantified by multiplying GHG emissions from light-duty vehicles and heavy-duty vehicles, respectively, by 0.0039 and 0.019. Reductions achieved by Pavley, LCFS, and ACC were removed from the light-duty emissions forecast to avoid double counting.

Local Emissions Reduction Strategies

Energy Efficiency and Renewable Energy

BE-1. Green Building Ordinance

Objective: Achieve 15% less energy use than the 2013 Title 24 requirements (which took effect January 1, 2014) for new nonresidential and residential buildings.

The *Oroville 2030 General Plan* (2030 General Plan) encourages new development to meet the guidelines of the California Energy Star New Homes Program and use 15% less energy than the 2008 State Energy Efficiency Standards (Title 24). To meet this objective, the City will adopt a Green Building Ordinance to require all new residential and nonresidential buildings to exceed the Energy Commission's 2013 Building Energy Efficiency Standards under Title 24 (which took effect in 2014) by at least 15% (or any subsequent standards that replace the current Title 24 Standards). Consistent with the City's 2030 General Plan, the Green Building Ordinance will also include guidelines for cool roofs, high efficiency heating systems, passive design, and energy efficient appliances.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of BE Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
323	0.5%	3.7%	8.6%	$220–10	$700,000–$160,000	$100,000

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Strategy requirements would apply to buildings constructed between 2016 and 2020.
- Single-family homes that exceed the Title 24 standards by 15% will achieve a 0.75% reduction in electricity use and a 12.45% reduction in natural gas use in 2020 (California Air Pollution Control Officers Association 2010:Table BE-1.2).
- Multi-family homes that exceed the Title 24 standard s by 15% will achieve a 0.75% reduction in electricity use and a 11.55% reduction in natural gas use in 2020 (California Air Pollution Control Officers Association 2010:Table BE-1.2).
- Nonresidential facilities that exceed the Title 24 standards by 15% will achieve a 4.20% reduction in electricity use and a 9.00% reduction in natural gas use in 2020 (California Air Pollution Control Officers Association 2010:Table BE-1.1)

Analysis Method:

Energy savings achieved by exceeding Title 24 were obtained from CAPCOA (2010). These values were multiplied by the forecasted electricity and natural gas consumption for buildings constructed between 2016 and 2020 to obtain total energy reductions. Energy savings from overlapping State and local strategies were removed from the energy forecast to avoid double counting. GHG emissions reductions achieved by the strategy were quantified by multiplying the energy reductions for each building type by the appropriate RPS-adjusted utility emission factors.

Initial capital costs are incurred by residential and nonresidential building owners to install energy-efficiency upgrades. Costs can vary significantly, depending on building size and type, climate zone, and technology. It is likely that the less expensive energy-efficiency improvements were captured by efforts to meet Title 24 standards, and thus the incremental cost of exceeding Title 24 standards can be greater than average energy efficiency efforts. For this analysis, estimates on initial costs to exceed Title 24 standards by 15% were developed using Gabel Associates (2010), which provides a range of cost estimates for different building types and upgrade scenarios.[2] Annual cost savings were calculated by multiplying electricity and natural gas reductions by the appropriate PG&E utility rates.

BE-2. Residential Energy Efficiency Retrofits

Objective: Achieve the voluntary residential energy efficiency retrofit goals outlined in Table 2 by 2020. Providing a variety of retrofit packages allows homeowners to select and customize retrofit options that meet their needs.

Table 2. Voluntary Residential Energy Efficiency Retrofit Goals

Retrofit Level	Implementation Goal	Minimum Retrofits
Basic	10% of existing single-family homes	• Replace interior high use incandescent lamps with compact florescent lamps (CFLs) • Seal air leaks
Advanced	7% of existing single-family homes	• All *basic* retrofits • Seal duct leaks • Install a programmable thermostat • Replace windows with double-pane, solar-control low E-argon gas wood frame windows
Premium	5% of existing single-family homes	• All *advanced* retrofits • Insulate the attic • Replace electric clothes dryers with natural gas dryers • Replace natural gas furnaces with ENERGY STAR labeled models
Multi-family	5% of existing multi-family homes	• Will vary on a case-by-case basis. Retrofits should reduce energy consumption (electricity and natural gas) by at least 15%, relative to existing conditions.

[2] Gabel Associates (2010) is focused on Climate Zone 9. Similar estimates were not available for Climate Zone 11, of which the City of Oroville is a part, so Climate Zone 9 is used as a proxy.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of BE Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
624	1.0%	7.1%	16.6%	$240–$60	$1,700,000–3,000,000	$300,000

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Strategy goals would apply to residential buildings constructed before 2016.
- Energy reductions achieved by the basic retrofit level would be 997 kWh and 68 therms per single-family house (U.S. Department of Energy 2013a).
- Energy reductions achieved by the advanced retrofit level would be 1,114 kWh and 140 therms per single-family house (U.S. Department of Energy 2013a).
- Energy reductions achieved by the premium retrofit level would be 2,041 kWh and 226 therms per single-family house (U.S. Department of Energy 2013a).
- Initial costs per single-family retrofits are $880 to $1,900 for the basic level, $2,600 to $4,800 for advanced, and $5,200 to $8,400 for premium (U.S. Department of Energy 2013a).

Analysis Method:

Energy savings associated with the single-family retrofit levels were estimated using the DOE's Home Energy Saver™ (HES). Electricity and natural gas savings provided by the HES were multiplied by the implementation goals (see Table 2) and the estimated number of homes in 2016 to obtain total energy reductions for single-family residences. Energy reductions achieved by multi-family retrofits were quantified assuming the upgrades would reduce energy consumption by 15%, relative to BAU conditions. GHG emissions reductions achieved by the strategy were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

Upfront retrofit costs for single-family homes were estimated using the HES. For most upgrades, costs reflect the assumption that updates will be made at the end of the useful life of the currently-installed appliance or furnace (and thus represent the incremental cost of the more energy efficient unit). Upfront retrofit costs for multi-family homes were based on costs and energy savings reported by the California Home Energy Retrofit Coordinating Committee (2010). These costs were scaled for the City based on total energy reductions. Annual cost savings for both single- and multi-family homes were calculated by multiplying electricity and natural gas reductions by the appropriate PG&E utility rates.

BE-3. Nonresidential Energy Efficiency Retrofits

Objective: Retrofit 15% of existing nonresidential buildings by 2020 to achieve a building-wide energy reduction (natural gas and electricity) of 20%, relative to existing conditions.

Energy efficiency upgrades at commercial and industrial buildings will reduce energy consumption and could provide a variety of co-benefits for the workforce. For example, a well-built energy-efficient structure is more durable and directly reduces certain health risks (e.g., mold, dust mites). Energy efficient buildings also improve general comfort by equalizing room temperatures and reducing indoor humidity.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of BE Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
1,399	2.3%	15.9%	37.2%	$530–$500	$200,000–$700,000	$700,000

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Strategy goals would apply to nonresidential buildings constructed before 2016. Of these buildings, 15% would perform energy efficiency retrofits.
- The cost per square foot for building energy audits ranges from $0.18 to $0.50 for a comprehensive energy audit (AECOM 2010).
- The cost per square foot for building energy retrofits (5-20% energy efficiency improvement) are $0.30 to $1.01 (Pike Research 2010; AECOM 2010).

Analysis Method:

Energy reductions achieved by nonresidential retrofits were quantified assuming the upgrades would reduce facility-wide energy use by 20%. This reduction was multiplied by the forecasted electricity and natural gas consumption for participating buildings constructed before 2016. Energy savings from overlapping State and local strategies were removed from the energy forecast to avoid double counting. GHG emissions reductions achieved by the strategy were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

Upfront costs would be incurred to conduct an energy audit and perform the physical retrofits. Costs of conducting building energy audits were estimated based on the total square footage of participating nonresidential buildings and the cost per square foot for energy audits. A similar method was used to estimate upfront costs associated with the physical retrofit. Annual energy cost savings were calculated by multiplying the electricity and natural gas reductions by the appropriate PG&E utility rates.

BE-4. Energy Efficient Lighting Standards

Objective: Reduce electricity consumption with energy-efficient lighting.

