MCCAP

Marin County Climate Action Plan

Public Draft
August 2014

Prepared by:
ICF International

Prepared for:
Marin County

Photo: Carlos Porrata

PUBLIC DRAFT

MARIN COUNTY CLIMATE ACTION PLAN 2014 UPDATE

PREPARED BY:
ICF INTERNATIONAL

PREPARED FOR:
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Acronyms and Abbreviations

AB	Assembly Bill
AB 32	Assembly Bill 32
ABAG	Association of Bay Area Governments
ARB	California Air Resources Board
BAAQMD	Bay Area Air Quality Management District
BACERP	Bay Area Climate & Energy Resilience Project
BAU	Business-as-Usual
BayREN	Bay Area Regional Energy Network
BCDC	Bay Conservation and Development Commission
C&D	construction and demolition
CAA	federal Clean Air Act
CAP Update	Climate Action Plan Update
CAPCOA	California Air Pollution Control Officers Association
CCA	Community Choice Aggregation
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
CMSA	Central Marin Sanitation Agency
CO_2e	carbon dioxide equivalents
County	County of Marin
Countywide Plan	2007 Marin Countywide Plan
EIR	Environmental Impact Report
EO	Executive Order
EPA	U.S. Environmental Protection Agency
GHG	greenhouse gas
GWP	global warming potential
HFCs	hydrofluorocarbons
JPA	Joint Powers Authority
LGOP	Local Governments Operations Protocol
MCE	Marin Clean Energy
$MMTCO_2e$	million metric tons of carbon dioxide equivalent
MT	metric tons
MTC	Metropolitan Transportation Commission
$MTCO_2e$	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 & Electric Company
PS	Performance Standard for New Development
RPS	Renewables Portfolio Standard
SB 375	Senate Bill 375
SCS	sustainable communities strategy
SF_6	sulfur hexafluoride
SMART	Sonoma-Marin Area Rail Transit
TAM	Transportation Authority of Marin
VMT	vehicle miles traveled
WECS	Wind Energy Conversion Systems

Executive Summary

Photo: Marin Community Development Agency

Executive Summary

Introduction

The County of Marin (County) acknowledges the consensus among leading scientists that without action to reduce greenhouse gas (GHG) emissions, climate change due to global warming will pose a considerable threat to the environment and to human health and society.

Marin County was one of the first counties in California to take formal action addressing GHG emissions when it adopted the *Marin County Greenhouse Gas Reduction Plan*[1] in 2006 (2006 GHG Reduction Plan). Measures identified in the GHG Reduction Plan were then incorporated into the *Marin Countywide Plan* update which was adopted in 2007. The 2006 GHG Reduction Plan set a target to reduce GHG emissions from both community and municipal activities in the unincorporated areas of Marin County by at least 15% below 1990 levels by 2020. The County government and private sector have invested heavily in energy efficiency, renewable energy, alternative fuel vehicles, water conservation, and waste minimization to reduce GHG emissions substantially. By 2012, the County had already reduced community emissions to 15% below 1990 levels—8 years ahead of the 2020 target.

This document, the *Marin County Climate Action Plan 2014 Update* (CAP Update), builds on the 2006 GHG Reduction Plan and provides an update of GHG emissions in 2012, forecasts of emissions for 2020, and an assessment of actions that the County will take to further reduce emissions by 2020. The CAP Update includes two targets.

- **2020 Community Emissions Reduction Target**—a goal to reduce GHG emissions from community activities in the unincorporated areas of Marin County by at least 30% below 1990 levels by 2020. This target is more than the 2006 GHG Reduction Plan target and more ambitious than the state's goals in Assembly Bill (AB) 32, which commits to reducing statewide GHG emissions to 1990 levels by 2020. California Executive Order S-03-05, which was issued in 2005, articulates a long-term goal for the state of 80% below 1990 emissions levels by 2050. If adopted, the County's target of 30% below 1990 levels by 2020 would be one of the most ambitious local jurisdiction reduction targets in California and the United States. Because the County is already ahead of their 2006 community target for 2020, Marin is now adopting a more aggressive community target in the CAP Update to achieve even greater reductions than previously planned in an attempt to get ahead of the curve and be on-track to meet the S-03-05 statewide target for 2050.
- **2020 Municipal Emissions Reduction Target**—a goal to reduce GHG emissions from the County's municipal activities by at least 15% below 1990 levels by 2020. This target is consistent with the 2006 GHG Reduction Plan target. Because the County is on-track to meet the original 2006 municipal target for 2020, Marin is retaining the same target for the CAP Update.

The proposed new community emissions target would put the County on the forefront of climate action planning in California, and put the County on a trajectory to reduce emissions significantly by the year 2050.

[1] At that time, the term "Climate Action Plan" had not yet been adopted but the Greenhouse Gas Reduction Plan was the functional equivalent of a CAP.

This CAP Update describes the County's plan for reaching these targets, including specific strategy areas for each of the major emissions sectors, and provides details on the 2012 and projected 2020 emissions in the unincorporated areas.

Implementing state measures and the local measures in the CAP Update would avoid the generation of more than 100,000 metric tons of carbon dioxide equivalent ($MTCO_2e$) in the year 2020 (annually), which is equivalent to the following individual actions (U.S. Environmental Protection Agency 2014):

- removing more than 20,000 passenger vehicles from the road each year, or;
- reducing gasoline consumption by more than 11 million gallons per year, or;
- providing renewable energy to power over 9,000 homes each year.

The actions in the CAP Update are priority actions and intended for near-term implementation, such that the County can achieve its GHG reduction targets for 2020 for the unincorporated areas of Marin County.

Marin County Greenhouse Gas Emissions Inventories and Forecasts

In 2012, estimated GHG emissions generated by community activities in Marin County's unincorporated areas were approximately 477,000 $MTCO_2e$ (Figure ES-1), or per capita emissions of approximately 7.1 $MTCO_2e$ for the 67,000 residents in the unincorporated areas. This amount is equivalent to the annual GHG emissions generated by approximately 100,000 passenger vehicles. Of these total emissions, as shown in Figure ES-1, On-Road transportation and building energy use are the largest sources of emissions (35% each). The third largest source is agriculture (23%), followed by off-road equipment (4%), solid waste treatment (2%), wastewater treatment (1%), and water conveyance (0.2%).

For municipal activities from County government operations, estimated GHG emissions in 2012 were approximately 15,000 $MTCO_2e$ (Figure ES-2), or emissions of 7.0 $MTCO_2e$ per County employee. This amount is equivalent to the annual GHG emissions generated by approximately 3,000 passenger vehicles. Of these total emissions, as shown in Figure ES-2, employee commute is the largest source of emissions (43%). Building energy use is the second largest source of emissions (36%). The third largest source is the vehicle fleet (18%), followed by wastewater treatment (1.4%), streetlights and traffic signals (0.6%), refrigerants (0.4%), stationary sources (0.4%), solid waste generation (0.3%), and water conveyance (0.2%).

The CAP Update is composed of State and local actions to reduce GHG emissions within the unincorporated areas. The State actions considered in the CAP Update include the Renewables Portfolio Standard, Title 24 Standards for Commercial and Residential Buildings (Energy Efficiency and CALGREEN), Pavley/Advanced Clean Cars (Vehicle Efficiency), the Low Carbon Fuel Standard, and various AB 32 transportation reduction strategies. These State actions generally do not require action from the County but will result in local GHG reductions in the unincorporated areas.

As the County grows, energy consumption, water usage, waste generation, and transportation activities will increase. For the CAP Update, the County developed two business-as-usual (BAU) forecasts to evaluate the impacts of this growth on future GHG emissions in 2020, one for community emissions (referred to as the *2020 BAU Community Forecast*) and one for municipal emissions (referred to as the *2020 BAU Municipal Forecast*). These forecasts are based on changes in population, households, and employment and represent scenarios that do not consider the effects of future local, State, or federal actions to reduce GHG emissions. Table ES-1 compares the 2020 BAU Community Forecast to the 1990 and 2012 Community GHG Inventories and indicates that community GHG emissions are expected to increase by 13,392 $MTCO_2e$ (3%) between 2012 and 2020. Much of this difference is attributable to increases in building energy use, vehicle trips, and off-road equipment. Table ES-2 compares the 2020 BAU Municipal Forecast to the 1990 and 2012 Municipal GHG Inventories and indicates that municipal GHG emissions are expected to increase by 1,899 $MTCO_2e$ (13%) between 2012 and 2020. This difference is largely due to the new emergency operations facility and increasing activity as the County hires new employees.

State and Local Actions

The following state and local actions will reduce GHG emissions in the County.

RPS: The RPS obligates certain utilities to procure at least 33% of retail sales from renewable resources by 2020.

Title 24: Requires that building shells and building components be designed to conserve energy and water.

Pavley: Will reduce GHG emissions from automobiles and light-duty trucks by 30% from 2002 levels by the year 2016.

LCFS: Will reduce GHG emissions by requiring a low carbon intensity of transportation fuels sold in California by at least 10% by the year 2020.

Figure ES-1. Marin County 2012 Community Greenhouse Gas Emissions Inventory by Sector

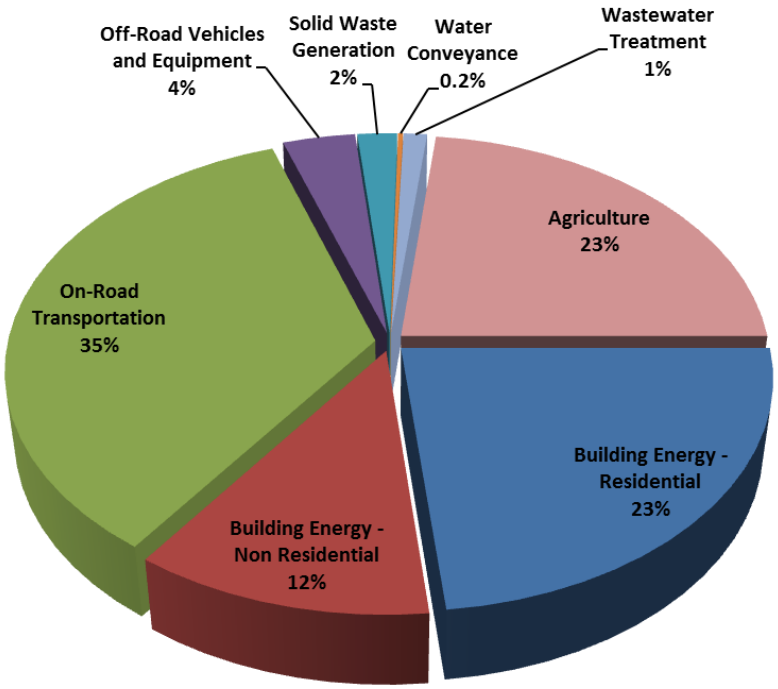


Table ES-1. Marin County 1990 and 2012 Community Greenhouse Gas Emissions Inventories and 2020 Business-as-Usual Forecast

Emission Sector[a]	Emissions ($MTCO_2e$)			Percent Growth	
	1990	2012	2020	1990–2012	2012–2020
Building Energy—Residential	131,265	111,484	115,713	-15%	4%
Building Energy—Non-Residential	74,190	55,142	61,194	-26%	11%
On-Road Transportation	193,544	166,773	167,002	-14%	0.1%
Off-Road Vehicles and Equipment	19,300	17,126	19,823	-11%	16%
Solid Waste Generation	14,414	9,362	9,358	-35%	-0.04%
Water Conveyance	1,319	1,157	1,215	-12%	5%
Wastewater Treatment	5,453	5,562	5,745	2%	3%
Agriculture	122,366	110,850	110,798	-9%	-0.05%
Marin County Total	**561,851**	**477,456**	**490,848**	**-15%**	**3%**
Emissions for Informational Purposes					
Stationary Sources ($MTCO_2e$/year)	–	648	688	–	6%
Forestry ($MTCO_2e$/year)	–	*-207,151*	*-207,151*	–	*0%*
Rangeland Soil Carbon Stock (MT C)[b]	–	*10,783,021*	*10,783,021*	–	*0%*
Aboveground Carbon Stock (MT C)[b]	–	*7,248,888*	*7,248,776*	–	*0%*

Notes:
$MTCO_2e$ = metric tons of carbon dioxide equivalent.
MT C = metric tons of carbon.

[a] Additional emissions sources that were not estimated (or included in the inventory or forecasts) include aircraft, non-local passenger rail, freight rail, ferries, ozone depleting substances, and other gases with high global warming potential.

[b] Rangeland soil carbon and aboveground carbon stock numbers are in units of metric tons of carbon, not metric tons of carbon dioxide equivalent. These are reported on a total mass basis, not on an annual basis.

Figure ES-2. Marin County 2012 Municipal Greenhouse Gas Emissions Inventory

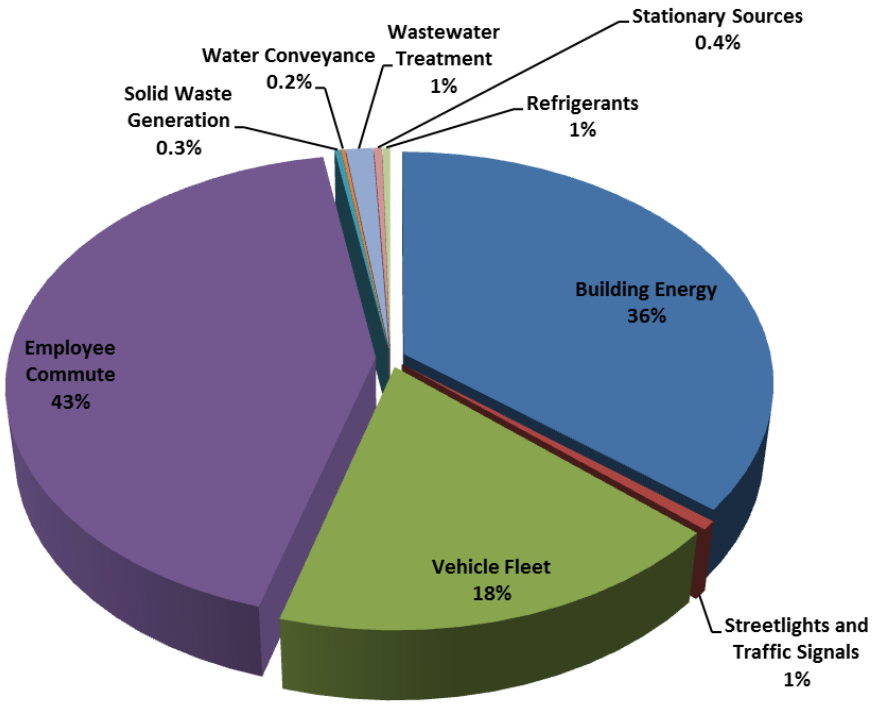


Table ES-2. Marin County 1990 and 2012 Municipal Greenhouse Gas Emissions Inventories and 2020 Business-as-Usual Forecast

Emission Sector[a]	Emissions ($MTCO_2e$)			Percent Growth	
	1990	2012	2020	1990–2012	2012–2020
Building Energy	3,100	5,457	6,642	76%	22%
Streetlights and Traffic Signals	52	95	97	83%	2%
Vehicle Fleet[b]	4,900	2,732	2,973	-44%	9%
Employee Commute	7,100	6,528	6,957	-8%	7%
Solid Waste Generation	29	47	50	63%	6%
Water Conveyance	0	29	32	–	10%
Wastewater Treatment	0	207	222	–	7%
Stationary Sources	0	59	63	–	7%
Refrigerants	0	61	78	–	28%
Marin County Total	**15,181**	**15,215**	**17,114**	**0%**	**12%**

Notes:
$MTCO_2e$ = metric tons of carbon dioxide equivalent.
[a] Emissions from energy consumed in leased facilities are not included because energy use data were not available from Pacific Gas & Electric.
[b] Emissions from off-road vehicles are included in the vehicle fleet sector.

Actions to Reduce Greenhouse Gas Emissions

The CAP Update includes a variety of regulatory and incentive-based strategies that will reduce GHG emissions from both existing and new development in the county. Local strategies adopted by the County will supplement State programs and achieve additional emissions reductions.

There are 13 local community actions and 8 local municipal actions included in the CAP Update. These local actions are grouped into the following strategy areas.

- Energy Efficiency and Renewable Energy (community and municipal actions).
- Land Use, Transportation, and Off-Road Equipment (community actions only).
- Vehicle Fleet and Employee Commute (municipal actions only).
- Water Conservation and Wastewater Treatment (community and municipal actions).
- Waste Reduction, Reuse, and Recycling (community and municipal actions).
- Agriculture (community actions only).
- GHG Performance Standard (community actions only).

Many of the local actions are cost effective, particularly in the Energy Efficiency and Renewable Energy strategy area, with several energy efficiency investments that can recoup initial costs in 1–5 years. In addition to reducing GHG emissions, all local actions have many co-benefits, such as improved public health.

The following figures present the GHG Reduction Targets for community and municipal emissions. They show the BAU emissions for 2020 along with the contribution of state and local measures, by individual sector, toward the target. Figure ES-3 presents the community greenhouse gas reduction goal, and Figure ES-4 presents the municipal greenhouse gas reduction goal.

Greenhouse Gas Reduction Goals

Figure ES-3. Marin County Community Greenhouse Gas Reduction Goal

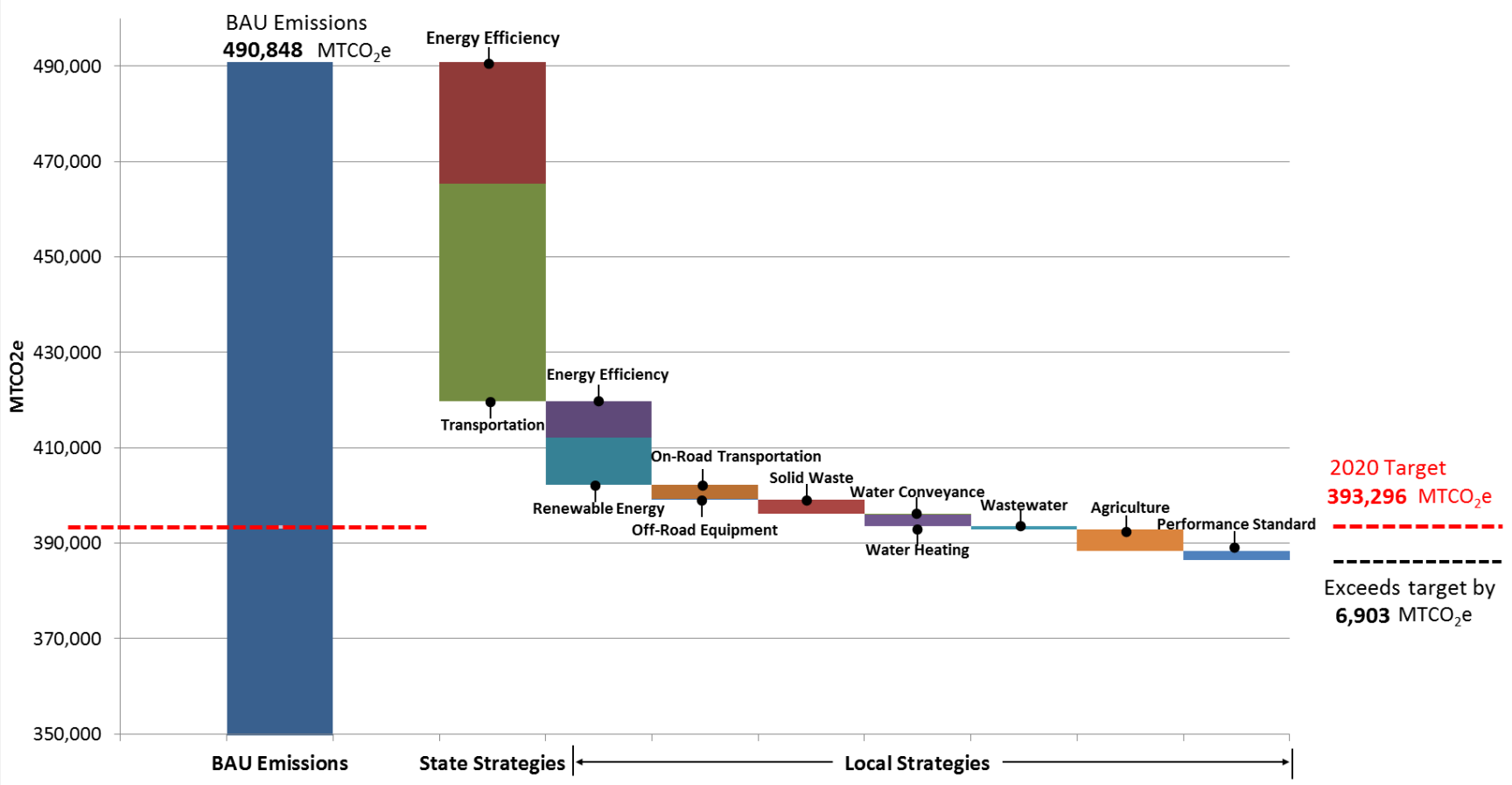
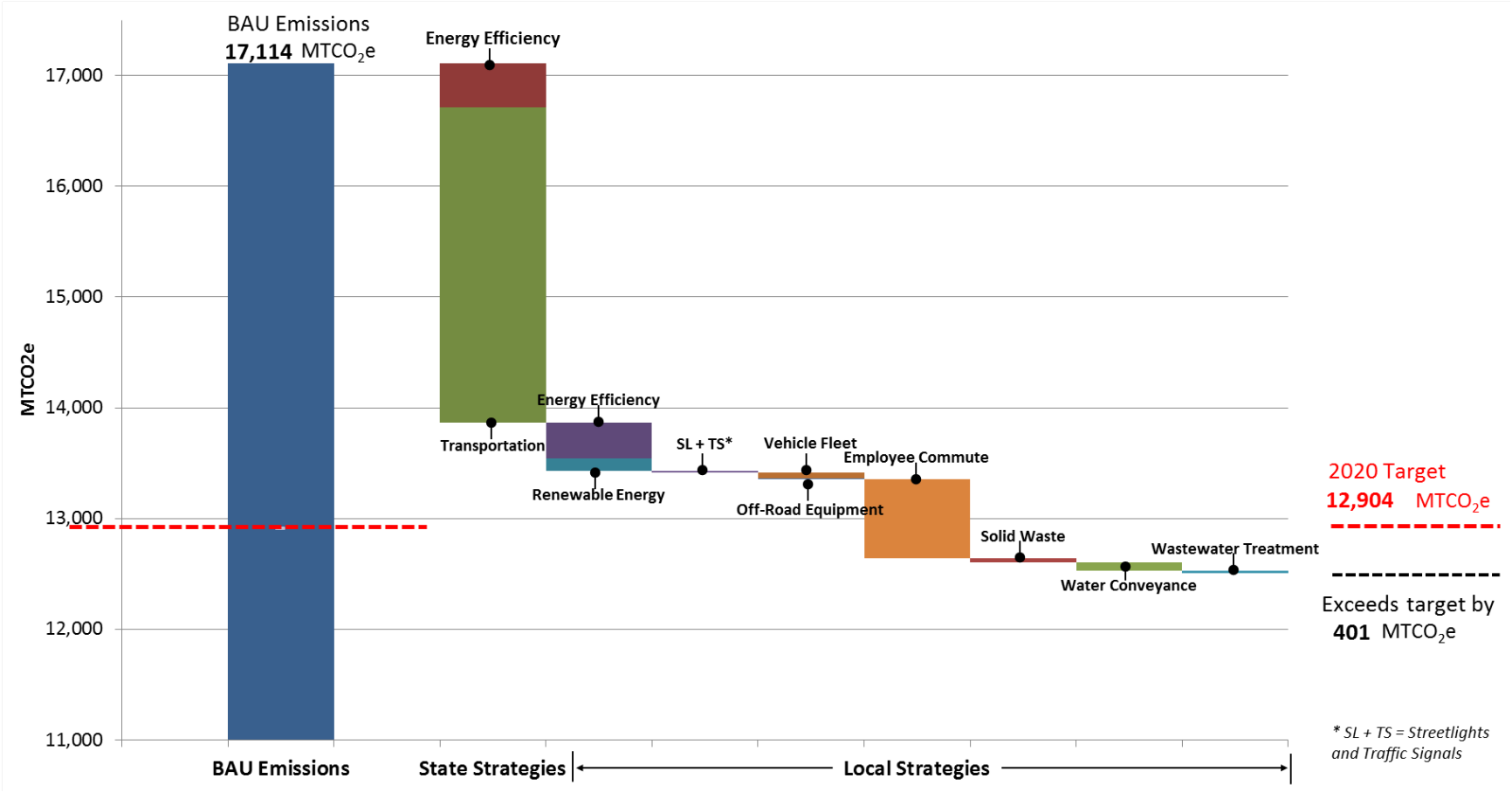


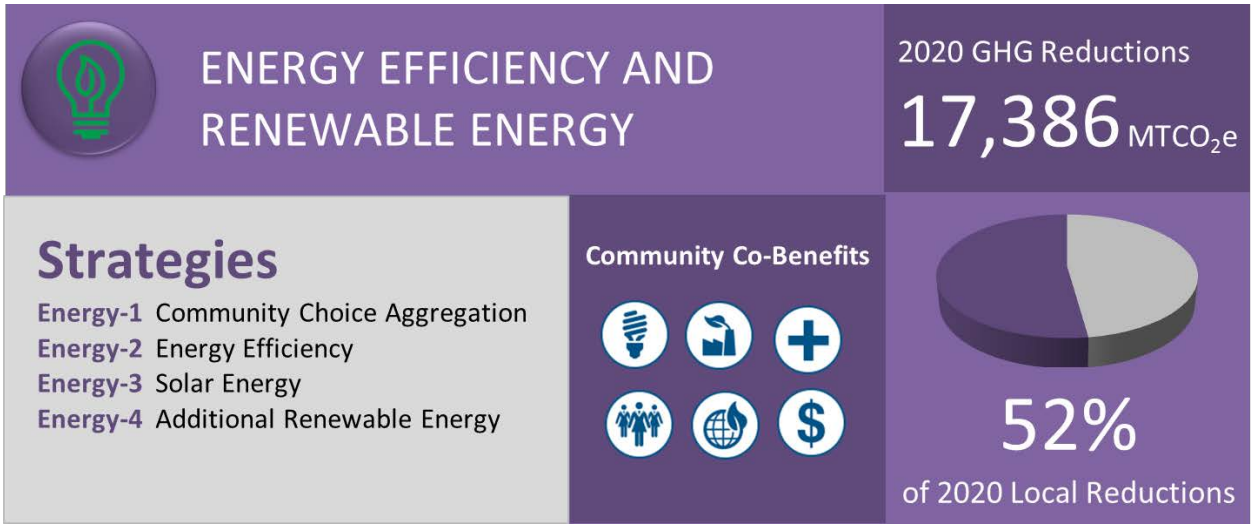
Figure ES-4. Marin County Municipal Greenhouse Gas Reduction Goal



The following summaries for each strategy area include information on existing and continuing initiatives, estimated GHG reductions, potential community co-benefits, and the relevant CAP Update actions. Anticipated community co-benefits are presented in Figure ES-5.

Figure ES-5. Community Co-Benefits

Community Actions




WATER CONSERVATION AND WASTEWATER TREATMENT
2020 GHG Reductions
3,259 MTCO2e
Strategies
Water/Wastewater-1 Water Conservation
Water/Wastewater-2 Increase Pump Efficiency
Water/Wastewate-3 Reduce Wastewater Generation
Community Co-Benefits
10%
of 2020 Local Reductions
AGRICULTURE
2020 GHG Reductions
4,638 MTCO2e
Strategies
Agriculture-1 Methane Capture and Combustion at Dairies and Livestock Operations
Community Co-Benefits
14%
of 2020 Local Reductions
GHG PERFORMANCE STANDARD
2020 GHG Reductions
1,920 MTCO2e
Strategies
PS-1 GHG Performance Standard for New Development
Community Co-Benefits
Varies
6%
of 2020 Local Reductions

Municipal Actions

Implementation Program

The County faces many challenges—and correspondingly many opportunities—as it moves to reduce GHG emissions. Establishing a realistic and effective management program is necessary to ensure the CAP Update meets its GHG reduction objectives and is implemented in a timely and efficient manner. The County's Sustainability Team will lead and coordinate the County's efforts on implementing, monitoring, and managing the emissions reduction strategies. Composed of County staff, the Sustainability Team will be responsible for updating and adaptively managing the CAP Update.

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

Following adoption of the CAP Update, the emissions reduction strategies will be implemented to ensure the County's 2020 emissions reduction targets are achieved. Beginning in 2015, strategies will be prioritized for implementation 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 Sustainability Team early in the implementation process.

During each year of implementation, the County will monitor emissions reductions achieved by the State and local strategies. Data collected by routine monitoring will document the County's progress in reducing emissions and enable the County to make informed decisions on future priorities, funding, and scheduling. The County will also update the Community and Municipal Inventories, first in 2017 and again in 2019, to measure overall emissions trends in the community. The updated inventories will be submitted to the Board of Supervisors and distributed to the public for review. As the year 2020 approaches, the County will develop reduction targets for years beyond 2020 to continue the County's commitment to reducing GHG emissions.

Adaptation Plan

Adaptation refers to reducing the impact of unavoidable climate change effects. Although Marin currently enjoys a relatively mild climate, climate change may exacerbate existing climate-related hazards in the county (such as increased incidence of flooding) or introduce new challenges (such as erosion or coastal and bayland flooding due to sea level rise). These climate change effects could have wide-ranging impacts across the county's various economic sectors. It is important that Marin County considers potential climate change vulnerabilities as it moves forward with other planning activities.