The City will upgrade existing street lights with light emitting diode (LED) bulbs. It will also provide incentives to encourage existing residential and nonresidential buildings to replace existing outdoor lights with more efficient bulbs.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of BE Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
156	0.3%	1.8%	4.2%	$1,400–$1,000	$800,000–$1,300,000	$275,000

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Strategy goals for residential and nonresidential outdoor lighting fixtures would apply to buildings constructed before 2016. Of these buildings, 25% would replace existing incandescent bulbs with LED bulbs.
- 5.20% of nonresidential electricity would be used for outdoor lighting (California Energy Commission 2006).
- 5.69% of residential electricity would be used for outdoor lighting (California Energy Commission 2006).
- Installation of an outdoor LED fixture achieves a 75% reduction in energy usage, relative to an incandescent bulb (U.S. Environmental Protection Agency 2011).
- A total of 1,409 streetlights would be replaced with LED bulbs.
- Streetlights would operate 11 hours per day, 365 days per year (ICLEI 2010).
- Residential and nonresidential outdoor lights operate 1,132 and 4,380 hours per year (California Public Utilities Commission 2009; U.S. Department of Energy 2012b).
- The BAU streetlight profile for incandescent bulbs would be (ICLEI 2010):
  - 20% Mercury Vapor (182 watts)
  - 6% Metal Halide (200 watts)
  - 64% High Pressure Sodium Cutoff (192 watts)
  - 10% Low Pressure Sodium Cutoff (180 watts)
  - 0% LED (120 watts)
- Costs for retrofitting existing streetlights with LED bulbs range from $410 to $825 per streetlight (U.S. Department of Energy 2008).
- Annual maintenance savings associated with LED bulbs range from $14 to $15 per streetlight (U.S. Department of Energy 2008).

Analysis Method:

Residential and Nonresidential Outdoor Lighting

Energy reductions achieved by replacing existing outdoor residential and nonresidential lighting fixtures with LED bulbs were quantified assuming the LED bulbs would reduce outdoor lighting electricity by 75%. This reduction was multiplied by the forecasted outdoor electricity consumption for participating buildings constructed before 2016. Electricity savings from overlapping State and local strategies were removed from the energy forecast to avoid double counting. GHG emissions reductions achieved by outdoor lighting retrofits were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

Capital costs were estimated assuming an incremental cost per LED blub of approximately $14. The total number of replaced bulbs was based on the average bulb wattage and operating hours for residential and nonresidential buildings (U.S. Department of Energy 2012b). Maintenance cost savings were based on an annual replacement rate (based on the rated life of incandescent versus LED bulbs), incremental material costs, and installation costs scaled for climate zone 11 (California Public Utilities Commission 2009). Annual energy cost savings were calculated by multiplying electricity and natural gas reductions by the appropriate PG&E utility rates.

Streetlights

Electricity reductions achieved by energy-efficient streetlights were calculated based on the difference in electricity usage between the existing streetlight profile and an all LED-streetlight profile. Existing electricity consumption was estimated assuming existing streetlights were a mix of mercury vapor, metal halide, and high/low pressure sodium cutoff fixtures. GHG emissions reductions achieved by replacing all streetlights with LED bulbs were quantified by multiplying the difference in electricity consumption by the appropriate RPS-adjusted utility emission factors.

Capital costs were calculated based on the number of replaced bulls and the cost per retrofit. A similar method was used to calculate annual cost savings.

BE-5. Solar Installations for New Development

<u>Objective:</u> Implement solar energy installation requirements for new buildings to increase renewable energy generation.

All new solar installations will be required to comply with Chapter 21A (Solar Energy Code) of the Oroville Municipal Code regarding siting and setback standards.

<u>Summary Metrics:</u>

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of BE Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
184	0.3%	2.1%	4.9%	$2–($340) (direct); $220–$110 (PPA)	$2,700,000–$3,300,000	$200,000 (direct); $37,000–$18,000 (PPA)

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy efficiency and renewable energy strategies.

<u>Assumptions:</u> In addition to assumptions listed in Table D-1, the following were also considered.

- Residential projects of six units or more constructed between 2016 and 2020 would be required to install solar photovoltaic (PV) on 50% of new homes in the development.
- Each residential solar system would generate 5,583 kWh per year (U.S. Department of Energy 2013b).

- Nonresidential projects greater than or equal to 25,000 square feet constructed between 2016 and 2020 would be required to incorporate onsite solar energy generation to provide a minimum of 25% or more of the project's energy needs.
- Approximately 48% of total building square footage constructed between 2016 and 2020 will be associated with projects greater than 25,000 square feet (based on parcel data).
- Initial costs for a residential system (4kW, roof-mounted) range from $4.9 to $5.7 per watt (Lawrence Berkeley National Laboratory and U.S. Department of Energy 2013).
- Initial costs for a nonresidential system (40 kW roof-mounted) ranges from $4.3 to $5.3 per watt (Lawrence Berkeley National Laboratory and U.S. Department of Energy 2013).
- Solar systems would have a 25-year lifetime (U.S. Department of Energy 2013b).

<u>Analysis Method:</u>

The PVWatts model was used to calculate the energy potential of each residential solar installation. This value was multiplied by forecasted number of participating homes constructed between 2016 and 2020 to determine total residential energy reductions achieved by the strategy. Nonresidential energy reductions were calculated by multiplying the minimum renewable energy potential (25%) by the forecasted electricity consumption for buildings constructed after 2016 that are greater than 25,000 square feet. Electricity savings from overlapping State and local strategies were removed from the nonresidential energy forecast to avoid double counting. GHG emissions reductions were then quantified by multiplying the total energy reductions by the appropriate RPS-adjusted utility emission factors.

The cost analysis considered two financing scenarios:

- **Direct Purchase**: The building owner is assumed to directly purchase and install the solar panels
- **Power Purchase Agreement**: The building owner enters into a power purchase agreement (PPA) with a local company who owns and maintains the solar panels.

Total capital costs under the direct purchase scenario were calculated on a per-project basis based on an initial cost of $4.9 to $5.7 (residential) and $4.3 to $5.3 (nonresidential) per watt installed. The lower residential cost includes rebate payments from the California Solar Initiative (CSI) at $0.20 per watt and a federal investment tax credit (ITC) of 30% of the system cost, applied after the CSI rebate. The lower nonresidential cost scenario includes the CSI performance based incentive (PBI) of $0.03 per kWh for the first five years of operation, as well as solar renewable energy certificate (SREC) valued at $10 per MWh. The higher cost scenarios only include the ITC. For both residential and nonresidential systems, annual operating costs of $0.02 per watt were assumed, based on the PVWatts model. Annual energy cost savings were based on electricity production (which decreases slightly each year due to system degradation), multiplied by the appropriate PG&E utility rates.

No upfront costs were assumed under the PPA scenario. Annual costs savings were estimated to be 10 to 20% off the retail value of the electricity generated.

BE-6. Solar Installations for Existing Development

<u>Objective:</u> Achieve the following voluntary solar installation goals for existing development.

- 15% of existing single-family residences install solar PV.

- 10% of existing nonresidential developments install solar PV to provide a minimum of 25% or more of the building's energy needs.

All solar installations will be required to comply with Chapter 21A (Solar Energy Code) of the Oroville Municipal Code regarding siting and setback standards.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of BE Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
1,000	1.7%	11.4%	26.6%	(\$60)–(\$320) (direct); \$220–\$110 (PPA)	\$15,600,000–\$18,400,000	\$1,100,000–\$1,000,000 (direct); \$200,000–\$100,000 (PPA)

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Strategy goals would apply to residential buildings constructed before 2016.
- Each residential solar system would generate 5,583 kWh per year (U.S. Department of Energy 2013b).

Analysis Method:

The approach for calculating electricity, emissions reductions, and costs is similar to what is described for BE-5, *Solar Installations in New Development*. However, the strategy was assumed to apply to existing developments constructed before 2016, as specified in the strategy objective.

BE-7. Local Renewable Energy Development

Objective: Expand local renewable energy production to meet at least 25% of the City's municipal electricity demand in 2020.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of BE Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
69	0.1%	0.8%	1.8%	(\$100)–(\$770) (direct); \$210–\$100 (PPA)	\$1,300,000–\$1,700,000	\$100,000–\$60,000 (direct); \$14,000–\$7,000 (PPA)

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Municipal electricity in 2020 would be 1,846,329 kWh.

- Initial costs would range from $4.0 to $5.0 per watt was assumed, based on costs for similar sized systems in California in 2012 (Lawrence Berkeley National Laboratory and U.S. Department of Energy 2013).
- The solar system would have a 25-year lifetime (U.S. Department of Energy 2013b).

Analysis Method:

Electricity reductions achieved by renewable energy production were calculated by multiplying the forecasted 2020 municipal electricity demand by 25%. Emissions reductions were then quantified by multiplying the total energy reductions by the appropriate RPS-adjusted utility emission factors.

The cost analysis considered two financing scenarios:

- **Direct Purchase:** The City is assumed to directly purchase and install a 330 kW ground-mounted solar PV system.
- **Power Purchase Agreement**: The City enters into a PPA with a local company who owns and maintains the solar panels.

Total capital costs under the direct purchase scenario were calculated based on an initial cost of $4.0 to $5.0 per watt installed. The lower cost scenario includes CSI PBI payments of $0.12 per kWh for the first five years of operation, as well as SREC valued at $10 per MWh. Annual operating costs of $0.02 per watt were assumed, based on the PVWatts model. Annual energy cost savings were based on electricity production (which decreases slightly each year due to system degradation), multiplied by the appropriate PG&E utility rates.

No upfront costs were assumed under the PPA scenario. Annual costs savings were estimated to be 10 to 20% off the retail value of the electricity generated.

Land Use and Transportation

LUT-1. Residential and Commercial Density

Objective: Increase the density of residential and commercial development to reduce vehicle trips and increase alternative modes of transportation (e.g., biking, transit).

Higher density developments generally produce fewer trips than development configured with typical suburban densities. Higher density sites are also more conducive to transit, bicycle use, and walking. For example, transit ridership increases with density, which justifies enhanced transit service.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions	% of Local Reductions	% of LUT Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Medium	-	-	-	-	-	-

[a] Qualitative analysis of the strategy indicates that potential emissions reductions could be between 500 and 1,000 $MTCO_2e$.

Assumptions: N/A

Analysis Method: Emissions reductions achieved by increased residential and commercial density have not been quantified or counted toward attainment of the City's CAP target. Inclusion of GHG benefits achieved by LUT-1 in future CAP updates is contingent on project implementation and the development of metrics to track emissions reductions. Costs and savings associated with the strategy are presented qualitatively in the Chapters 3 and 4 of the CAP.

LUT-2. Mixed-Use Development

Objective: Establish mixed-use development requirements for all specific plans.

Mixed use development produces less vehicle miles traveled (VMT) on a per capita basis as compared to traditional development. Geographically proximate land uses can decrease VMT since trips between land use types are shorter and may be accommodated by non-auto modes of transport. For example, when residential areas are in the same neighborhood as retail and office buildings, a resident does not need to travel outside of the neighborhood to meet his/her trip needs.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of LUT Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
227	0.4%	2.6%	16.0%	-	-	-

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for land use and transportation strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Strategy would reduce 2020 light-duty VMT by 807,469 annual miles (Fehr & Peers 2014).

Analysis Method:

Based on modeling conducted by Fehr & Peers, LUT-2 was assumed to result in a light-duty VMT reduction of 807,469 annual miles. Implementation of the strategy is not anticipated to significantly affect the distribution vehicle speeds within the City. Consequently, the percentage reduction in VMT was assumed to be commensurate with the percentage reduction in GHGs. Emissions reductions associated with the strategy were therefore calculated by multiplying the percentage reduction in VMT by emission factors produced by EMFAC2011 for light-duty vehicles.

Costs and savings are qualitatively presented in the Chapters 3 and 4 of the CAP.

LUT-3. Balanced Mode Circulation Plan

Objective: Create and maintain a transportation system that is safe and efficient and provides access in an equitable manner that optimizes travel by all modes.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions	% of Local Reductions	% of LUT Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Low	-	-	-	-	-	-

[a] Qualitative analysis of the strategy indicates that potential emissions reductions would be less than 500 $MTCO_2e$.

Assumptions: N/A

Analysis Method: Emissions reductions achieved by the balanced mode circulation plan have not been quantified or counted toward attainment of the City's CAP target. Inclusion of GHG benefits achieved by LUT-3 in future CAP updates is contingent on project implementation and the development of metrics to track emissions reductions. Costs and savings associated with the strategy are presented qualitatively in the Chapters 3 and 4 of the CAP.

LUT-4. Pedestrian Network Improvements

Objective: Promote pedestrian friendly design within the City.

An easily accessible and well-connected pedestrian network encourages people to walk instead of drive, which reduces vehicle use and VMT. Minimizing barriers to pedestrian access and interconnectivity can also increase the likelihood of walking.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of LUT Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
486	0.8%	5.6%	34.2%	-	-	-

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for land use and transportation strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Strategy would reduce 2020 light-duty VMT by 1,725,284 annual miles (Fehr & Peers 2014).

Analysis Method:

Based on modeling conducted by Fehr & Peers, LUT-4 was assumed to result in a light-duty VMT reduction of 1,725,284 annual miles. Implementation of the strategy is not anticipated to significantly affect the distribution vehicle speeds within the City. Consequently, the percentage reduction in VMT was assumed to be commensurate with the percentage reduction in GHGs. Emissions reductions associated with the strategy were therefore calculated by multiplying the percentage reduction in VMT by emission factors produced by EMFAC2011 for light-duty vehicles.

Costs and savings are qualitatively presented in the Chapters 3 and 4 of the CAP.

LUT-5. Traffic Calming

Objective: Incorporate traffic calming improvements on 25% of streets and intersections in new development areas and low VMT generating areas of the City.

Traffic calming measures encourage people to walk or bike instead of using a vehicle. This mode shift will result in a decrease in VMT. Traffic calming features may include: marked crosswalks, count-down signal timers, curb extensions, speed tables, raised crosswalks, raised intersections, median islands, tight corner radii, roundabouts or mini-circles, on-street parking, planter strips with street trees, chicanes/chokers, and others.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of LUT Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
18	0.0%	0.2%	1.3%	-	-	-

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for land use and transportation strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Strategy would reduce 2020 VMT by 51,703 annual miles (Fehr & Peers 2014).

Analysis Method:

Based on modeling conducted by Fehr & Peers, LUT-5 was assumed to result in a VMT reduction of 51,703 annual miles. Implementation of the strategy is not anticipated to significantly affect the distribution vehicle speeds within the City. Consequently, the percentage reduction in VMT was assumed to be commensurate with the percentage reduction in GHGs. Emissions reductions associated with the strategy were therefore calculated by multiplying the percentage reduction in VMT by emission factors produced by EMFAC2011 for all vehicle types.

Costs and savings are qualitatively presented in the Chapters 3 and 4 of the CAP.

LUT-6. EV Charging Stations

Objective: Expand public charging facilities to promote electric vehicle usage within the City and greater Butte County area. Adopt a goal to install at least one (1) direct current (DC) charging station to support fast charging and four (4) Level II charging stations.

This strategy would support plug-in hybrid electric vehicle (PHEV) purchase by the general public by enabling charging stations in key locations throughout Oroville to allow PHEV use for shorter trips in and around Oroville. Cooperative planning with Chico could increase potential for PHEV trips between the County's two largest cities.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of LUT Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
24	0.0%	0.3%	1.7%	-	$96,000–$200,000	-

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for land use and transportation strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Installation of four Level II charging stations would serve four PHEV and/or BEV per day, resulting in a 50 electric-VMT (eVMT) increase.
- Installation of one DC charging station would serve six battery electric vehicles (BEV), resulting in a 69 eVMT increase.

- Anticipated mix of PHEV (10-mile range, 20-mile range, and 40-mile range) and BEV is based on the ARB's projections under the Zero Emission Vehicle (ZEV) "Most Likely Compliance Scenario."
- Charging PHEV and BEV would consume the following quantities of electricity:
  - PHEV-10 mile range: 5 kWh per charge
  - PHEV-20 mile range: 6 kWh per charge
  - PHEV-40 mile range and BEV (Level II charger): 7.4 kWh per charge
  - BEV (DC charger): 20.0 kWh per charge
- PHEV and BEV would replace new vehicles with an average fuel economy of 27 miles per gallon.
- On average, PHEV and BEV travel 41 miles per day.

<u>Analysis Method:</u>

GHG emissions generated by EV are attributed to VMT in all-electric mode (i.e., e-VMT) and gasoline mode. E-VMT was calculated based on the anticipated future fleet mix, vehicle range, and charging times required for Level II and DC charging stations. Miles traveled in all-electric mode were assumed to displace miles traveled using a gasoline-engine with an average fuel economy of 27 miles per gallon. Emissions reductions were therefore determined as the difference between the emissions attributable to the EV versus the emissions that would have otherwise occurred using an average conventional gasoline vehicle.