Current research efforts have shown that Marin County and the North Bay region have already experienced some changes in climate, including increases in temperature and precipitation. Projections indicate that temperatures will continue to increase (North Bay Climate Adaptation Initiative 2013a), and that the region will likely experience a shift to drier summers and wetter winters characterized by heavier rain events (North Bay Climate Adaptation Initiative 2013a), and there could be a rise in local sea levels (Cayan et al. 2008; Knowles 2010, State of California Ocean Protection Council 2013). Increases in temperature, changes in precipitation, and sea level rise could result in the increased frequency or intensity of certain climate hazards, including shifts in the water supply and demand, wildfires, extreme heat, and inland flooding. Section 7 of this report explores the impacts of these climate hazards, potential adaptation actions, and suggests key stakeholders to engage relative to the following sectors: water, natural heritage, transportation, agriculture, energy, and human health.

There are many adaptation efforts already underway in Marin County. The County has proven to be a leader in thinking about adaptation and taking action to increase resiliency of local resources. However, there has not been a consolidated look at the vulnerabilities of Marin County across sectors and climate change stressors. A more comprehensive, county-wide vulnerability assessment would help highlight where resources should be focused under adaptation planning efforts. Furthermore, effective adaptation requires coordination across many different stakeholders within a county, and a "big picture" understanding of the sectors and geographic locations that are most vulnerable would help demonstrate where coordination and collaboration are most needed.

Funding Acknowledgement

Funding for the CAP Update was provided in part by the Marin County Energy Watch (MCEW), a joint project of Pacific Gas and Electric (PG&E) and the County of Marin[3].

[3] MCEW is funded by California utility ratepayers under the auspices of the California Public Utilities Commission.

Chapter 1
Introduction and Purpose

Photo: Fabio Sironi

Chapter 1
Introduction and Purpose

1.1 Purpose of the Climate Action Plan Update

The County of Marin (County) plans to reduce and avoid greenhouse gas (GHG) emissions associated with both community and municipal activities, which include everyday activities of local residents and businesses within the unincorporated county along with municipal County government operations. The goal of this CAP Update is two-fold: to reduce community GHG emissions to 30% below 1990 levels—a goal referred to as the *2020 Community Emissions Reduction Target;* and to reduce municipal GHG emissions to 15% below 1990 levels by 2020—a goal referred to as the *2020 Municipal Emissions Reduction Target*. Emissions that result from the County's municipal operations are distinct from community activities and include activities like municipal building operation and operation of the County's police and fire vehicles.

The CAP Update consolidates many of the County's existing initiatives on climate change and provides a blueprint for a more sustainable future. The actions outlined in the CAP Update have other benefits beyond reducing GHG emissions, and will improve air quality, reduce traffic congestion, and create new opportunities for walking and biking. The County's 2020 emissions reduction targets go above and beyond larger statewide efforts established by Assembly Bill (AB) 32, the California Global Warming Solutions Act. New development proposed within the county can use the CAP Update to address GHG impacts and streamline project-level environmental review of climate change impacts under the California Environmental Quality Act (CEQA). The CAP Update therefore serves as a mechanism to facilitate sustainable development as well as a tool to support community-wide reductions in GHG emissions.

The CAP Update also outlines a plan to adapt to climate change, which will better prepare the County 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 County's strategy to address climate change. The CAP Update 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 Basic Terms

Definitions of common terms used in this CAP Update appear below.

- **AB 32.** The California Global Warming Solutions Act of 2006, widely known as AB 32, requires the California Air Resources Board (ARB) to develop and enforce regulations for the reporting and verification of statewide GHG emissions. The heart of the bill is the requirement that statewide GHG emissions must be reduced to 1990 levels by the year 2020 of the AB 32 Scoping Plan.

- **AB 32 Scoping Plan**. The Scoping Plan for AB 32 was developed by ARB and approved in December 2008. The Scoping Plan has a range of GHG reduction actions, which include direct regulations, compliance mechanisms, monetary and non-monetary incentives, voluntary actions, and market-based mechanisms such as a cap-and-trade system. ARB has already adopted numerous regulations and is currently conducting additional rulemaking for reducing GHG emissions to achieve the emissions cap by 2020. On May 15, 2014, ARB posted the first update to the Scoping Plan. This update builds upon the initial Scoping Plan with new strategies and recommendations, identifies opportunities to leverage existing and new funds, defines the climate change priorities of ARB for the next 5 years, and builds a foundation to support the long-term goals identified in Executive Orders S-3-05 and B-16-2012. The update also presents the State's progress toward meeting the 2020 GHG emission reduction goals defined in the initial Scoping Plan. 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 (2008), which is roughly equivalent to 1990 emission levels.
- **Business-as-Usual (BAU) Forecasts**. BAU represents a future scenario that does not consider the possible reduction of GHG emissions that may result from any legislation or regulation that would go into effect after the inventory year. The BAU projections are estimates of future emissions based on energy and carbon intensity in the existing economy with the expected increases in population and economic growth in the future. Two BAU forecasts are presented in this CAP Update: the *2020 BAU Community Forecast*, which estimates GHG emissions from the community, and the *2020 BAU Municipal Forecast*, which estimates GHG emissions from County operations.
- **Community GHG Emissions Inventory**. Abbreviated as *Community Inventory*, this inventory quantifies GHG emissions occurring in association with the land uses within the jurisdictional boundaries of the unincorporated county, and generally consists of emissions sources that the community can influence or control. The inventory includes emissions that occur both inside and outside the jurisdictional boundaries, but only to the extent that such emissions are due to land uses and activities within the unincorporated county. Data from the 1990 Community Inventory and the 2012 Community Inventory are presented in this CAP Update.
- **Municipal GHG Emissions Inventory**. Abbreviated as *Municipal Inventory*, this inventory quantifies GHG emissions occurring in association with municipal operations and activities of the County government. The inventory boundaries are defined by the "operational control" approach, which means that the local government has the full authority to introduce and implement its operating policies at each emissions source. Examples include County buildings, vehicle fleet, and activities required to provide services to the community. Data from the 1990 Municipal Inventory and the 2012 Municipal Inventory are presented in this CAP Update.
- **Emissions Type**. GHG emissions can be classified as either *direct* (emissions that occur at the end use location, such as natural gas combustion for building heating) or *indirect* (emissions that result from consumption at the end use location but occur at another location, such as the consumption of electricity in a residence which results in emissions that occur at the power plant). The CAP Update addresses both types of emissions. The term *emissions* refers to GHG emissions and not to emissions of air quality pollutants.
- **Unit of Measure**. The unit of measure used throughout the CAP Update is metric tons of carbon dioxide equivalent ($MTCO_2e$). Presenting inventories in carbon dioxide equivalence allows

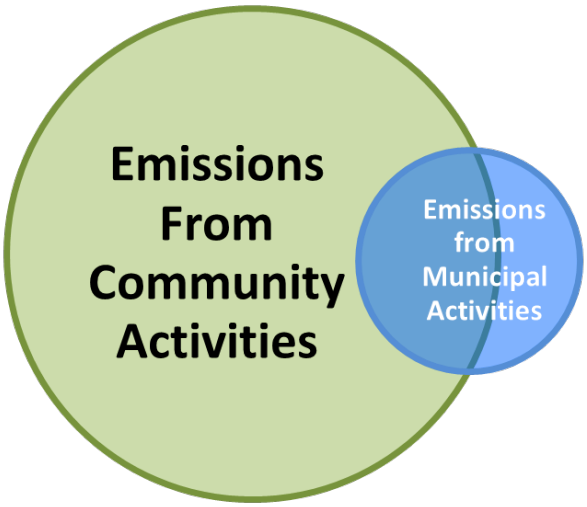
characterization of the complex mixture of GHG as a single unit taking into account that each gas has a different global warming potential (GWP). One million $MTCO_2e$ is abbreviated $MMTCO_2e$.

1.3 Community and Municipal Climate Action Planning

The CAP Update includes various programs and policies that will reduce community GHG emissions to 30% below 1990 levels and municipal GHG emissions to 15% below 1990 levels. The 2012 Community Inventory focuses on GHG emissions that result from activities within the unincorporated areas of the County. Some of these emissions may be due to municipal activities and some may not. The 2012 Municipal Inventory focuses on GHG emissions that result from the County's municipal operations and does not include GHG emissions generated by the community (i.e., these emissions are included in the 2012 Community Inventory).

Within the CAP Update, community actions and municipal actions are distinct from one another with separate approval processes and timelines. However, there may be some minor overlap in the emissions that are accounted for in both inventories where County facilities and actions occur in the unincorporated County areas. The emissions in these sectors may be counted as both municipal and community emissions, as illustrated in Figure 1-1. For example, employee commute emissions are counted as municipal emissions, but they may also occur in the unincorporated areas and would therefore be included in vehicle miles traveled data for the unincorporated areas. As such, there may also be some overlap in the associated actions to reduce these emissions. Because some of the County's operations take place within the jurisdiction of cities and pertain only to municipal operations, the County's municipal emissions do not entirely overlap with community emissions in the unincorporated areas (Figure 1-1). To the extent that any overlap of programs or policies may occur, the County anticipates working with all appropriate departments and stakeholders to ensure that these programs and policies are developed as efficiently as possible, while still meeting both the community and municipal goals of the CAP Update.

Figure 1-1. Overlap between Community Emissions and Municipal Emissions[4]



[4] The sizes of the circles are not to scale but attempt to illustrate the difference between community and municipal emissions.

1.4 Contents of the Climate Action Plan Update

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

- Chapter 1, *Introduction and Purpose*, describes the purpose of the CAP Update and provides recommendations for using the CAP Update.
- Chapter 2, *Climate Change Science and Regulations*, summarizes information about climate change projections and GHG regulations.
- Chapter 3, *Updated Emissions Inventories and Forecasts*, includes the 1990 and 2012 GHG emissions inventories for community and municipal activities, as well as the County's 2020 BAU forecasts.
- Chapter 4, *Community Greenhouse Gas Reduction Goals and Measures*, identifies the County's community emissions reduction goals for the CAP Update and describes the measures the County will pursue to reduce community GHG emissions. The chapter estimates potential GHG reductions and associated co-benefits for each measure.
- Chapter 5, *Municipal Greenhouse Gas Reduction Goals and Measures*, identifies the County's municipal emissions reduction goals for the CAP Update and describes the measures the County will pursue to reduce municipal GHG emissions. The chapter estimates potential GHG reductions and associated co-benefits for each measure.
- Chapter 6, *Greenhouse Gas Reduction Measure Implementation*, provides recommendations for implementing the GHG reduction measures, including funding approaches, County actions, and mechanisms for monitoring and updating the analysis.
- Chapter 7, *Climate Change Adaptation*, discusses the implications of climate change within the county and outlines adaptation strategies.
- Chapter 8, *References*, includes citations for the documents used to prepare the CAP Update.

1.5 How to Use the Climate Action Plan Update

Public agencies and private developers can use the CAP Update to comply with project-level review requirements pursuant to the California Environmental Quality Act (CEQA). CEQA guidelines specify that CEQA project evaluation of GHG emissions can "tier off" a programmatic analysis of GHG emissions, provided that the programmatic analysis (or climate action plan) 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.

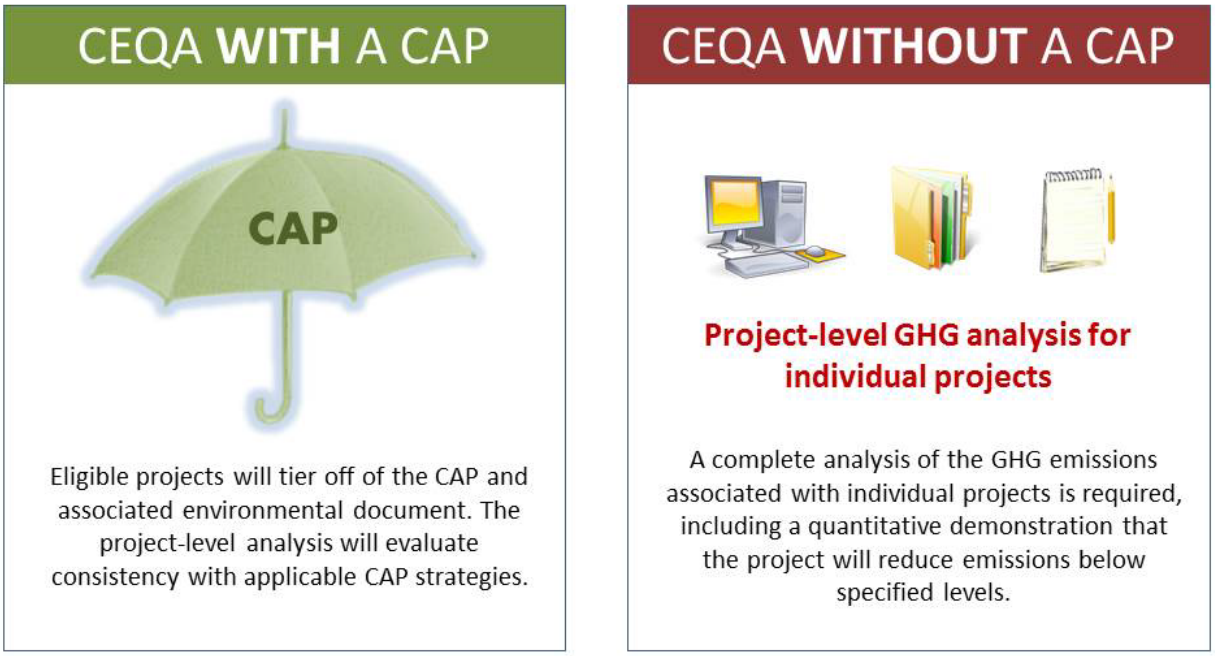
- Specify measures or a group of measures, including performance standards that substantial evidence demonstrates, if implemented on a project-by-project basis, would collectively achieve the specified emissions level.
- Monitor the plan's progress.
- Adopt the GHG reduction strategy in a public process following environmental review.

The CAP Update meets CEQA Guidelines Section 15183.5 listed above by 1) quantifying all primary sectors of GHG emissions within the county for 1990, 2012, and 2020; 2) including a reduction target of 30% below 1990 levels for community emissions, which is above and beyond the recommendations in the AB 32 Scoping Plan for municipalities to support the overall AB 32 reduction targets; 3) analyzing community emissions for the County and including predicted growth expected by 2020; 4) including specific measures to achieve the overall reduction target; 5) including periodic monitoring of plan progress; and 6) submitting the CAP Update to be adopted in a public process following compliance with CEQA.

Once the CAP Update is adopted, project-specific environmental documents that incorporate applicable CAP measures can tier off the CAP (and any necessary CEQA documentation for adoption of the CAP) to meet project-level CEQA evaluation requirements for GHG emissions. Tiering can eliminate the need to prepare a quantitative assessment of project-level GHG emissions. Rather, project-specific environmental documents that rely on the CAP Update can qualitatively evaluate GHG impacts by identifying all applicable CAP measures and describing how those measures have been incorporated into the project design and/or identified as mitigation. This type of tiered analysis can reduce project costs and streamline the County CEQA process as it relates to GHG emissions. Projects that demonstrate consistency with applicable CAP Update actions 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). The CEQA process for all issues other than GHG emissions would not be affected by the CAP streamlining

Figure 1-2 shows the benefits of tiering off of the CAP and associated environmental document (also known as *project streamlining*) to meet CEQA requirements.