Upfront costs include hardware, permitting, installation, and trenching/concrete for the Level II and DC charging stations (ICF International 2013). The cost analysis assumed a public-private partnership arrangement, in which the City of Oroville covered 50% of upfront costs, and then transferred ownership and operations to a private third-party.

LUT-7. Voluntary Commute Trip Reduction (CTR) Programs

<u>Objective:</u> Support and expand voluntary CTR programs at businesses and employment facilities.

CTR programs discourage single-occupancy vehicle trips and encourage alternative modes of transportation, such as carpooling, taking transit, walking, and biking. The main differences between a voluntary and a required program are:

- Monitoring and reporting are not required.
- Performance standards (e.g., trip reduction requirements) are not required.

CTR programs provide employees with assistance in using alternative modes of travel through a combination of incentives and disincentives. CTR programs should include all of the following:

- Carpooling encouragement
- Ride-matching assistance
- Preferential carpool parking
- Flexible work schedules for carpools
- Identification of in-house transportation coordinator
- Vanpool assistance

- Bicycle end-trip facilities (parking, showers and lockers)

Other strategies may also be included as part of a voluntary CTR program. These include new employee orientation, event promotions and publications, flexible work schedules for all employees, transit subsidies, parking cash-out or priced parking, shuttles, emergency ride home, and improved onsite amenities.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of LUT Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
265	0.4%	3.0%	18.7%	-	-	-

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for land use and transportation strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Strategy would reduce 2020 light-duty VMT by 941,758 annual miles (Fehr & Peers 2014).

Analysis Method:

Based on modeling conducted by Fehr & Peers, LUT-7 was assumed to result in a light-duty VMT reduction of 941,758 annual miles. Implementation of the strategy is not anticipated to significantly affect the distribution vehicle speeds within the City. Consequently, the percentage reduction in VMT was assumed to be commensurate with the percentage reduction in GHGs. Emissions reductions associated with the strategy were therefore calculated by multiplying the percentage reduction in VMT by emission factors produced by EMFAC2011 for light-duty vehicles.

Costs and savings are qualitatively presented in the Chapters 3 and 4 of the CAP.

LUT-8. Intelligent Transportation Systems (ITS)

Objective: Implement ITS for new roadways and existing congested corridors.

ITS can optimize the use of existing and future roadway networks. For example, signal timing and coordination projects ensure that traffic signals along a corridor communicate, allowing vehicles to travel through the corridor without excessive starting or stopping. ITS can reduce fuel usage and emissions, but will not directly affect VMT.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions	% of Local Reductions	% of LUT Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Low	-	-	-	-	-	-

[a] Qualitative analysis of the strategy indicates that potential emissions reductions would be less than 500 $MTCO_2e$.

Assumptions: N/A

Analysis Method: Emissions reductions achieved by ITS not been quantified or counted toward attainment of the City's CAP target. Inclusion of GHG benefits achieved by LUT-8 in future CAP updates is contingent on project implementation and the development of metrics to track emissions reductions. Costs and savings associating the strategy are presented qualitatively in the Chapters 3 and 4 of the CAP.

LUT-9. Idling Ordinance

Objective: Limit heavy-duty vehicle idling to 3 minutes to reduce exhaust emissions and fuel consumption.

The current idling limit adopted by the ARB and Butte County Air Quality Management District (BCAQMD) regulations is 5 minutes. This strategy will reduce the limit to 3 minutes and encourage contractors (as part of permitting requirements) to submit a construction vehicle management plan that includes the following information: idling time requirements; requiring hour meters on equipment; and documenting the serial number, horsepower, age, and fuel of all onsite equipment.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of LUT Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
37	0.1%	0.4%	2.6%	$430	$0	$16,000

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for land use and transportation strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- An average of 1 gallon of fuel is consumed per idle-hour and 1.7 gallons per operating-hour (U.S. Environmental Protection Agency 2009).
- Equipment idles for an average of 45 minutes per 8-hour day (Kable 2004; U.S. Environmental Protection Agency 2009).

Analysis Method:

Baseline emissions from construction equipment idling were quantified using the ratio of idle to operating fuel consumption. Although construction equipment were assumed to idle 45 minutes, it is unlikely the idling would occur at a single time. The ARB's idling regulation for heavy-duty vehicles (5 minutes) was therefore used a proxy to determine the percentage reduction in potential idling emissions from implementation of the strategy. Reducing idling time from 5 minutes to 3 minutes is a 40% reduction. Emissions savings associated with this strategy were therefore calculated by multiplying baseline idling emissions by 0.40.

No capital costs were assumed given that automatic engine shut down/start up systems should already be installed to comply with ARB's idling regulation. Annual cost savings were based on avoided fuel use, reduced maintenance (e.g., fewer oil changes), and reduced engine overhauls. The mileage per gallon for construction vehicles was assumed to be 160 gallons per thousand miles (Harrington and Krupnick 2012), and the avoided maintenance cost per mile was calculated at $0.08 (based on a $25 oil change every 3,000 miles and a $7,000 engine overhaul every 100,000 miles).

LUT-10. Electric-Powered Construction Equipment

Objective: Ensure that at least 25% of construction equipment on annual projects utilize electric power instead of gasoline or diesel fuel.

Electric equipment goals for construction equipment will be included as part of the discretionary requirement process for new development projects in the City. The City will work with construction contractors, as needed, to determine the components of their fleets.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of LUT Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
317	0.5%	3.6%	22.3%	-	-	-

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for land use and transportation strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Electrification of diesel powered construction equipment would result in a 72.90% reduction in GHG emissions (California Air Pollution Control Officers Association 2010).
- Electrification of two-stroke gasoline powered construction equipment would result in a 64.10% reduction in GHG emissions (California Air Pollution Control Officers Association 2010).

Analysis Method:

The OFFROAD2007 model calculates vehicle operating emissions by fuel type (e.g., diesel, gasoline) and average horsepower. Emissions reductions achieved by the strategy were calculated by multiplying the model outputs by vehicle class by CAPCOA's (2010) anticipated percentage reduction in GHG emissions for switching to electric power.

Costs and savings are qualitatively presented in the Chapters 3 and 4 of the CAP.

LUT-11. Electric-Powered Landscaping Equipment

Objective: Reduce gasoline-powered landscaping equipment use and/or reduce the number and operating time of such equipment. Pursue a voluntary goal for 5% of landscaping equipment operating in the City's to be electric- or battery-powered by 2020.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of LUT Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
45	0.1%	0.5%	3.2%	-	-	-

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for land use and transportation strategies.

Assumptions: All assumptions utilized for the analysis of this strategy are identified in Table D-1.

Analysis Method:

The OFFROAD2007 model calculates vehicle operating emissions by fuel type (e.g., diesel, gasoline) and average horsepower. Emissions reductions achieved by the strategy were calculated by multiplying the model outputs by vehicle class by CAPCOA's (2010) anticipated percentage reduction in GHG emissions for switching to electric power.

Costs and savings are qualitatively presented in the Chapters 3 and 4 of the CAP.

Waste Reduction

WR-1. Waste Diversion Goal

Objective: Divert from landfills at least 75% of waste generated in the City overall and 65% of construction and building materials and demolition debris.

Existing waste management programs collectively diverted 59% of waste generated in the City to recycling centers and other end uses in 2006. Implementation of this strategy will further the amount of diverted waste to at least 75% by 2020. The City will work with Norcal Waste Systems to expand existing services and support or organize education and outreach programs.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of WR Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
1,983	3.3%	22.7%	100.0%	($50–$180)	-	($90,000–$400,000)

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for waste reduction strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Oroville would have a BAU waste diversion rate of 59% (CalRecycle 2013). [3]
- Oroville would generate 34,989 tons of solid waste in 2020, of which, 20,644 tons would be landfilled under BAU conditions.
- One ton of landfilled waste generates 0.29 $MTCO_2e$.
- Weighted average cost per ton diverted ranges from $11 to $45 (City of Santa Monica 2013).

Analysis Method:

WR-1 would increase the waste diversion rate from 59% under BAU conditions to 75%. Landfilled waste in 2020 was recalculated assuming a 75% diversion rate and subtracted from the BAU scenario to calculate the volume of additional diverted waste achieved by the strategy. Avoided GHG emissions from increased diversion were quantified by multiplying the additional diverted waste by the average landfill emissions per ton of waste landfilled.

[3] CalRecycle stopped tracking waste diversion rates in 2007. The organization now reports per capita waste disposal, rather than a diversion percentage. The "waste diversion equivalent" for Oroville in 2010, which is calculated from the per capita disposal and adjusted for ash disposal from the POPI Biomass Power Plant, is approximately 50%. The reduction in diverted waste, relative to 2006, may be due to effects of the economic downturn on recycling programs, as well as methodological differences in comparing a diversion rate and diversion rate equivalent. Since the 2006 diversion rate is based on actual reporting, rather than calculated from waste disposal information, the value is used to support this analysis. Relying on the 2006 diversion rate may also yield a slightly conservative estimate of emissions reductions, considering that the 2010 diversion equivalent indicates that diversion in 2010 might have been slightly lower than 59%.

The cost analysis estimated the potential incremental cost to the City for new and expanded policies, programs, and infrastructure to increase diversion. This level of cost information specific to the City was not available; however, the City of Santa Monica recently conducted a cost analysis for its Zero Waste Strategic Operations Plan, and these costs were used as a proxy (City of Santa Monica 2013). The Santa Monica report considers a suite of program options for residential single-family, multi-family, and commercial sources, and estimates the incremental change in the annual cost for each program per ton diverted. Costs include collection, handling and processing costs, as well as administrative and overhead costs; savings include avoided disposal costs. Some programs—such as weekly organics and recyclable collection, biweekly refuse collection, and wet/dry collection for single- and multi-family residences, and behavior change market and wet/dry collection for commercial customers—were found to be highly cost-effective, resulting in net cost savings on an annual basis. Other programs—such food scrap collection—were less cost effective, resulting in net annual costs. For the cost analysis, the weighted average cost per ton diverted was calculated across all proposed programs and applied to the additional diverted wasted.

Water Conservation

WC-1. Per-Capita Water Use Reduction

Objective: Meet (or exceed) the State-established per capita water use reduction goal[4] as identified by Senate Bill (SB) X7-7 for 2020.

This strategy will reduce embodied energy use associated with water conveyance and treatment, along with fugitive emissions associated with wastewater treatment processes resulting from treatment of wastewater generated within the City. Specific per capita water use reduction goals vary by water agency. The City's Green Building Ordinance (see BE-1) will include the new strategies for water efficiency, retrofits, education, runoff control, water auditing, and supply improvements.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of WC Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
1,646	2.7%	18.8%	100.0%	-	-	-

[a] Presented in terms of $MTCO_2e$. Water efficiency improvements will reduce water consumption, which will likewise contribute to reductions in building energy use. For example, efficient faucets that use less water will require less electricity and natural gas for hot water heating. Approximately 89% (1,461 $MTCO_2e$) of the GHG emissions reductions achieved by WC-1 are associated with reduced hot water heating. The remaining reductions (186 $MTCO_2e$) are related to reduction in energy use required to transport, distribute, and treat water

[b] State and local reductions for all sectors.

[c] Local reductions for water conservation strategies.

[e] Little price difference is found between higher and lower efficiency fixtures, and thus the incremental cost for faucets, toilets, and showerheads is assumed to be zero. Weather-based irrigation systems could range from $150–$350 per residential system, or $1,500–$4,000 per commercial system.

[f] Annual savings for upgraded indoor fixtures is estimated around $200. Annual subscription services for smart irrigation systems can range up to $50 for residential and $200 for commercial.

[4] The State goal is a 20% reduction in per capita water use compared to baseline levels.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Water energy intensities were based on the 2010 Inventory and were assumed to be 1,222, 833, and 790 kWh per million gallons for the Thermalito Water and Sewer District (TWSD), South Feather Water and Power Agency (SFWPA), and California Water Service Company (Cal Water).
- BAU water consumption rates were assumed to be 276 gallons per capita per day (gpcd) for TWSD and SFWPA and 333 gpcd for Cal Water (South Feather Water and Power Agency 2012; California Water Service Company 2011).[5]
- SB X7-7 targets were assumed to be 221 gpcd for TWSD and SFWPA and 268 gpcd for Cal Water (South Feather Water and Power Agency 2012; California Water Service Company 2011).

Analysis Method:

Implementation of SB X7-7 will reduce per capita water use, relative to BAU conditions. Water reductions achieved by SB X7-7 were calculated by multiplying the percentage reduction in per capita water use for each water agency by the amount of water they are forecasted to provide to the City in 2020. Electricity savings from reduced water movement and treatment were quantified by multiplying the estimated water reductions by the appropriate agency-specific energy intensities. Reductions in building energy consumption were calculated by multiplying the water reductions by the percentage of hot water used in buildings, an assumed proportion of gas and electric water heaters, and the amount of energy it takes to heat a gallon of water for both heater types. Total energy reductions from water movement and hot water heating were multiplied by RPS-adjusted utility emission factors to estimate emissions reductions. Reductions in fugitive emissions from wastewater treatment were also quantified by multiplying the water reduction by the average treatment emissions per ton of gallon of processed water.

Costs and savings were only quantified for the residential sector due to the inherent variability in the types of fixtures and strategies available to the nonresidential sector. Homes were assumed to install "very low-flow" plumbing fixtures for bathroom and kitchen faucets, showerheads, and toilets, as well as weather-based irrigation systems. Assuming fixtures are replaced at the end of their useful life, the incremental cost of low-flow fixtures is zero (California Energy Commission 2011, 2013a, and 2013b). Weather-based irrigation control systems are estimated to cost between $150 and $350 per system (Consol 2010).

WC-2. Recycled Water Use

Objective: Encourage recycled water use for non-potable sources (such as landscaping irrigation, dust control, or fire suppression).

There is currently no recycled water supply for Oroville. Developing recycled water infrastructure would reduce embodied energy use associated with water conveyance and treatment, as well as fugitive emissions associated with wastewater treatment processes resulting from treatment of wastewater generated within the City. Use of recycled water in the City must be consistent with the appropriate provisions of Title 22 and approval of the State Health Department.

[5] Water data for SFWP was used as a proxy for TWS since data specific to TWS were unavailable.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions	% of Local Reductions	% of WC Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Low	-	-	-	-	-	-

[a] Qualitative analysis of the strategy indicates that potential emissions reductions would be less than 500 $MTCO_2e$.

Assumptions: N/A

Analysis Method: Emissions reductions achieved by recycled water use have not been quantified or counted toward attainment of the City's CAP target. Inclusion of GHG benefits achieved by WC-2 in future CAP updates is contingent on coordination with the Sewerage Commission-Oroville Region and the development of recycled water infrastructure. Costs and savings associating the strategy are presented qualitatively in the Chapters 3 and 4 of the CAP.

Trees and Agriculture

TR-1. Urban Forests

Objective: Plant at least 400 trees per year within the City beginning in 2016.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TR Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
2	0.0%	0.0%	100.0%	($36,000)	$300,000	($50,000)

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for trees and agriculture strategies.

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- Strategy requirements would take effect in 2016.
- 150 trees per year would be planted by developers adjacent to private property. The remaining 250 trees would be planted by the City and developers in the public right of way.
- Average tree planting age is 1 year and 65% of planted trees would survive.
- Trees would be a mix of maple, pistachio, crape myrtle, ash, oak, sycamore, pear, and elm.
- Upfront costs were assume range from $142 to $197 per tree, based on whether root barriers are present (ICF International 2014)
- Annual maintenance costs were assumed to be $34 per tree (City of Goleta 2009).

Analysis Method:

Energy savings from reduced building cooling and heating were obtained from the U.S. Forest Service's (2011) Tree Carbon Calculator for each tree species. The values were multiplied by the expected number of trees planted per year. Only trees planted by developers adjacent to private property were included in the calculations; trees planted in the public right of way were not assumed to provide building shade. GHG emissions reductions achieved by the strategy were quantified by multiplying the total energy reductions by the appropriate RPS-adjusted utility emission factors. Carbon sequestration benefits were not evaluated as they are outside the scope of the CAP.

The City would incur upfront costs to plant, stake, and mulch trees. Maintenance costs were estimated based on a study conducted by the City of Goleta (2009). Cost savings were not calculated for benefits such as air quality, health, property value, or intrinsic value improvements; some studies show a net benefit for trees when these co-benefits are monetized. A lifetime of 40 years for each tree was assumed (McPherson et al. 1999).