Figure 1-2. CEQA and the CAP: Project Streamlining Benefits



Chapter 2
Climate Change and Regulatory Overview

Photo: Marin Community Development Agency

Chapter 2

Climate Change Science and Regulations

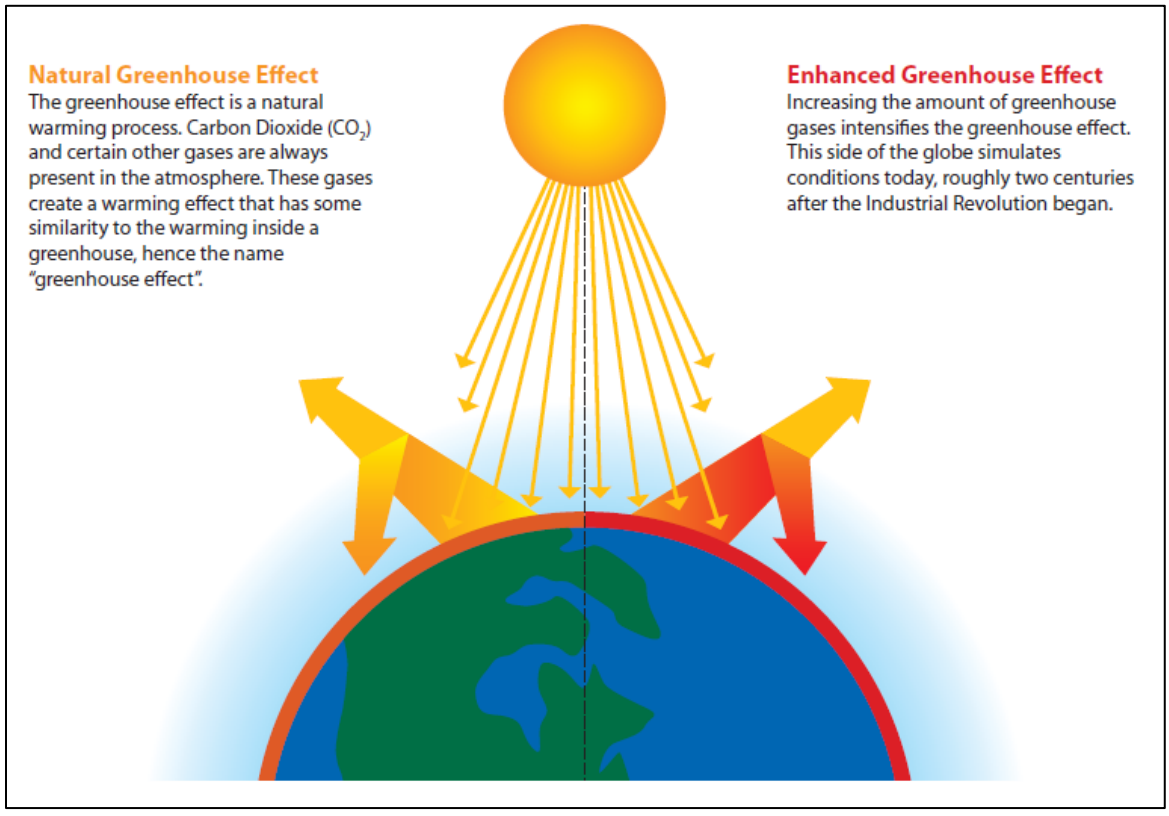
2.1 Introduction

This chapter provides a background on climate change and the greenhouse effect, a summary of local climate change effects, and an overview of climate change regulations, including state and local actions.

2.2 Background on Climate Change and GHG Emissions

The phenomenon known as the *greenhouse effect* keeps the atmosphere near Earth's surface warm enough for the successful habitation of humans and other life forms. The greenhouse effect is created by sunlight that passes through the atmosphere (Figure 2-1). Some of the sunlight striking Earth is absorbed and converted to heat, which warms the surface. The surface emits a portion of this heat as infrared radiation, some of which is absorbed by GHGs in the atmosphere and re-emitted in all directions, including back toward Earth's surface. Human activities that generate GHGs increase the amount of infrared radiation absorbed by the atmosphere, thus enhancing the greenhouse effect and amplifying the warming of the Earth (Center for Climate and Energy Solutions 2011).

Figure 2-1. The Greenhouse Effect



Increases in fossil fuel combustion and deforestation have exponentially 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, variable precipitation, and increased frequency and intensity of extreme weather events (Intergovernmental Panel on Climate Change 2013). Large-scale changes to Earth's climate system are collectively referred to as *climate change*.

Climate Change and Global Warming

The terms *global warming* and *climate change* are often used synonymously, but they refer to two different processes. Increasing global surface temperatures as a result of rising atmospheric concentrations of GHGs, in excess of natural levels, is known as *global warming*. Large-scale changes to the Earth's system induced by higher global surface temperatures 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 the result of human-made 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-made GHG emissions are accelerating the magnitude and pace of climate change.

AB 32 identifies the following compounds as the major GHGs: carbon dioxide, methane, nitrous oxide, perfluorinated carbons (PFCs), sulfur hexafluoride, and hydrofluorocarbons (HFCs). Generally, these emissions are quantified in terms of $MTCO_2e$ emitted per year, which accounts for the relative warming capacity, or global warming potential (GWP) of each gas. Water vapor is not identified by AB 32 as a key GHG because natural concentrations and fluctuations far outweigh anthropogenic influence. Table 2-1 describes the key characteristics and sources of the six major GHGs identified by AB 32.

Sources, Sinks, and Global Warming Potentials for Greenhouse Gases

Natural and human activities that generate GHGs are commonly referred to as emissions *sources*. The burning of fossil fuels to power buildings and vehicles is the primary source of CO_2 and a key contributor of CH_4 and N_2O emissions. A GHG *sink* removes and stores GHGs. For example, vegetation is a sink because it removes atmospheric CO_2 during respiration.

GHGs are not created equally. The Global Warming Potential, or GWP, is used to compare GHGs based on their potential to trap heat and remain in the atmosphere. Some gases can absorb more heat than others, and thus have a greater impact on global warming. For example, CO_2 is considered to have a GWP of 1, whereas N_2O has a GWP of 265. This means that N_2O is 265 times more powerful than CO_2.

Table 2-1. Principal Greenhouse Gas 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	28	12.4
Nitrous Oxide	N_2O	• Agricultural practices • Nylon production • Gas-fired power plants • Nitric acid production • Vehicle emissions	265	121
Perfluorinated Carbons	CF_4 C_2F_6	• Aluminum production • Semiconductor manufacturing	6,63–11,100	10,000 – 50,000
Sulfur Hexafluoride	SF_6	• Power distribution • Semiconductor manufacturing • Magnesium processing	23,500	3,200
Hydrofluorocarbons	HFC-23 HFC-134a HFC-152a	• Consumer products • Automobile air conditioners • Refrigerants	138–12,400	1.5–222

Source: Intergovernmental Panel on Climate Change 2013.

The majority of GHG emissions generated in the United States and California are in the form of carbon dioxide. In 2011, for example, carbon dioxide accounted for 84% of the federal GHG inventory, with most of these emissions generated through the combustion of fossil fuels. Fossil fuels are burned to create electricity and heat to power 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 federal GHG inventory. The transportation sector is the next largest source GHG emissions (28%) (U.S. 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%) for a total of 61% of the state's emissions (California Air Resources Board 2013). By comparison, the unincorporated county follows the federal trend with emissions from on-road transportation and building energy use constituting the largest sources of emissions (each representing 35% of the total 2012 community inventory for a total of 70%). Other sources of GHG emissions generated in the United States and California include industrial processes, commercial and residential buildings, and agricultural activities.

2.3 Local Climate Change Effects

Increases in Extreme Heat Conditions. Heat waves and very high temperatures could last longer and become more frequent. On average, the North Bay region (including Marin County) is expected to warm 2–7 degrees Fahrenheit over land by mid-century (North Bay Climate Adaptation Initiative 2013a). Extreme heat in this historically temperate climate may threaten human health, cause heat stress in animals, and shorten the expected lifespan or increase the need for repairs in the built environment.

Inland Flooding. Increased intensity of winter storm events combined with sea-level rise may cause more frequent flooding, especially in low-lying areas. An increase in the variability of rainfall could contribute to an increase in the likelihood of the frequency and intensity of extreme events such as floods in the North Bay (Micheli et al. 2012; North Bay Climate Adaptation Initiative 2013a).

Rising Sea Levels. Sea levels are expected to steadily rise by mid-century, which could inundate portions of the coastline (Cayan et al. 2008; Knowles 2010, State of California Ocean Protection Council 2013). Increased sea levels and elevation of storm surge could cause more area within the county to be temporarily or permanently inundated by salt and brackish waters.

Shift in Water Demand and Supply. Although models project divergent trends of either more or less precipitation in the future, all scenarios indicate more variability and intensity of extreme events, including droughts (Flint et. al. 2012; North Bay Climate Adaptation Initiative 2013a). Shifting precipitation patterns and extended periods of drought would limit the available supply of water. Increased temperatures and low soil moisture increase the demand for water as people require more water for their gardens, agriculture, etc.

Wildfires. The risk of wildfire danger in Marin County will likely increase due to increased temperatures and shifts in precipitation patterns, which may include extended dry spells (Westerling and Bryant 2008; North Bay Climate Adaptation Initiative 2013b).

Changes in Growing Season. 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, sea level, and other climate-related effects (Cornwell et al. 2012; North Bay Climate Adaptation Initiative 2013b).

Shift in Energy Demand and Supply. Increased temperatures and a decreased (or inconsistent) water supply could have a negative impact on the availability of energy. Although there are no electric generation facilities in Marin County, changes in energy supply and demand could lead to higher energy prices, brownouts, or other impacts that affect Marin.

2.4 Climate Change Regulations

2.4.1 Federal, State, and Regional Initiatives

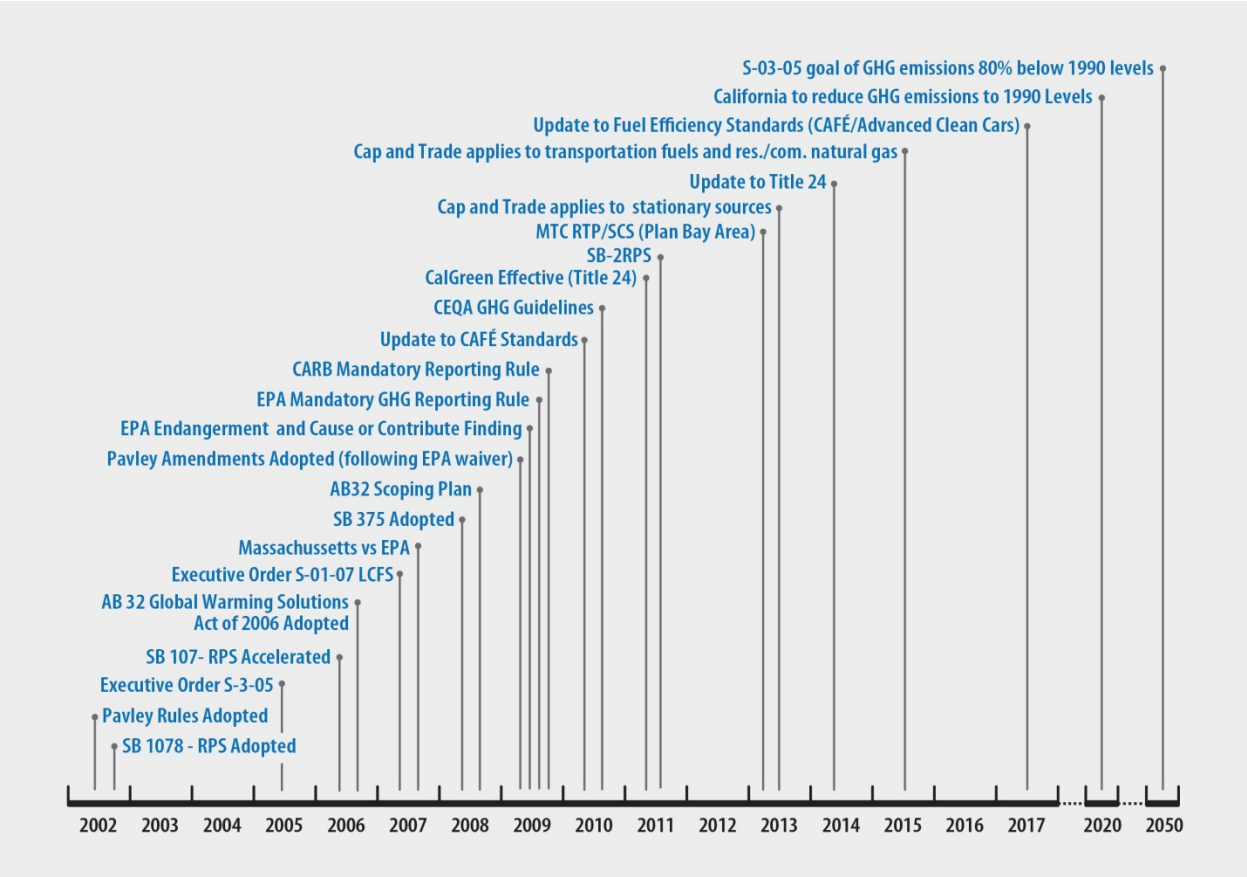
Climate change is widely recognized as an imminent threat to the global climate, economy, and population. The U.S. Environmental Protection Agency (EPA) has acknowledged potential threats imposed by climate change in a Cause or Contribute Finding, which found that the GHG emissions from new motor vehicles contribute to pollution that threatens public health and welfare and was a necessary finding prior to adopting new vehicle emissions standards that reduce GHG emissions. Federal climate change regulation under the federal Clean Air Act (CAA) is also currently under development. Standards for carbon dioxide emissions from new fossil-fuel-fired electricity power plants have also been proposed by the EPA and outlined in the *President's Climate Action Plan*. If approved, these standards would be the first to establish national GHG limits for the electric power industry. In summer 2014, the EPA released draft emissions standards for existing electricity power plants that are scheduled to be adopted in 2015.

California has adopted statewide legislation to address various aspects of climate change and reduce GHG emissions. AB 32 codified the State's GHG emissions target by requiring that statewide GHG emissions be reduced to 1990 levels by 2020. The AB 32 Scoping Plan identifies specific measures to achieve this goal and requires that the 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 for both their municipal operations and the community, consistent with those of the State.

The Metropolitan Transportation Commission (MTC) is the metropolitan transportation organization in the region. Pursuant to Senate Bill 375 (SB 375), MTC has adopted a sustainable communities strategy (SCS) that promotes reductions in on-road transportation GHG emissions by fostering improved regional land use policies and increased transit and other alternatives to vehicular travel.

The Bay Area Air Quality Management District (BAAQMD) leads regional regulation of stationary sources and also often coordinates with local governments on reduction of air pollution from new projects, both of which can also result in reduction of GHG emissions.

Figure 2-2. Key Federal, State, and Regional Greenhouse Gas Legislation



2.4.2 Local Actions

Marin County has a long history of implementing and promoting initiatives to protect the environment and conserve natural resources. The County'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 County and will contribute to long-term GHG reductions. Many of these actions were included in the 2006 *Marin County Greenhouse Gas Reduction Plan* (2006 GHG Reduction Plan). The CAP Update builds on these existing programs and proposes additional strategies the County and community can implement to help reduce GHG emissions within Marin County.

Community Actions

- **Marin Clean Energy**. Marin Clean Energy, launched in 2010, is a community choice aggregation program and electricity provider that works with Pacific Gas & Electric Company (PG&E) to provide customers with 50–100% renewable energy.
- **Green Business Program**. Business in the county can be certified with Green Business Program if they pledge to stay green, and select measures to conserve water, conserve energy, reduce

waste, and prevent pollution. Businesses that participate receive streamlined environmental assistance, money saving opportunities, and promotional items to distribute to customers.

- **Marin Energy Watch Partnership**. The Marin Energy Watch Partnership provides resources and incentives to residents, businesses, and public agencies to increase energy efficiency. All public agencies, business, and residences in the county who are PG&E or Marin Clean Energy customers can participate.
- **Energy Upgrade California**. Property owners in the county can apply for rebates, incentives, and financing through the Energy Upgrade California Program. In addition, the County offers a $1,000 incentive for homeowners who have completed an Advanced Upgrade Package and who host a Home Showcase Event.
- **Marin Clean Energy—Solar Rebate**. This program provided a $500 solar rebate for Marin Clean Energy customers in 2011 and 2012. Funds have been exhausted but may be available again in the future.
- **Marin Clean Energy—Energy Efficiency Programs**. Energy efficiency programs and financing are offered for multi-family, single-family and commercial properties.
- **Bay Area Regional Energy Network (BayREN)—Energy Efficiency Programs**. Programs include additional rebates for the Energy Upgrade California program, commercial property assessed clean energy (PACE) financing, codes and standards programs, and a multi-family program.
- **Green Building Requirements**. The County passed a green building ordinance in November 2010 that requires green building standards to be met by both residential and commercial new construction and remodels.
- **Various Transportation-Related Actions**. The 2006 GHG Reduction Plan outlined a number of actions to reduce GHG emissions associated with on-road transportation, including improving traffic signal synchronization/ decreasing stop rate and time; encouraging community car-sharing; expanding local or regional bus service in range and/or frequency; offering prioritized parking for hybrid cars; expanding community bicycle infrastructure (e.g., dedicated bicycle lanes, additional bicycle parking spaces); expanding the Safe Routes to School Program; fostering downtown neighborhood development; encouraging mixed-use development; promoting transit-oriented development; establishing city-centered corridors; instituting growth boundaries, ordinances, or programs to limit suburban sprawl; implementing a Housing Overlay Zone focused on a city-centered corridor, and maintaining a jobs/housing balance.
- **Zero Waste Marin**. The Marin Hazardous and Solid Waste Joint Powers Authority (JPA) seeks to send zero tons of waste to landfills by the year 2025.
- **Construction and Demolition Reuse and Recycling Ordinance (Ordinance No. 3389)**. All building and demolition permits must use a 50% minimum of reused or recycled construction and demolition materials. This ordinance was passed in September 2003.
- **Plastic Bag Ban (Ordinance No. 3553)**. Stores shall not provide single-use carry-out bags to customers at the point of sale. Stores shall make reusable bags available to customers. This ordinance was passed in January 2011.

- **Polystyrene Ban (Ordinance No. 3531)**. Prohibits the use of polystyrene foam disposable food packaging and requires the use of environmentally preferable food packaging (biodegradable and compostable materials) by retail food vendors, restaurants, and County facilities. This ordinance was passed in November 2009.
- **Various Waste-Related Actions**. The 2006 GHG Reduction Plan outlined a number of actions to reduce GHG emissions associated with solid waste, including establishing/expanding recycling programs in the community, implementing a solid waste reduction program through the creation of reuse facilities/programs, establishing a system for reuse or recycling of construction and demolition materials, and producing electricity from recovered methane in local landfills.
- **Wood Smoke Reduction Ordinance (Ordinance No. 3395) and Wood Stove and Insert Replacement Rebate Program**. Non-EPA Phase II Certified wood burning heaters or wood burning fireplaces will not be allowed in new construction, additions, or remodels; and will be removed for all remodels and additions over 500 square feet. The County is offering a rebate for the proper removal and replacement of non-EPA certified wood-burning appliances with cleaner burning stoves or gas insert replacements.
- **Graywater Systems Ordinance (Ordinance No. 3564)**. This ordinance amended the building code to establish standards for permitting the reuse of graywater systems.
- **Marin Carbon Project**. This program seeks to identify potential strategies for enhancing soil carbon sequestration in range lands. The project focuses on carbon farming, which implements practices to increase the rate at which carbon dioxide is removed from the atmosphere and converted to plant material and soil organic matter on farms and range lands. The goal of a carbon farming project is to sequester more carbon from enhanced land management and/or conservation practices than is emitted through farming operations.

Municipal Actions

- **Solar and Streetlights.** Since 2003, the County has installed 1 MW of solar panels on municipal facilities along with over 2,000 energy-efficient LED street lights.
- **Various Vehicle Fleet and Employee Commute Actions.** The 2006 GHG Reduction Plan outlined a number of actions to reduce GHG emissions associated with the municipal vehicle fleet and employee commuting, including encouraging carpooling or vanpooling by municipal employees; encouraging telecommuting by municipal employees; purchasing fuel efficient (e.g., hybrid) and/or smaller fleet vehicles; and implementing the employee carpool program, the guaranteed ride home program, and the transit reimbursement program.

Chapter 3
Updated Emissions Inventory and Forecast

Photo: Marin Community Development Agency

Chapter 3
Updated Emissions Inventories and Forecasts

3.1 Introduction

The unincorporated areas of Marin County comprise of more than 430 square miles and are home to over 67,000 residents. These areas are economically, geographically, and socially diverse, which presents unique challenges and opportunities for robust climate action planning.

Marin County's 2012 Community Inventory serves as a snapshot of current emissions to see how the County has made progress in reducing GHG emissions since the 2006 GHG Reduction Plan. It builds on the foundation created by the 2006 GHG Reduction Plan for climate action planning efforts in the county. Specifically, the inventory identifies existing emissions sources and the magnitude of their emissions, which enables the County to tailor specific reduction strategies based on the community's unique emissions profile.

The inventory also supports development of the 2020 BAU Community 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. A BAU projection is an estimate of future emissions; it does not include the effects of *any* new federal, State, or local measures. The CAP Update 2020 BAU Community Forecast is similar to a BAU projection but differs slightly because 1) the data used to forecast 2020 emissions include General Plan socioeconomic assumptions and 2) the transportation emissions forecast accounts for future planned highway and transit network improvements (including the launch of SMART). Local actions and all other State regulations (e.g., AB 32) are not included in the forecast. Please refer to Appendix B for additional information on this topic.

Like the 2012 Community Inventory, the County's 2012 Municipal Inventory serves as a snapshot of current municipal emissions to illustrate how the County has made progress in reducing municipal GHG emissions since the 2006 GHG Reduction Plan—it also builds on the foundation created by this plan, enabling the County to tailor specific reduction strategies based on the unique emissions profile of local government operations. The inventory also supports development of the 2020 BAU Municipal Forecast, which is a prediction of how municipal emissions may change in the future, in absence of State and local actions to reduce GHG emissions.

This chapter describes the 2012 Community Inventory and 2020 BAU Community Forecast for Marin County along with the 2012 Municipal Inventory and 2020 BAU Municipal Forecast.

3.2 Overview of Analysis Methods

3.2.1 Community Emissions Overview

Marin County's 2012 Community Inventory and 2020 BAU Community Forecast include GHG emissions generated by activities within the unincorporated areas. The inventory also includes emissions that occur outside the unincorporated areas, 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 the unincorporated areas are considered even though the power plants themselves may not be located within the unincorporated areas. Each of Marin's cities/towns is responsible for developing their own Climate Action Plan for emissions from their jurisdictions. However, staffs from the County and cities coordinate their climate efforts through various joint programs including the Marin Climate Energy Partnership, Marin Clean Energy and the Marin Hazardous and Solid Waste Joint Powers Authority.

The 2012 Community Inventory and 2020 BAU Community Forecast are divided into seven major sectors. Each sector represents a subset of community emissions, and some comprise multiple emissions-generating activities. For example, natural gas and electricity consumption are both included in the building energy sector. The seven sectors analyzed represent the major emissions categories within the county and are defined as follows.

Estimating Building Energy Emissions

Here is a quick overview of how GHG emissions are estimated for the building energy sector:

Step 1: Determine which utilities supply electricity and natural gas to residents and businesses in the unincorporated areas.

Step 2: Obtain annual energy usage from the utilities. Electricity consumption is provided in terms of kilowatt-hours, whereas natural gas usage is provided in terms of therms.

Step 3: Multiply electricity and natural gas quantities by GHG emission factors.

Step 4: Add emissions from electricity and natural gas to determine total GHG emissions from building energy use.

- **Building Energy**—emissions from electricity generation and natural gas combustion by residential, commercial, and industrial buildings.
- **On-Road Transportation**—fuel consumption emissions from vehicles operating within the unincorporated areas.
- **Off-Road Vehicles and Equipment**—fuel consumption emissions from use of off-road equipment (e.g., cranes, bulldozers, lawnmowers, water craft).
- **Solid Waste Generation**—methane emissions from waste generated by the community within the unincorporated areas.
- **Water Conveyance**—emissions from electricity and natural gas consumption associated with water conveyance, including groundwater pumping, local water distribution, and surface water diversion.
- **Wastewater Treatment**—process (i.e., fugitive) emissions from community wastewater treatment.
- **Agriculture—**nitrogen oxide emissions from fertilizer application and methane emissions from manure management and enteric fermentation from livestock in the unincorporated areas.

Additional emissions were estimated for informational purposes but were not included in the inventory for the following reasons.

- **Stationary Sources**—stationary fuel combustion and process emissions for residences and industrial and commercial facilities (does not include natural gas combustion; this is included in the building energy sector). These emissions were not included because the County has limited jurisdictional control over stationary sources, and large stationary point source emissions are regulated by the State of California (under AB 32 through cap-and-trade) and through the EPA

(under the Clean Air Act) for GHG emissions. Thus, in particular for the larger stationary point sources, local regulation of such sources (as part of this CAP Update) can be duplicative of State and federal authority.

- **Forestry**—carbon sequestration from forested lands reported as an annual value (in $MTCO_2e$ per year). Sequestration from urban and natural forests and sequestration from national forests represent an emissions "sink."[5] Forest lands are considered emissions "sinks" because these lands naturally remove carbon dioxide from the atmosphere. However, as these existing urban and natural forests are part of global atmospheric carbon cycling, *the U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions* (ICLEI–Local Governments for Sustainability 2012) recommends that this emissions sink be disclosed but not combined with other emissions created by human activity in an emissions inventory. The emissions sink potential of the existing forested lands can provide a useful comparison to the emissions sources in the inventory or to changes in the emissions sink that might result from future land use change.
- **Rangeland Soil Carbon Stock**—carbon storage in rangeland soils; this represents total storage and not sequestration or emissions. Units presented are in metric tons of carbon, not $MTCO_2e$. This was not included in the inventory or forecast because ICLEI does not recommend combining global atmospheric carbon cycling with other anthropogenic emissions in an emissions inventory as noted above. Carbon storage in non-rangeland soils has not been estimated due to lack of data,
- **Aboveground Carbon Stock**—carbon stock in aboveground biomass in the county such as croplands, rangeland/pasture, oak woodlands/riparian woodlands, shrublands, and vineyards. This is not a source or sink of GHG emissions; it just represents the total amount of carbon storage in biomass in 2012. Units presented are in metric tons of carbon, not $MTCO_2e$. This was not included in the inventory or forecast because ICLEI does not recommend combining global atmospheric carbon cycling with other anthropogenic emissions in an emissions inventory as noted above.

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 primary protocol used to develop the community inventory is the *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions* (ICLEI–Local Governments for Sustainability 2012). Additional protocols were consulted as needed. The 2012 Community Inventory was developed using actual activity data, like kilowatt-hours of electricity consumed, reported by local utilities and other entities. The 2020 BAU Community Forecast is based on expected growth in the population, employment, and households. All emissions were quantified in terms of $MTCO_2e$. Please refer to Appendix B for detailed information on methods and assumptions used to prepare the 2012 Community Inventory and 2020 BAU Community Forecast.

3.2.2 Municipal Emissions Overview

Marin County's 2012 Municipal Inventory and 2020 BAU Municipal Forecast include GHG emissions generated by the County's local government operations as it provides services to the public. The 2012 Municipal Inventory and 2020 BAU Municipal Forecast are divided into nine major sectors.

[5] An *emissions sink* is a natural or artificial reservoir that accumulates and stores GHG or carbon-containing compounds for an indefinite period.

Each sector represents a subset of municipal emissions, and some comprise multiple emissions-generating activities. For example, natural gas and electricity consumption are both included in the building energy sector. The nine sectors analyzed represent the major emissions categories associated with municipal operations and are defined as follows.

- **Building Energy**—emissions from electricity generation and natural gas combustion by County-owned buildings.[6]
- **Streetlights and Traffic Signals**—emissions from electricity generation to operate County-owned streetlights and traffic signals.
- **Vehicle Fleet**—fuel consumption emissions from County vehicles (e.g., police cars, fire trucks).
- **Employee Commute**—fuel consumption emissions from County employees commuting to and from their worksites.
- **Solid Waste Generation**—methane emissions from waste generated by municipal operations.
- **Water Conveyance**—emissions from electricity and natural gas consumption associated with the conveyance of water to County facilities, including groundwater pumping, local water distribution, and surface water diversion.
- **Wastewater Treatment**—process (i.e., fugitive) emissions from the treatment of wastewater generated by municipal operations.
- **Stationary Sources**—stationary fuel combustion for County-owned stationary source equipment.
- **Refrigerants**—fugitive emissions (leaks) from equipment that require the use of refrigerants (e.g., vending machines, refrigerators, air conditioners).

Emissions generated by municipal activities were analyzed using widely accepted methodologies and procedures that are recommended by federal, State, and local air quality management agencies. The primary protocols used to develop the 2012 Municipal Inventory are the ARB's Local Governments Operations Protocol (LGOP; California Air Resources Board 2010) and the 2012 *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions* (ICLEI–Local Governments for Sustainability 2012). Additional protocols were consulted as needed. The 2012 Municipal Inventory was developed using actual activity data, like kilowatt-hours of electricity consumed in County buildings, reported by local utilities and other entities. The 2020 BAU Municipal Forecast is based on expected growth in County employees and incorporates plans for new building construction. All emissions were quantified in terms of $MTCO_2e$. Please refer to Appendix B for detailed information on methods and assumptions used to prepare the 2012 Municipal Inventory and 2020 BAU Municipal Forecast.