TR-2. Oak Tree Loss Mitigation Ordinance

Objective: Minimize oak trees losses from new development by requiring the replacement of removed trees.

The ordinance will require the replacement of oak tree and/or the payment of a fee to compensate for the loss.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions	% of Local Reductions	% of TR Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Low	-	-	-	-	-	-

[a] Qualitative analysis of the strategy indicates that potential emissions reductions would be less than 500 $MTCO_2e$.

Assumptions: N/A

Analysis Method: Emissions reductions achieved by the Oak Tree Loss Mitigation Ordinance have not been quantified or counted toward attainment of the City's CAP target. Inclusion of GHG benefits achieved by TR-2 in future CAP updates is contingent on project implementation and the development of metrics to track emissions reductions. Costs and savings associating the strategy are presented qualitatively in the Chapters 3 and 4 of the CAP.

TR-3. Local Food Initiatives

Objective: Incentivize and support local farmers markets and locally grown food.

Consistent with Task D1 of the Scope of Work for the Sustainable Code Update, the City will adopt local food initiatives. Establishing local farmer's markets has the potential to provide community residents with a more local source of food, protect local agricultural lands, and support local agricultural jobs. Co-benefits associated with locally grown foods include reduced VMT, as well as displaced carbon-intensive food production practices (if the food is grown organically). However, it should be noted that transportation GHG emissions are usually only a small part of the lifecycle emissions; the largest fraction is usually in the production part of the lifecycle, which may or may not differ for local farms compared to more distance farms. Accordingly, it is unlikely emissions reduction benefits associated with this strategy can be quantified as part of the City's CAP.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions	% of Local Reductions	% of TR Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Low	-	-	-	-	-	-

[a] Qualitative analysis of the strategy indicates that potential emissions reductions would be less than 500 $MTCO_2e$.

Assumptions: N/A

Analysis Method: Emissions reductions achieved by the local food initiatives have not been quantified or counted toward attainment of the City's CAP target. Inclusion of GHG benefits achieved by TR-3 in future CAP updates is contingent on project implementation and the development of metrics to track emissions reductions. Costs and savings associating the strategy are presented qualitatively in the Chapters 3 and 4 of the CAP.

Optional Strategies

Community Choice Aggregation

Objective: Explore the feasibility of becoming a Community Choice Aggregator (CCA) and implement a voluntary program (if feasible) to achieve lower levels of GHG emissions for electricity than what PG&E would provide.

Assembly Bill 117 (2002) enables California cities and counties, either individually or collectively, to supply electricity to customers within their jurisdiction by establishing a CCA program. Unlike a municipal utility, a CCA does not own transmission and delivery systems, but is responsible for providing electricity to residents and businesses. The CCA may own electric generating facilities, but more often, it purchases electricity from private electricity generators. Marin County, Sonoma County, Humboldt County, and the City of San Francisco are in various stages of implementing a CCA.

The Oroville CCA would have to get sufficient participation in the City to produce net reductions, relative to electricity delivered by PG&E. Ultimately, the net effect on GHG emissions will depend on the ratio of renewable and non-renewable energy achieved under the CCA.

Summary Metrics: This strategy is considered optional and is not counted towards the City's 2020 reduction target. Preliminary analysis indicates that if the City implemented the strategy by 2020, an additional 2,500 $MTCO_2e$ could be reduced as a result of the CCA. These reductions would be achieved in addition to the State's RPS (see S-1—*Renewables Portfolio Standard*).

Assumptions: In addition to assumptions listed in Table D-1, the following were also considered.

- 80% of Oroville residents would participate in the CCA.
- The emission factor for CCA-provided non-renewable electricity is 0.428 $MTCO_2e$ per kWh (California Air Resources Board 2013).

Analysis Method:

As noted in the strategy objective, two zero-carbon options were quantified as part of the CCA. It was assumed that 95% of participating customers would be enrolled with the 70% zero-carbon option and the remaining 5% of participating customers would enroll in the 100% zero-carbon option. The zero-carbon goal under both options was assumed to be achieved using a combination of qualifying renewables (e.g., solar PV, wind) as well as hydropower (large-scale hydropower does not qualify under the RPS).

Community-wide electricity subject to the CCA was calculated by subtracting energy reductions achieved by all energy efficiency and renewable energy strategies included in the CAP. Base GHG emissions generated by this electricity were estimated assuming 100% of the energy would be supplied by PG&E after compliance with the RPS in 2020. This represents the baseline emissions estimate without the CCA.

The amount of CCA-provided zero-carbon electricity was calculated by multiplying the 2020 baseline electricity by the participation rate (80%) and zero-carbon goals for each option. The remaining CCA-provided electricity was assumed to be provided by unspecified nonrenewable sources. Electricity provided to the 20% of Oroville residents that elected not to participate in the CCA was assumed to be provided by PG&E. GHG emissions for the CCA-provided nonrenewable electricity and PG&E provided electricity were calculated using the appropriate utility emission factors. These emissions were subtracted from the baseline electricity emissions to determine total GHG emissions reductions.

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Appendix E
Funding and Financing Options

This appendix provides information on funding and financing options available to support implementation of the emissions reduction strategies. The funding options may be available to the City of Oroville (City), public agencies, community members, or a combination of entities, as noted below. The City will pursue a number of financing strategies to support overall management of the Climate Action Plan (CAP). The City may also promote several of the community-oriented funding options described below as part of CAP incentives, outreach, and education.

Federal and State Funding Options

California Air Resources Board Programs

The California Air Resources Board (ARB) manages a variety of air pollution incentives, grants, and credit programs that could be used to help fund local transportation strategies. The following programs offer grant opportunities over the next several years. Residents, businesses, and fleet operators may be eligible to receive funds or incentives, depending on the program rules.[1]

- Air Quality Improvement Program (Assembly Bill 118).
- Enhanced Fleet Modernization Program (Assembly Bill 118).
- Carl Moyer Program—Voucher Incentive Program (administered by California Air Pollution Control Officers Association).
- Goods Movement Emission Reduction Program.
- Loan Incentives Program.
- Lower-Emission School Bus Program/School Bus Retrofit and Replacement Account.
- Providing Loan Assistance for California Equipment (PLACE) Program.

California Department of Resources Recycling and Recovery Grant Program

California Department of Resources Recycling and Recovery (CalRecycle) grants are authorized by State legislation to assist public entities in the safe and effective management of the waste stream. Funds are intended to reduce, reuse, and recycle all waste; encourage development of recycled-content products and markets; protect public health; and foster environmental sustainability.

Energy Efficient Mortgage

Energy Efficiency Mortgages (EEMs) may be available to some City residents. An EEM credits a home's energy efficiency upgrades and gives borrowers the opportunity to finance cost-effective, energy-saving

[1] For more information on the incentive programs, please visit: http://www.arb.ca.gov/ba/fininfo.htm.

measures as part of a single mortgage. Borrowers typically need to have a home energy rater conduct a home energy assessment before financing is approved. This rating verifies that the home is energy-efficient. EEMs are typically used to purchase a new home that is already energy efficient, such as an ENERGY STAR–qualified home.

Federal Tax Credits for Energy Efficiency

Federal government tax credits are available to City residents through 2016. The tax credits provide a discount of 30% of cost with no upper limit for geothermal heat pumps, small wind turbines (residential), and solar energy systems. The 2016 tax credits also include 30% of the cost up to $500 per 0.5 kilowatt (kW) of power capacity for fuel cells in a principal residence.

Planning Grants from the Strategic Growth Council

The Strategic Growth Council (SGC) of the State Department of Conservation (DOC) manages competitive grants for cities, counties, and designated regional agencies that promote sustainable community planning and natural resource conservation. The DOC has allocated approximately $18 million of Proposition 84 funds for competitive grants to support development, adoption, and implementation of Sustainable Community planning elements, including, but not limited to, CAPs and general plan amendments. The grants awarded from this solicitation will cover up to a 3-year project period. Grant requests for amounts from $100,000 to $1,000,000 will be considered. SGC funds were used in the development of this CAP.

State Funding for Infrastructure

The State's Infill Infrastructure Grant Program may be used by the City to help fund strategies that promote infill housing development. Grants are available to support funding for infrastructure improvements necessary for specific residential or mixed-use infill development projects.

Transportation-Related Funding

The following funding sources that may be utilized to fund strategies related to transit, bicycle, or pedestrian improvements. Residents, businesses, and fleet operators can receive funds or incentives depending on the program.