3.2.3 Previous Inventories

Marin County assessed community and municipal GHG emissions for a number of years as part of its 2006 GHG Reduction Plan. Emissions were estimated for the years 1990, 1995, 2000, and 2005. Community emissions included emissions for the entire County, including both the cities and the

[6] Energy use in leased facilities for which the County does not pay the utility bill is not included because PG&E did not provide energy use information for these facilities. These sites constitute only 7% of total municipal building square footage.

unincorporated areas. The municipal emissions included activities associated with local government operations. These inventories used slightly different methods and data sources from those used in the inventory for this CAP Update, as data sources have expanded and improved, and methods for calculating emissions have grown more robust.

The previous community inventories included emissions for building energy (residential, commercial, and industrial), transportation, waste, and agriculture. The previous municipal inventories included emissions for buildings, streetlights, vehicle fleet, employee commute, and waste. The new inventories contained in this CAP Update include additional emissions sectors to encompass more sources of emissions and provide a more comprehensive picture of emissions associated with the county. In addition, the CAP update includes a revised 1990 inventory of community emissions in order to be consistent with the latest GHG protocols, and so that 1990 emissions are consistent with the 2012 GHG inventory and 2020 BAU forecast. This is important because the 2020 GHG reduction target is based on 1990 emissions, so consistent GHG accounting across all years of analysis is necessary.

The 1990 municipal emissions are not completely consistent with the 2012 emissions in terms of sectors, data, and methods. There were some significant data gaps in the 1990 Municipal Inventory, which makes comparisons between years difficult. These data gaps include missing utility data for certain buildings (including some fire stations and the fairgrounds), missing electricity consumption data for some streetlights and traffic signals, over-reported solid waste diversion, fuel sold to other agencies not controlled by the County in the vehicle fleet sector, and a lack of data for water use, wastewater treatment, stationary sources, and refrigerants. Because of these data gaps, comparing municipal emissions in 1990 with emissions in 2012 (or 2020) should be done with care.

3.3 Marin County Community Inventories and Forecast

3.3.1 1990 and 2012 Emissions Inventories

Total GHG emissions generated by community activities occurring in the unincorporated areas of the county in 2012 were 477,456 $MTCO_2e$, which is approximately 0.1% of California's GHG emissions in the same year.[7] This is a 15% decrease from estimated 1990 emissions, which were 561,851 $MTCO_2e$.

As shown in Table 3-1 and Figure 3-1, building energy represents the largest source of community emissions (approximately 35% of the 2012 Community 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 in the residential, commercial, and industrial sectors. On-road transportation emissions are the second largest source of emissions, accounting for 35% of total emissions in the unincorporated areas. Similar to the building energy sector, transportation is typically a considerable component of a community's total GHG emissions, ranging from 30% to 70% depending on other sources and local conditions. The majority of on-road emissions in the county come from personal and light-duty vehicles. The third largest source is agriculture, with a contribution of 23% of the total 2012 Community Inventory, followed by off-road equipment (4%), solid waste treatment (2%), wastewater treatment (1%), and water conveyance (0.2%).

[7] California statewide GHG emissions in 2011 were 448.11 million metric tons of CO_2e (California Air Resources Board 2013).

Table 3-1. Marin County 1990 and 2012 Community Greenhouse Gas Inventories

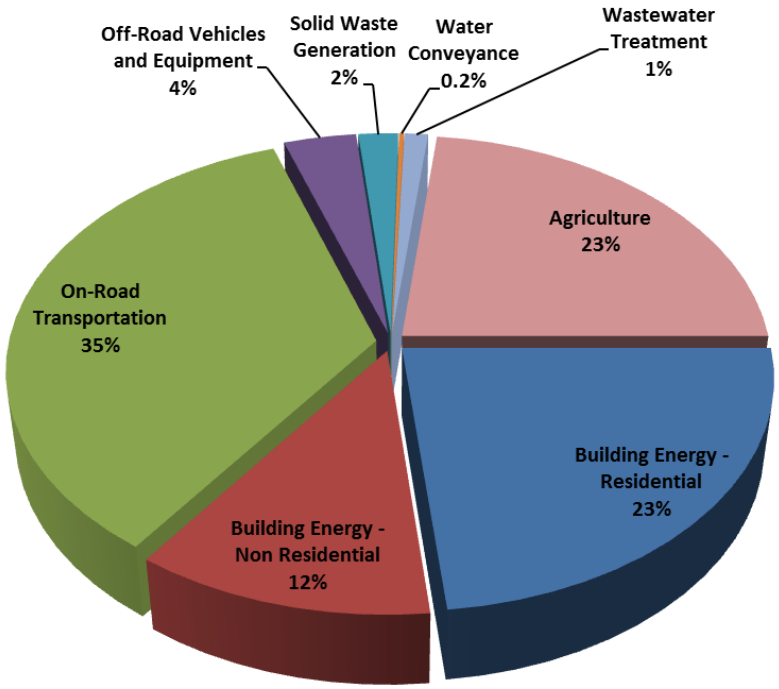
Emission Sector[a]	1990 Inventory		2012 Inventory	
	Emissions ($MTCO_2e$)	Percent of Inventory	Emissions ($MTCO_2e$)	Percent of Inventory
Building Energy— Residential	131,265	23%	111,484	23%
Building Energy— Non Residential	74,190	13%	55,142	12%
On-Road Transportation	193,544	34%	166,773	35%
Off-Road Vehicles and Equipment	19,300	3%	17,126	4%
Solid Waste Generation	14,414	3%	9,362	2%
Water Conveyance	1,319	0.2%	1,157	0.2%
Wastewater Treatment	5,453	1%	5,562	1%
Agriculture	122,366	22%	110,850	23%
Marin County Total	**561,851**	**100%**	**477,456**	**100%**
Emissions for Informational Purposes				
Stationary Sources($MTCO_2e$/year)	–	–	*648*	–
Forestry ($MTCO_2e$/year)	–	–	*-207,151*	–
Rangeland Soil Carbon Stock (MT C) [b]	–	–	*10,783,021*	–
Aboveground Carbon Stock (MT C)[b]	–	–	*7,248,888*	–

Notes:
$MTCO_2e$ = metric tons of carbon dioxide equivalent.
MT C = metric tons of carbon.

[a] Additional emissions sources that were not estimated (or included in the inventory) include aircraft, non-local passenger rail, freight rail, ferries, ozone depleting substances, and other gases with high global warming potential.

[b] Rangeland soil carbon and aboveground carbon stock numbers are in units of metric tons of carbon, not metric tons of carbon dioxide equivalent.

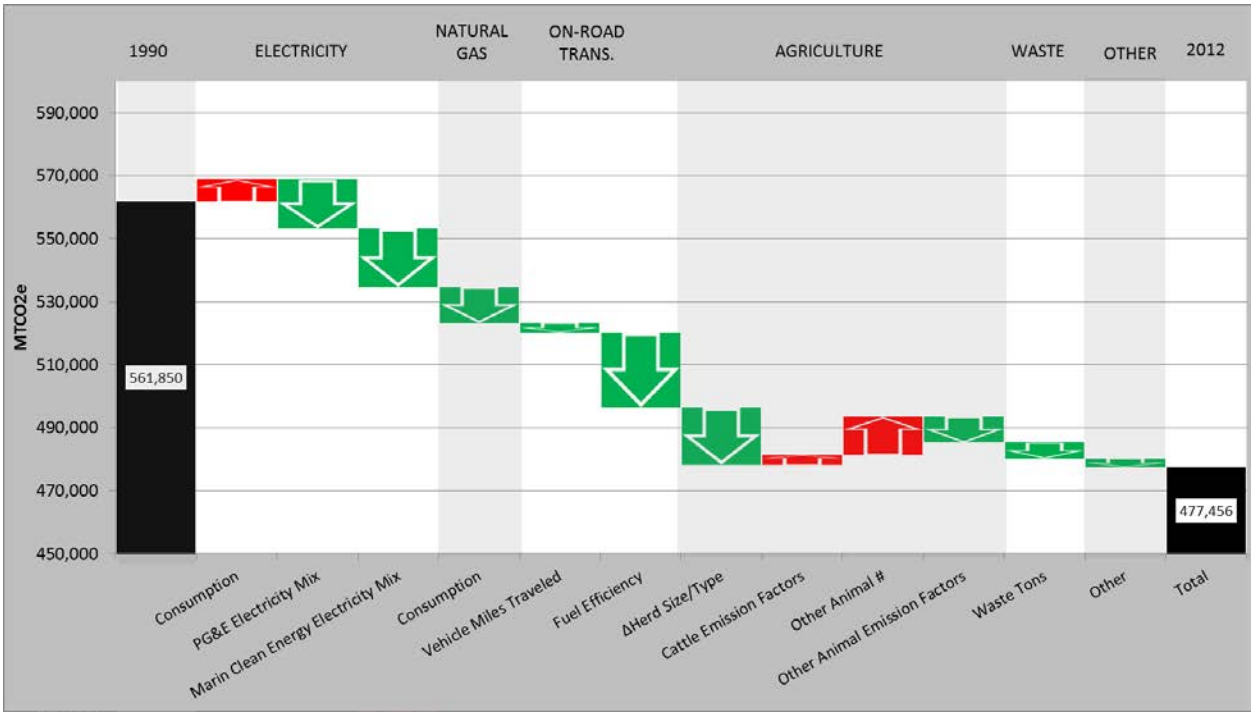
Figure 3-1. Marin County 2012 Community Inventory by Sector



Community emissions have decreased by 15% from 1990 levels. This decrease is due to a number of factors, including changes in energy use, increases in renewables, and increases in vehicle fuel efficiency. Figure 3-2 presents a graphical representation of the causes of the 15% decrease in emissions from 1990 to 2012. A summary of these changes is presented below.

- **Electricity**. Electricity consumption increased slightly, as a result of growth within the county. However, emissions from electricity generation have decreased significantly, due to the increased use of renewable energy sources in PG&E's electricity generation mix, and because of Marin Clean Energy, a Community Choice Aggregation (CCA) program, which supplies additional renewable electricity to county homes and businesses.
- **Natural Gas**. Natural gas consumption decreased likely due to improving efficiency.
- **On-Road Transportation**. Vehicle miles traveled (VMT) decreased and vehicles got much more fuel efficient.
- **Agriculture**. The livestock herd size decreased and changed in composition, and the cattle emission factors slightly increased (due to changes in diet). The number of non-livestock animals (chickens, goats, swine) increased, raising emissions slightly.
- **Waste**. Total tons of waste going to landfills decreased, due to expanded recycling and composting programs.
- **Other Emissions**. Emissions from other sectors, including water treatment and off-road vehicles and equipment, decreased slightly.

Figure 3-2. Trends in Community Emissions from 1990 to 2012 by Sector



3.3.2 2020 Business-as-Usual Forecast

The 2020 BAU Community 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 Association of Bay Area Governments' (ABAG's) 2013 *Plan Bay Area* (Wong pers. comm.). Since the forecast does not account for GHG reductions achieved by the CAP Update or other State actions, it represents a starting point for the County's 2020 Community Emissions Reduction Target.

Is the 2020 Forecast a BAU Projection?

A "business as usual" (BAU) projection is an estimate of future emissions; it does not include the effects of *any* new federal, state, or local measures. The 2020 forecast is similar to a BAU projection but differs slightly because: 1) the data used to forecast 2020 emissions includes ABAG socioeconomic assumptions; and 2) the transportation emissions forecast accounts for future planned highway and transit network improvements. Local actions and all other State regulations (e.g., AB 32) are not included in the forecast. Please refer to Appendix B for additional information on this topic.

As shown in Table 3-2 and Figure 3-3, community GHG emissions are expected to increase modestly by 13,392 $MTCO_2e$ (2.8%) from 2012 to 2020. The majority of this increase in emissions is due to increases in building energy use, vehicle trips, and off-road equipment. Energy consumption, transportation activity, and off-road equipment emissions will increase as a result of the limited amount of new development and increased construction activity. However, this development is anticipated to occur in the unincorporated county at a very low rate compared to the more urbanized areas of the state.

GHG emissions from waste generation and agriculture activities are expected to slightly decrease relative to the 2012 Community Inventory. Reductions in waste-related emissions are predominantly a result of improvements in the methane capture rate at regional landfills. The decline in agriculture emissions is a result of expected reductions in overall agricultural activity.

Despite these changes, the overall emissions profile for the 2020 BAU Community Forecast is similar to the 2012 Community Inventory, with building energy, transportation, and agriculture representing the top three sources and a vast majority (93%) of emissions (see Figure 3-3).

Table 3-2. Summary of Marin County's 2020 Business-as-Usual Community Forecast and Comparison to the 2012 and 1990 Community Inventories ($MTCO_2e$)

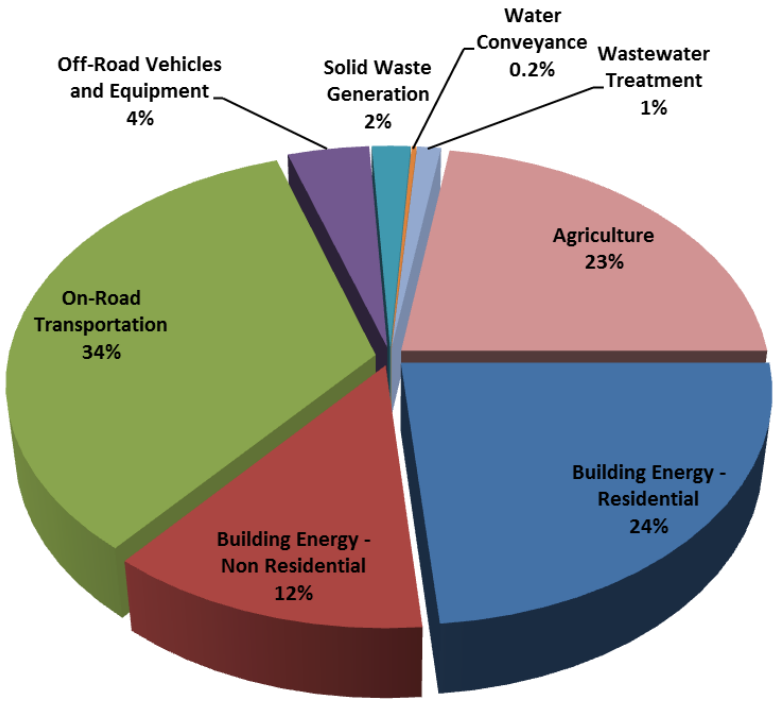
Emission Sector[a]	2020 BAU Forecast		Change in Emissions	
	Emissions ($MTCO_2e$)	Percent of Forecast	From 1990	From 2012
Building Energy—Residential	115,713	24%	-15,552	4,229
Building Energy—Non Residential	61,194	12%	-12,996	6,052
On-Road Transportation	167,002	34%	-26,542	229
Off-Road Vehicles and Equipment	19,823	4%	523	2,697
Solid Waste Generation	9,358	2%	-5,056	-4
Water Conveyance	1,215	0.2%	-104	58
Wastewater Treatment	5,745	1%	292	183
Agriculture	110,798	23%	-11,568	-52
Marin County Total	**490,848**	**100%**	**-71,003**	**13,392**
Emissions for Informational Purposes				
Stationary Sources (MTCO2e/year)	*688*	–	–	–
Forestry (MTCO2e/year)	*-207,151*	–	–	–
Rangeland Soil Carbon Stock (MT C)[b]	*10,783,021*	–	–	–
Aboveground Carbon Stock (MT C)[b]	*7,248,776*	–	–	–

Notes:
$MTCO_2e$ = metric tons of carbon dioxide equivalent.
MT C = metric tons of carbon.