- Safe, Accountable, Flexible, Efficient Transportation Equity Act—Legacy for Users (SAFETEA-LU)
- Surface Transportation Program (STP) Fund, Section 1108
- Congestion Mitigation and Air Quality Improvement Program(CMAQ), Section 1110
- Transportation Enhancement Activities (TEA)
- National Recreational Trails Program
- National Highway System Fund (NHS)
- National Highway Safety Act, Section 402
- Transit Enhancement Activity, Section 3003
- Section 3 Mass Transit Capital Grants
- Bridge Repair & Replacement Program (BRRP)

- Federal Transit Administration (FTA) 5309
- FTA Small Starts
- FTA Section 5311(f)
- California's Bicycle Transportation Account
- Environmental Enhancement and Mitigation (EEM) Program
- Safe Routes to School (SR2S)
- Office of Traffic Safety (OTS)
- Transportation Development Act (TDA) Article III
- Transportation Funds for Clean Air (TFCA, formerly AB 434)
- Flexible Congestion Relief (FCR) Program
- State Highway Operations and Protection Program (SHOPP)

Regional and Local Funding Options

Butte County Air Quality Management District

Butte County Air Quality Management District (BCAQMD) offers several grant programs related to air quality improvement, as noted below. The air district also promotes State programs offered by the ARB, such as the Carl Moyer Program. Residents, businesses, and fleet operators may be eligible to receive funds or incentives, depending on the program rules.[2]

- Clean Air Funds (Assembly Bill 2766).
- Special Clean Air Fund.
- California Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP) (administered by the California Center for Sustainable Energy).
- Special grants (current grants include TIMBER Program, Take Care of Our Air at Our Schools).

Butte Regional Transit

While the City does not have control over how Butte Regional Transit chooses to expend its resources, it is possible that Butte Regional Transit could take the following measures to generate revenue that would lead to reductions in GHG emissions.

- **Bus Stop Sponsorships**. Sponsorship of bus stops through advertising has been used as a revenue source.
- **Transit Fare Increases**. Increased fares could help fund capital improvements, although increases also have the potential to decrease ridership in the short term.

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[2] For more information on the incentive programs, please visit: http://www.bcaqmd.org/page/incentives-grants-rebates.php.

- **Parcel Tax**. An election consistent with Proposition 218[3] could serve to increase the existing level of taxation and provide additional funding for transit-related capital improvements. However, in the current economic climate, this may not be a likely financing source unless economic conditions improve and community support for such a taxation approach is favorable.

Public Utility Enterprises

The Sewage Commission—Oroville Region (SCOR) is supported by rates that cover the cost of infrastructure and operations. An increase in these rates to fund capital improvements associated with local reduction measures could be considered by the Commission.

Supplemental Benefits Funds

The Supplemental Benefits Fund (SBF) of $61.3 million is paid to the City by the California Department of Water Resources (DWR) and State Water Contractors (SWC) in annual installments. The fund can be used to support local emissions reduction strategies that provide economic and recreation benefits for the community.

Utility-Sponsored Funding Options

California Solar Initiative

Pacific Gas and Electric (PG&E) is one of three utilities participating in the State's Go Solar Initiative. This program provides a variety of rebates, incentives, and other types of support for both existing and new homeowners. Program rebates apply to solar photovoltaics (PVs), thermal technologies, and solar hot water projects. The program is designed to accommodate single-family homes, commercial development, and affordable housing. The initiative has a total budget of $2.2 billion between 2007 and 2016 for solar generation and $250 million between 2010 and 2017 for thermal systems (i.e., new solar hot water systems).

Energy Upgrade California

Energy Upgrade California is funded by the American Recovery and Reinvestment Act, California utility ratepayers, and private contributions. It is administered by participating utilities, like PG&E. Under this program, a homeowner selects one of two energy upgrade packages, basic or advanced, with each offering different enhanced options. The program connects homeowners with home energy professionals, including participating contractors and Whole-House Home Energy Raters. It also offers rebates, incentives, and financing. For instance, homeowners can get up to $4,000 back on an upgrade through a local utility.

Other Utility Programs

PG&E and the local water service providers offer a variety of rebates and incentives for single-family homes, multi-family homes, and commercial and industrial developments. PG&E programs apply to

[3] Proposition 218 requires voter approval for new general taxes affecting private property, new and increased property assessments, and property-related fees imposed as an "incident of property ownership."

energy efficiency improvements and renewable energy projects, whereas the water service provider programs apply to water conservation efforts.[4]

Privately-Sponsored Funding Options

Power Purchase Agreements

Power purchase agreements (PPAs) involve a private company that purchases, installs, and maintains a renewable energy technology through a contract that typically lasts 15 years. After 15 years, the company would uninstall the technology or sign a new contract.

On-Bill Financing

On-bill financing (OBF) can be used to support commercial energy-efficiency retrofits. Funding from OBF is a no-interest loan that is paid back through the monthly utility bill. Lighting, refrigeration, heating ventilation and air conditioning, and energy efficient streetlights are all eligible projects. Government agencies may qualify for loans between $5,000 and $250,000 per service account, with loan periods of up to 10 years. Business customers may qualify for loans between $5,000 and $100,000, with loan periods up to 5 years.

Assembly Bill 811 Districts Property-Assessed Clean Energy

The Property-Assessed Clean Energy (PACE) finance program is intended to finance energy and water improvements within a home or business through a land-secured loan, and funds are repaid through property assessments. Municipalities are authorized to designate areas where property owners can enter into contractual assessments to receive long-term, low-interest loans for energy and water efficiency improvements and renewable energy installation on their property.

The City adopted a FIGTREE PACE financing program on June 4, 2013, and established an energy fund with Ygrene in January 2014.[5]

Increased Rent

Builders who own and operate buildings (i.e., commercial buildings or apartment complexes) can use private equity to finance these improvements, with returns realized as future cost savings (e.g., reduced energy expenditures). As market conditions improve over time, rents can be increased to defray the investment costs.

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[4] For more information on available PG&E incentive programs and rebates, please visit: http://www.pge.com/myhome/saveenergymoney/rebates/ and http://www.pge.com/en/mybusiness/save/rebates/index.page. For more information on available water service provider programs, please visit: https://www.calwater.com/rebates-and-programs/, http://southfeather.com/, and http://www.twsd.info/.

[5] For more information on the City's PACE programs, please visit http://www.figtreefinancing.com/ and https://ygrene.us/.

Future Funding Options for City Implementation Costs

The City is not proposing any local fees or taxes at this time. While current economic conditions and fiscal realities limit funding options for the local reduction measures, additional funding sources that are currently infeasible may become realistic as the economy recovers. Potential future funding options are described below.

New Development Impact Fees

New development impact fees may have some potential to provide funding, but such fees are best implemented when the real estate market and overall regional economic conditions are strong.

Utility User Tax Increase

Increasing utility taxes could help fund ongoing implementation, operations, and maintenance efforts. Any increase of tax rates will need to be highly sensitive to current local economic conditions and overall local, state, and national economic and financial context.

Additional Local Sales Parcel Tax

Increasing local sales parcel taxes could help fund ongoing implementation, operations, and maintenance efforts. Any increase of tax rates will need to be highly sensitive to current local economic conditions and overall local, state, and national economic and financial context.

Community Facilities District Special Taxes

Creating special district taxes would require voter approval and should be directed towards strategies that achieve broad benefits for the community (e.g., transit, pedestrian, and bicycle facilities). Any increase of tax rates will need to be highly sensitive to current local economic conditions and overall local, state, and national economic and financial context.

General Obligation Bond

A general obligation bond is a form of long term borrowing and could be utilized to fund municipal improvements.

Appendix F
Climate Change Sensitivities

This appendix provides a brief discussion of the potential climate change sensitivities identified for each community element in Chapter 5, *Climate Change Adaptation*. Statements are only provided for climate change exposures rated as *yes* or *maybe* in Table 5-1.