[a] Additional emissions sources that were not estimated (or included in the inventory) include aircraft, non-local passenger rail, freight rail, ferries, ozone depleting substances, and other gases with high global warming potential.

[b] Rangeland soil carbon and aboveground carbon stock numbers are in units of metric tons of carbon, not metric tons of carbon dioxide equivalent.

Figure 3-3. Marin County's 2020 Business-as-Usual Community Forecast by Sector



3.4 Marin County Municipal Inventories and Forecast

3.4.1 1990 and 2012 Emissions Inventories

Total GHG emissions generated by municipal activities in 2012 were 15,215 $MTCO_2e$ (Table 3-3). This is a 0.2% increase from 1990 emissions, which were 15,181 $MTCO_2e$.[8]

As shown in Table 3-3 and Figure 3-4, employee commute represents the largest source of municipal emissions (approximately 43% of the 2012 Municipal Inventory). Employee commute is often one of the largest sources of GHG emissions in municipal inventories. Building energy is the second largest source of emissions, accounting for 36% of total municipal emissions. The third largest source is vehicle fleet, with a contribution of 18% of the total 2012 Municipal Inventory, followed by wastewater treatment (1.4%), streetlights and traffic signals (0.6%), refrigerants (0.4%), stationary sources (0.4%), solid waste generation (0.3%), and water conveyance (0.2%).

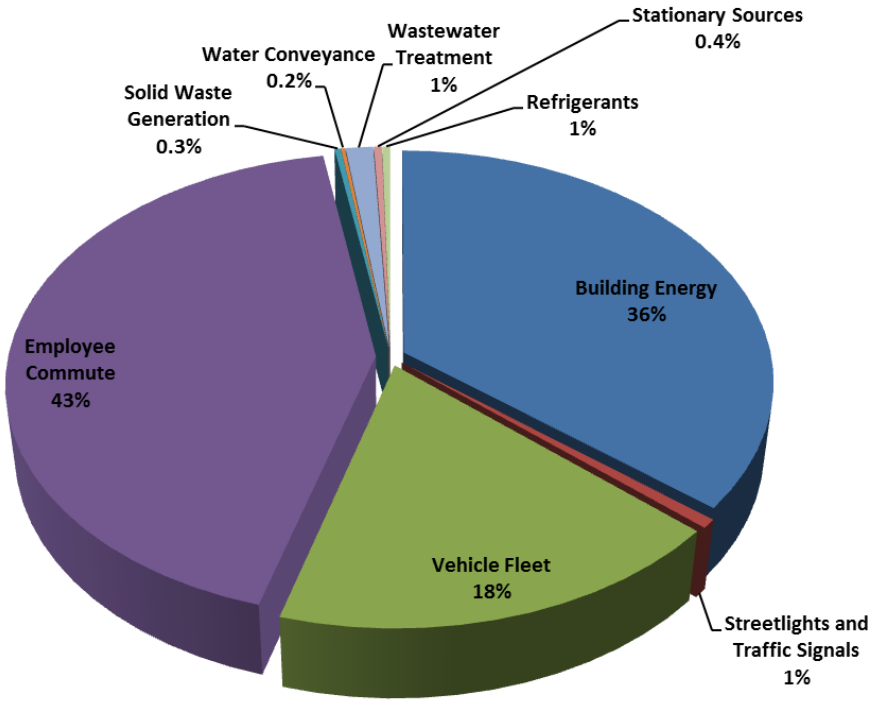
Table 3-3. Marin County 1990 and 2012 Municipal Inventories

	1990 Inventory		2012 Inventory	
Emission Sector	**Emissions ($MTCO_2e$)**	**Percent of Inventory**	**Emissions ($MTCO_2e$)**	**Percent of Inventory**
Building Energy	3,100	20%	5,457	36%
Streetlights and Traffic Signals	52	0.3%	95	1%
Vehicle Fleet	4,900	32%	2,732	18%
Employee Commute	7,100	47%	6,528	43%
Solid Waste Generation	29	0%	47	0.3%
Water Conveyance	-	-	29	0.2%
Wastewater Treatment	-	-	207	1%
Stationary Sources	-	-	59	0.4%
Refrigerants	-	-	61	0.4%
Marin County Total	**15,181**	**100%**	**15,215**	**100%**

Note:
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

[8] The 1990 municipal emissions are not completely consistent with the 2012 emissions in terms of sectors, data, and methods. There were some significant data gaps in the 1990 municipal inventory, which makes comparisons between years difficult.

Figure 3-4. Marin County 2012 Municipal Inventory by Sector



3.4.2 2020 Business-as-Usual Municipal Forecast

Similar to the community forecast, the 2020 BAU Municipal Forecast is a prediction of municipal 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 municipal employees and anticipated construction of new County facilities. Since the forecast does not account for GHG reductions achieved by the CAP Update or other State actions, it represents a starting point for the County's 2020 Municipal Emissions Reduction Target.

In 2020, the County's municipal operations are projected to result in the release of 17,114 $MTCO_2e$—an increase of approximately 12.5% over 2012 levels (Table 3-4). This change is attributable to a 1% growth in municipal employees per year along with the construction of the new emergency operations facility, a new County facility that is currently under construction. Most County services and activities will increase as the population in unincorporated areas grows, and this increase in service will also increase emissions.

GHG emissions from building energy are expected to increase relative to the 2012 Municipal Inventory, due primarily to the addition of the new emergency operations facility. All other sectors of the inventory are also anticipated to increase as the County hires more employees and expands its operations. Most notably, vehicle fleet and employee commute emissions increase between 2012 and 2020 due to this growth.

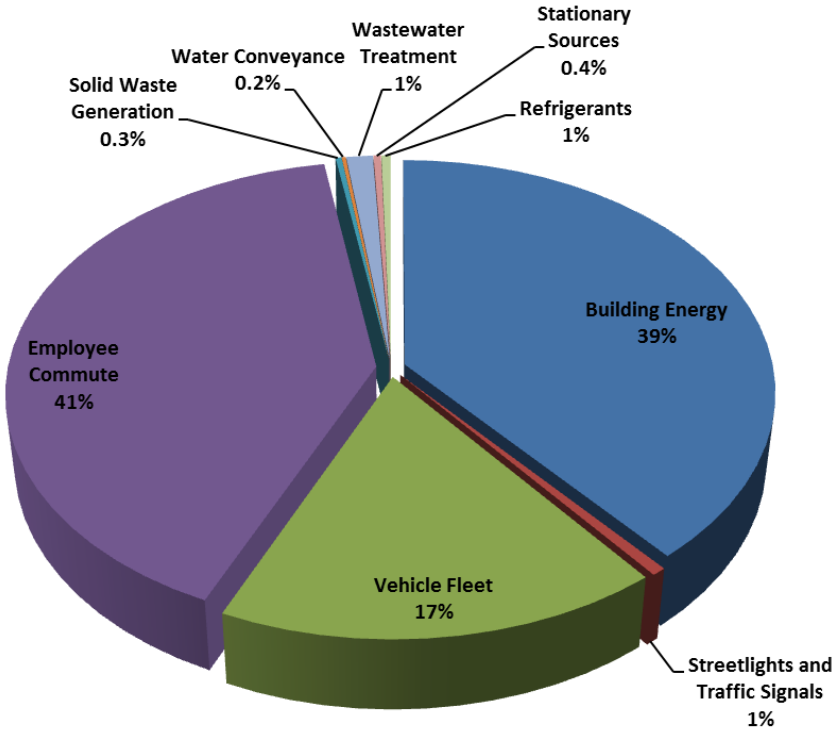
Despite these changes, the overall emissions profile for the 2020 BAU Municipal Forecast is similar to the 2012 Municipal Inventory, with building energy, employee commute, and vehicle fleet representing the top three sources and a vast majority (97%) of emissions (see Figure 3-5).

Table 3-4. Summary of Marin County's 2020 BAU Municipal Forecast and Comparison to the 2012 Municipal Inventory ($MTCO_2e$)

Emission Sector	2020 BAU Forecast		Change in Emissions	
	Emissions ($MTCO_2e$)	Percent of Forecast	From 1990	From 2012
Building Energy	6,642	39%	3,542	1,185
Streetlights and Traffic Signals	97	1%	45	2
Vehicle Fleet	2,973	17%	-1,927	241
Employee Commute	6,957	41%	-143	429
Solid Waste Generation	50	0.3%	21	3
Water Conveyance	32	0.2%	32	3
Wastewater Treatment	222	1%	222	15
Stationary Sources	63	0.4%	63	4
Refrigerants	78	0.5%	78	17
Marin County Total	**17,114**	**100%**	**1,933**	**1,899**

Note:
$MTCO_2e$ = metric tons of carbon dioxide equivalent.

Figure 3-5. Marin County's 2020 BAU Municipal Forecast by Sector



Chapter 4
Community Greenhouse Gas Reduction Goals and Measures

Photo: Marin Public Works Department

Chapter 4
Community Greenhouse Gas Reduction Goals and Measures

4.1 Introduction

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

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

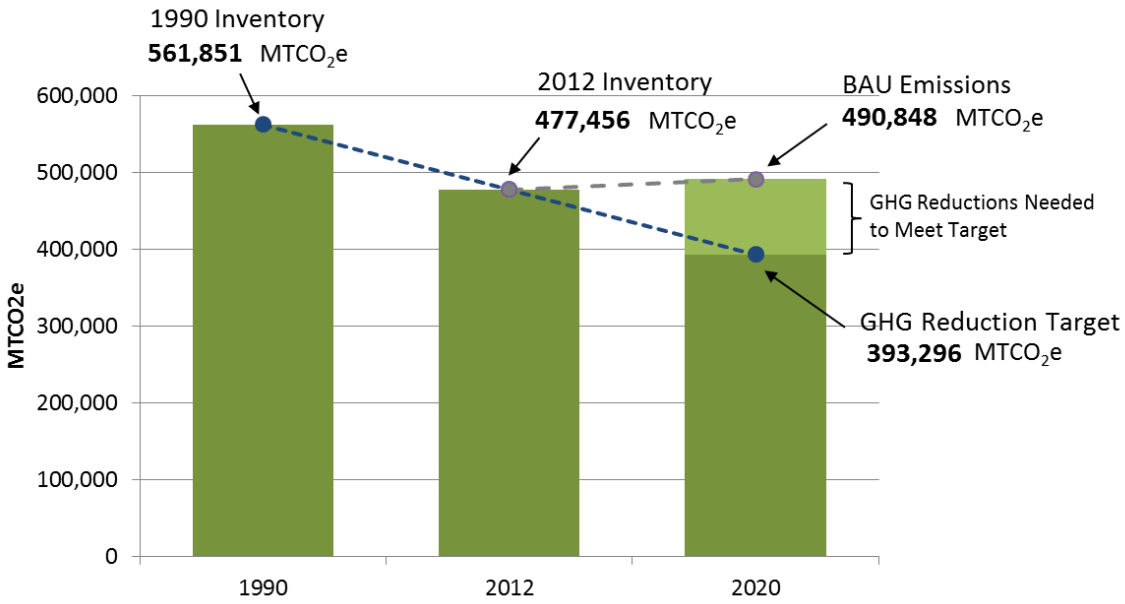
4.2 Marin County Greenhouse Gas Reduction Goals

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. In the 2006 GHG Reduction Plan, the County adopted an emissions reduction target for community emissions of 15% below 1990 levels by 2020. From 1990 to 2012, community emissions have been reduced by 15% below 1990 levels. To continue Marin County's progress on reducing emissions and help the County progress toward potential future state targets, this CAP Update sets a new community emissions target for 2020: 30% below 1990 emissions. This target reflects the County'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. Achieving this goal would avoid the generation of approximately 97,000 $MTCO_2e$ and reduce 2020 Community GHG emissions to approximately 393,000 $MTCO_2e$ from 490,848 $MTCO_2e$ under the BAU scenario. The strategies outlined this chapter represent a combination of local and State initiatives that will collectively lower future community GHG emissions in the county consistent with the County's reduction target (see Figure 4-1).

The County's 2020 emissions reduction target exceeds 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, which is roughly equivalent to

1990 emissions levels. The County's community emissions reduction target is 30% below 1990 emissions levels—a far more aggressive target than AB 32. California Executive Order S-03-05, which was issued in 2005, articulates a long-term goal for the state of 80% below 1990 emissions levels by the year 2050. In order to reach this target for 2050, the state will have to go above and beyond what is included in the AB 32 Scoping Plan for 2020. Marin County is attempting to get ahead of the curve and be on-track to meet the S-03-05 statewide target for 2050 by adopting an aggressive community target.

Figure 4-1. Marin County 2020 Community Emissions Reduction Goals



Community Emissions Reductions in Context

Implementation of the CAP Update would avoid the generation of more than 100,000 $MTCO_2e$ for the community, which is equivalent to the following actions (U.S. Environmental Protection Agency 2014):

- Removing more than 22,000 passenger vehicles from the road each year;
- Reducing gasoline consumption by more than 11 million gallons per year; and
- Providing renewable energy to power over 9,000 homes each year.

4.3 Climate Action Plan Framework

4.3.1 Reduction Measures

The CAP Update comprises a variety of State and local actions to reduce GHG emissions within the unincorporated areas. Statewide efforts to reduce GHG emissions are a fundamental part of the County's CAP Update. For example, the State's Renewables Portfolio Standard (RPS) will reduce the carbon content of electricity throughout the state, including in Marin County. Electricity provided to the County will therefore be cleaner and less GHG intensive than if the RPS had not been established.

The CAP Update includes the local impact of seven State actions to reduce GHG emissions, as discussed further in Section 4.5.1.

The County has identified 13 local community actions to supplement the 7 statewide initiatives. Although identified individually in the CAP Update, these actions 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 *Marin Countywide Plan* and are grouped into five strategy areas.

- Energy Efficiency and Renewable Energy.
- Land Use, Transportation, and Off-Road Equipment.
- Waste Reduction, Reuse, and Recycling.
- Water Conservation and Wastewater Treatment.
- Agriculture.

Coordinating GHG reduction programs will streamline CAP implementation and potentially boost GHG reduction outcomes through synergies created among measures.

The majority of the 13 local actions include voluntary, incentive-based programs that will reduce emissions from both existing and new development in the county. Several other actions will be implemented by the County or other agencies within the region. A small subset of actions will establish mandates for development, either pursuant to State regulations or through existing County programs. Together, the CAP Update actions will improve building energy efficiency and renewable energy production, increase alternative modes of transportation, enhance open spaces, and reduce water consumption and waste generation. The actions were selected following a comprehensive review of candidate strategies recommended by the California Attorney General, California Air Pollution Control Officers Association (CAPCOA), existing CAPs throughout California, and the *Marin Countywide Plan*.