Community Element	**Discussion**
Government continuity	Flooding, storms, wildfires, and extreme heat events could impact the ability of staff to get to work and the availability of resources. Electricity and internet services may be limited or cut off during any of these events. Extended extreme heat events may result in power outages. Oroville is the county seat, making this community element particularly important at the county level.
Water/sewer/solid waste plant and delivery	Extreme heat, storms, flooding, and wildfires may damage or disrupt service at the Sewerage Commission—Oroville Region (SCOR). Flooding, storms, and wildfires could also damage service lines.
Water supply	Multiple climate change exposures could disrupt water supply or limit water quality and availability. Increased ambient temperatures will increase evaporation and moisture lost to the atmosphere from plant leaves. This process—referred to as *evapotranspiration*—could reduce surface water and groundwater supplies. Extreme heat may increase demand for limited resources and changes in snowpack could reduce surface and groundwater supplies. Storms, flooding, and wildfires could increase turbidity and decrease water quality. Shifts in the growing season and species distribution could impact water quality and necessitate purification.
Energy delivery	Extreme heat and increased ambient temperatures may increase the demand for electricity, affecting power reliability. Storms, flooding, and wildfires may cause physical damage to energy infrastructure (e.g., transmission lines).
Public safety	Extreme heat, storms, flooding, and wildfires may increase the demand for police, fire, and other emergency services.
Public health	Multiple climate change exposures could increase the need for public services, particularly among vulnerable populations. Shifts in ambient temperature and increased incidents of extreme heat may have negative health impacts on people with impaired or weak immune systems. Decreased snowpack, shifts in the growing season, and changes in species distribution may impact water-borne and vector-borne diseases and change local allergens. Flooding, storms, and wildfire may cause physical harm and increased emergency room visits.
Emotional and mental health	Multiple climate change exposures may impact emotional and mental health, either directly through physical damage or indirectly through the need to cope with direct impacts, such as storm damage and job loss.
Business continuity	With the exception of increased ambient temperatures, climate change exposures could impact the ability of staff to get to work and the availability of resources, such as electricity and internet service. Sensitivity of a particular business will be connected to their specific requisite resources (e.g., a business that relies on local crops is likely to be sensitive to a shift in the growing season, whereas a law firm probably would not).

Community Element	Discussion
Housing access	Storms, flooding, and wildfires may limit the availability of housing. Populations with limited resources (which may include seniors, low-income, unemployed, or underemployed individuals, those with limited English skills, renters, students, and seasonal residents) may be particularly sensitive to limited housing options. Extreme heat and an increase in ambient temperature may cause construction materials to deteriorate more rapidly, which could increase maintenance costs and/or lower home value.
Employment and job access	Multiple climate change exposures could adversely affect employment opportunities. Job availability is influenced by business continuity and the availability of resources, both of which will be impacted by climate change (see above). Additionally, jobs related to agriculture, fisheries, and forest productivity could be affected by changes in the growing season and species distribution. Job access may also be constrained by transportation disruptions (see below).
Food security/supply	It is unlikely that changes in the climate will impact local food security. However, all of the reviewed climate change exposures could impact food supply. For example, climate change in other areas could affect regional food production, reducing imports and the availability of food in Oroville.
Quality of life	Multiple climate change exposures could impact quality of life. Access to services may be limited by extreme weather or shifts in the growing season, temperatures, and species distribution, thus affecting quality of life for Oroville residents. Additionally, extreme events and changes in the local climate may disrupt individual patterns and lifestyle characteristics.
Social services	Extreme heat, storms, flooding, and wildfires will likely disrupt the availability of social services. If transportation, energy, and communication networks are damaged by these events, it is likely that social services will not be as readily available as they are without those disruptions.
Ecological function	Multiple climate change exposures could likely impact ecological function in Oroville. Terrestrial and aquatic flora and fauna are sensitive to changes in temperature, physical disturbances, and changes in water quality and quantity. Shifts in the temperature, extreme heat, snowpack, storms, flooding, and wildfire will impact the ability of the local ecology to function. However, natural systems are adaptive and may respond by shifting the growing season and moving to new locations.
Tourism and recreation	Extreme heat, storms, flooding, wildfires, a shift in the growing season, and changes in species distribution will likely impact tourism and recreation in Oroville. The City draws many summer tourists who recreate on the lake, hunt, and fish. Extreme events may deter people from visiting the area if recreational facilities are damaged. Shifts in the growing season and species distribution may increase or decrease the presence of game. Changes in the ambient temperature and snowpack are less likely to directly impact Oroville's tourism and recreation industry, but over time these exposures could shift tourism in the region.
Agriculture, forest, and fishery productivity	Multiple climate change exposures could likely affect agriculture, forest, and fish productivity. Similar to ecological function, these systems are accustomed to specific environments. Slight changes in the ambient temperature could have significant impacts on the growing season and the ability of pests to survive. Storms, flooding, and fire could destroy fish habitat, damage agricultural lands, and burn forests.

Community Element	Discussion
Industrial operations	Storms, flooding, and wildfire could directly impact industrial operations by causing damage to facilities or disrupting supply chain operations. Changes in the ambient temperature and extreme heat events may cause temporary shutdowns or increase the need for maintenance. Decreased snowpack may decrease the availability of water that may be necessary for some industrial operations.
Buildings: residential, commercial, industrial, government, institutional	Extreme storms, flooding, and wildfire could directly damage buildings. Changes in the ambient temperature and extreme heat events may increase the need for maintenance, depending on the type of building materials.
Parks and open space	Changes in the ambient temperature, extreme heat, storms, flooding, and wildfires may impact the built and natural features in parks and open space. Decreased snowpack may impact the quantity of water within lakes and streams (if present within a park). It should be noted that parks and open space are frequently designed to accommodate excess water as an effective method of flood control.
Recreational facilities	Storms, flooding, and wildfires may damage or destroy natural or artificial recreational facilities. Changes in ambient temperature and extreme heat may expedite the degradation of building materials and may negatively impact natural features at recreational facilities.
Transportation facilities and infrastructure	Extreme heat can cause pavement buckling and necessitate more frequent maintenance on transportation facilities and infrastructure. Roads and railways are particularly sensitive to changes in temperature, depending on the materials used in construction. Prolonged changes in ambient temperature may have a similar impact, speeding up the breakdown of materials. Storms, flooding, and wildfire could also block roads, block transportation lines, and damage facilities.
Lake Oroville Marina	Storms, flooding, and wildfire could cause direct damage to marine facilities. The fact that these facilities are located close to the water could increase the possibility of damage from extreme wind and flooding. Changes in the ambient temperature and extreme heat may cause material degradation to accelerate. A decrease in snowpack could alter the environment where marine facilities are constructed and leave certain facilities further from the water or elevated from the water.
Communication infrastructure	Storms, flooding, and wildfire will likely cause direct damage to communication infrastructure, such as telephone poles and internet lines. Extreme heat may also disrupt lines of communication if the demand for electricity causes power outages.
Dikes and levees	Storms and flooding may cause structural damage to dikes and levees. Changes in ambient temperature, extreme heat, and snowpack (relative to streamflow) may cause structures to degrade at an accelerated rate, depending on the design and materials used. These changes could also cause stress for plantings that may be used to stabilize living barriers. Wildfires may also cause direct damage to structures and plantings from fire or extreme temperatures.
General population	Storms and flooding are likely to cause direct harm to individuals who are exposed to the most extreme elements of the storm (even adults in good health with no physical limitations may be harmed in a flood or from the impacts of an extreme storm). Wildfires and extreme heat will likely cause a decline in air quality. While this will impact some individuals with respiratory problems, it is less likely to impact the general population. Similarly, extreme heat will likely affect individuals with compromised immune systems, but the general population will be less likely to suffer adverse consequence. Changes in species distribution (and diseases) may cause an increase in illness across the general population.

Community Element	Discussion
Populations that are more susceptible to health risks (children, elderly, people with compromised immune systems, chronic illness, or disabilities)	Storms, flooding, and wildfires are likely to cause more direct harm to people with limited mobility or compromised health. Wildfires and extreme heat will likely degrade air quality and have negative health consequences for young people with lungs that are not fully developed, individuals with respiratory diseases (i.e., people with asthma), and the elderly. Shifts in the growing season and species distribution will also likely impact populations with underdeveloped or compromised immune systems due to the possible increase in disease vectors. Increases in ambient heat and decreased snowpack may also affect these populations that are less adaptable to changing conditions.
Populations with limited resources (low-income, limited English, renters, seasonal residents)	Extreme heat, storms, flooding, and wildfires present the most direct threat to populations with limited resources. Changes in ambient heat, the snowpack, and species distribution (and diseases) may also disproportionately impact people without access to adequate resources and information. People with limited resources (finances, language, networks, or legal rights) may not have access to information to actively adapt to climate changes.