A number of the actions build on existing County programs, whereas others provide new opportunities to address climate change. Successful implementation of these actions will require commitment and dedication from the County, its various departments, and its residents. As discussed in Chapter 6, *Greenhouse Gas Reduction Measure Implementation Program*, the County will adaptively manage the implementation of the CAP Update to maximize GHG reductions and operational efficiency for each action. Accordingly, the County may revise actions or add new actions to ensure that the County achieves its 2020 Community Emissions Reduction Target. If adopted and implemented prior to 2020, new federal programs that achieve local GHG reductions beyond State and local mandates may also be added to the County's CAP Update.

The County will develop and lead the implementation of the majority of the 13 local actions. However, for a few of the CAP Update actions, another local agency, such as operators of water treatment facilities, will have primary responsibility for measure development. The County anticipates supporting the lead entities for these actions, as needed, to identify targets and other strategies for implementation. Despite the County's supporting role, these actions are considered a critical component of a comprehensive CAP, as many of the actions build upon and expand existing programs. Please refer to Chapter 6, *Greenhouse Gas Reduction Measure Implementation Program*, and Appendix C for additional information on lead entities for each action.

4.3.2 Emissions Reductions

Emissions reductions for 2020 are estimated for many State and local strategies. Strategies that do not currently support a quantitative reduction analysis are provided as supporting measures that strengthen the quantified measures (see Appendix C). Although emissions reductions have not been quantified for these strategies, they are still an important part of the CAP Update 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 in the future. Please refer to Appendix C for additional information on emission reduction quantification methods.

4.3.3 Cost–Benefit Analysis

Private residents, businesses, utilities, and other public sector agencies will incur some costs to implement the GHG reduction strategies included in the CAP Update. 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 Update 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 Appendix C: net present value (NPV), cost per $MTCO_2e$, and simple payback period. Please refer to Appendix C for cost information and additional information on cost quantification methods.

Cost-Effectiveness Terms Explained

Cost per MT CO_2e: This 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. A negative cost per ton indicates measures that result in net savings.

Simple payback period: The 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.

Net present value: Net present value (NPV) represents the current worth of a stream of costs and savings over the entire lifetime of the GHG reduction measure. To estimate current worth (or "present value"), future costs and savings are discounted to account for interest-earning potential and other considerations. A positive NPV indicates that a measure is cost-saving over its lifetime.

4.3.4 Community Co-Benefits

Implementing the CAP Update will result in environmental and community benefits that supplement the expected GHG emission reductions. For example, many of the actions will reduce criteria air pollutants in the county, including ozone, carbon monoxide, and fine particulates, which will improve public health. Measures to improve mobility and alternative modes of transportation will enhance walkability and mobility throughout the community. Active transport, like walking and biking, has been shown to substantially lower the burden of disease. These strategies can also

complement and encourage other, more sustainable modes of transportation, including public transit (Maizlish et al. 2011).

Several actions directly target resource efficiency within the county. Building energy and transportation actions will reduce electricity, natural gas, and gasoline usage, which may help lessen consumer sensitivity to increases in future energy prices. Reducing gasoline consumption has an additional benefit of reducing dependence on foreign oil supplies. Recycling and waste diversion programs will also reduce material consumption and the need for landfill space. Water efficiency improvements and land use measures will conserve natural resources and the long-term viability of the County's natural spaces. Open spaces may also offer aesthetic and recreational benefits for community members, as well as habitat for native wildlife and plants.

The combined implementation of the CAP Update actions provides an opportunity to lower carbon emissions and achieve a diverse suite of community co-benefits. Section 4.4 provides additional information on the relevant co-benefits for each community CAP strategy area.

Anticipated community co-benefits associated with the CAP Update are listed in Figure 4-2.

Figure 4-2. Community Co-Benefits

4.4 Meeting Marin County's Greenhouse Gas Reduction Goals

Combined, the State and local strategies included in the CAP Update are expected to reduce 2020 community-wide GHG emissions by approximately 105,000 $MTCO_2e$, which exceeds the 2020 Community Emissions Reduction Target by nearly 7,000 $MTCO_2e$. This is equivalent to removing more than 22,000 passenger vehicles from the road each year (U.S. Environmental Protection Agency 2014). As shown in Table 4-1, the majority (68%) of emissions reductions are achieved by State programs, such as the Pavley standards and RPS[9], which is typical of other CAPs throughout California. Local strategies implemented by the County 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 Update.

Table 4-1. Achieving Marin County's 2020 Community Greenhouse Gas Reduction Target—Sector View

Parameter	Emissions ($MTCO_2e$)
2020 BAU Community GHG Emissions Forecast[a]	490,160
2020 Community Emissions Reduction Target (30% below 1990 levels)[b]	393,296
Total Reductions Needed to Reach Target	***96,864***
2020 Emissions Reductions from State Strategies	71,155
2020 Emissions Reductions from Local Strategies	33,300
Energy Efficiency and Renewable Energy	19,879
Land Use and Transportation	3,018
Off-Road Equipment	84
Solid Waste Management	2,995
Water Conveyance[c]	188
Agriculture	579
Wastewater Treatment	4,638
GHG Performance Standard for New Development	1,920
$Total_2$ Emissions Reductions Achieved by the CAP Update	***104,455***
Emissions Reductions in Excess of Target ($Total_2$ minus $Total_1$)	7,591

Notes:
BAU = business as usual.
$MTCO_2e$ = metric tons of carbon dioxide equivalent.
[a] 2020 BAU emissions do not include stationary sources.
[b] Total GHG emissions in 1990 were 561,851 $MTCO_2e$; an 30% reduction equals 393,296 $MTCO_2e$.
[c] Water conveyance measures result in water efficiency improvements to 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 Water-1 are associated with reduced hot water heating. As such, these reductions are included in the Energy Efficiency and Renewable Energy strategy area. The 188 $MTCO_2e$ of reductions listed for this sector represent reduced energy use for pumping and treatment of water only.

Table 4-2 summarizes the community CAP Update strategies, including their estimated GHG reduction in 2020. Many of the local strategies are cost effective, particularly those that target energy efficiency and renewable energy (see Appendix C for details). In addition to reducing GHG

[9] 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.

emissions, all local strategies will result in community co-benefits, such as improved public health, resource conservation, and better air quality.

Table 4-2. Summary of 2020 Greenhouse Gas Emissions Reductions by Community Measure ($MTCO_2e$)

State Strategy		2020 GHG Reduction	% Total of Reductions	Co-Benefits[a]
State-1. Renewables Portfolio Standard		17,512	17%	
State-2. Title 24 Standards for Commercial and Residential Buildings		1,362	1%	
State-3. Lighting Efficiency and Toxics Reduction Act		6,419	6%	
State-4. Residential Solar Water Heaters		178	0.2%	
State-5. Pavley and Low Carbon Fuel Standard		42,920	41%	
State-6. Advanced Clean Cars		2,194	2%	
State-7. Assembly Bill 32 Vehicle Efficiency Measures		569	0.5%	
Strategy Area	**Local Strategy**	**2020 GHG Reduction**	**% Total of Reductions**	
 ENERGY EFFICIENCY AND RENEWABLE ENERGY	Energy-1. Community Choice Aggregation	2,744	3%	
	Energy-2. Energy Efficiency	7,548	7%	
	Energy-3. Solar Energy	7,093	7%	
	Energy-4. Additional Renewable Energy	0	0.0%	
 LAND USE, TRANSPORTATION, AND OFF-ROAD EQUIPMENT	Trans-1. Land Use Design and VMT Reduction	2,836	3%	
	Trans-2. Public Transportation	183	0.2%	
	Trans-3. Off-Road Equipment	84	0.1%	
 WASTE REDUCTION, REUSE, AND RECYCLING	Waste-1. Zero Waste by 2025	2,995	3%	
 WATER CONSERVATION AND WASTEWATER TREATMENT	Water/Wastewater-1. Water Conservation	1,212	1%	
	Water/Wastewater -2. Increase Pump Efficiency	109	0.1%	
	Wastewater/Wastewater-3. Reduce Wastewater Generation	1,939	2%	
 AGRICULTURE	Agriculture-1. Methane Capture and Combustion at Dairies and Livestock Operations	4,638	4%	
 GHG PERFORMANCE STANDARD	PS-1. GHG Performance Standard for New Development (PS)	1,920	2%	Varies

Notes:
[a] See Figure 4-2 for the key to the co-benefits symbols.

4.5 Measures to Reduce Greenhouse Gas Emissions

4.5.1 State Programs

Programs and initiatives undertaken by the State will contribute to local emissions reductions within the county. 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 the County will be cleaner and less GHG-intensive than if the State had not required the RPS.

Seven statewide initiatives will contribute to community emissions reductions. The majority of emissions reductions are gained from building energy efficiency standards and renewable energy generation requirements. For example, Title 24 standards for new residential and nonresidential buildings require building shells and components be designed to conserve energy and water. Additional GHG reductions will be achieved by statewide initiatives to improve vehicle fuel efficiency and reduce the carbon intensity of transportation fuels.

4.5.2 Local Measures

Energy Efficiency and Renewable Energy

Residential and nonresidential buildings within the county consume over 350 gigawatt-hours of electricity and 18.5 million therms of natural gas annually. Resources used to generate electricity, as well as the direct combustion of natural gas in buildings, emitted more than 160,000 $MTCO_2e$ in 2012, making building energy use the second largest source of community emissions (about 35%). Increases in population and employment, along with rising temperatures and cooling demands, will increase building energy use and associated GHG emissions in the future. By 2020, building energy emissions are forecast to exceed 175,000 $MTCO_2e$ and represent over 36% of total community emissions.

The CAP Update 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 non-GHG pollutant emissions (such as carbon monoxide, nitrogen oxides, and particulate matter), improved home values, enhanced energy security, and job creation.

One strategy is focused on increasing the renewable portion of the County's energy mix. Energy-1, *Community Choice Aggregation*, represents Marin Clean Energy's growth and expansion to new County customers. As Marin Clean Energy obtains new customers for both its Light Green (50% renewable) and Deep Green (100% renewable) electricity options, building energy emissions in the county will decrease.

The building energy strategies 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,

Energy-2, *Energy Efficiency,* includes 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 Energy-3, *Solar Energy,* which promotes solar energy installations in both existing and new buildings. Public participation is essential to these incentive-based strategies.

In addition to voluntary and incentive-based approaches, the CAP Update includes strategies that establish new regulatory procedures for construction. For example, Energy-3, *Solar Power*, identifies solar installation requirements for a variety of land uses, including new single-family homes and commercial developments. The County will support project developers with implementation of this strategy by identifying grants and incentives and providing education and outreach.

Land Use, Transportation, and Off-Road Equipment

Vehicle trips made by residents and employees are expected to increase slightly 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 167,000 $MTCO_2e$ and represent about 34% of the 2020 BAU Community Forecast. Strategies to support alternative modes of transportation, improve transportation efficiency, and reduce VMT are therefore an essential part of the CAP Update. 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 Update includes three general strategies to reduce GHG emissions from on-road vehicles and off-road equipment (e.g., construction equipment).

The first strategy promotes reduced vehicle travel and improvements to the existing efficiency of the transportation network. Trans-1, *Land Use Design and VMT Reduction,* integrates a variety of actions such as promoting the longstanding Countywide Plan growth control strategy of focusing new development in the city center corridor; supporting regional carpool and vanpool programs; and implementing transportation demand management programs. This strategy directly targets land use patterns to allow appropriate densities and improve the diversity of new housing types. It will support shorter trips that can be accommodated by non-motorized and alternative transportation. Trans-1 will also reduce vehicle trips by encouraging ride-sharing and car-sharing programs along with employer-sponsored commuting programs.

In addition to supporting smart land use and trip reduction, alternative transportation, Trans-2, *Public Transportation,* promotes an integrated, multi-modal transportation network that will support alternative forms of transportation and help reduce VMT. Under this strategy, the County will work with transit providers to identify where increases in transit service could be beneficial, will reduce GHG emissions, and be cost-effective for transit providers.[10]

[10] Not all transit service expansions may result in net GHG reductions. For example, low ridership routes may provide non-vehicle populations with mobility options during off-peak hours, but may not result in net GHG reductions, whereas expansion of commute or other higher ridership routes can often result in net GHG reductions.

The final strategy, Trans-3, *Off-Road Equipment*, is intended to reduce GHG emissions generated by off-road equipment. This strategy proposes an incentive program for electric landscaping equipment.

Waste Reduction, Reuse, and Recycling

In 2012, County residents and businesses generated an estimated 180,000 tons of waste, 46,000 tons of which is landfilled, generating about 9,300 $MTCO_2e$ in 2012 (about 2% of the total 2012 Community Inventory). Marin County has a comprehensive waste collection system that currently includes many 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 75% of all waste generated to recycling centers and other end uses (Marin County Civil Grand Jury 2014).

The Marin Hazardous and Solid Waste JPA seeks to send zero tons of waste to landfills by the year 2025. This program is supported by the County's existing recycling programs, the food waste collection program, the construction and demolition (C&D) waste ordinance, the plastic bag ban, and the polystyrene ban. The County recognizes that residents and businesses will play a vital role in achieving the waste diversion goals. Accordingly, Waste-1, *Zero Waste by 2025,* outlines a number of local recycling and composting initiatives that the County will implement in conjunction with the Marin Hazardous and Solid Waste JPA. This strategy aims for an 83% target diversion rate by 2020 to support the 2025 zero waste goal. Increased outreach and education are important tools that the County will use to help encourage participation in recycling and diversion programs. The County will promote financing to support increased waste diversion, as well as provide food waste and other green waste receptacles at County facilities visited by the public.

Water Conservation and Wastewater Treatment

Water conveyance represents less than 1% of the County's 2012 Community Inventory. Although it is a relatively small component of the County's GHG portfolio, homes and businesses throughout the county consume a significant amount of water through indoor plumbing and outdoor irrigation. It is estimated that an average three-bedroom California home uses 174,000 gallons of water each year (ConSol 2010). Water resources are an important part of the Marin County community and economy—local surface and groundwater provide the majority of water to the county, which is supplied by several water agencies including the Marin Municipal Water District, North Marin Water District, and Stinson Beach County Water District. Given the potential for future reductions in water supplies as a result of climate change, Water Conservation and Wastewater Treatment is a critical strategy area for the CAP Update.

Wastewater treatment emissions represent about 1% of the County's 2012 Community Inventory. Wastewater treatment results in fugitive emissions of methane and nitrous oxide through the treatment process. Reducing potable water use will reduce the amount of wastewater generated by businesses and residents, which will reduce treatment-related GHG emissions.

The County has identified two strategies to enhance community water conservation and management. Water/Wastewater-1, *Water Conservation*, outlines strategies to reduce water consumption consistent with SB X7-7.[11] The strategy is supported by a number of *Marin Countywide Plan* policies, requires new development to achieve Tier 1 Voluntary CALGreen water efficiency

[11] 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.

standards, and encourages existing development to achieve the Tier 1 standards. This program may also incorporate free water audits in conjunction with the three local water providers. Water efficiency training, education, and outreach will also be provided. Water reductions achieved by Water/Wastewater-1 will not only help conserve water, but also contribute to building energy savings through reduced electricity and natural gas for hot water heating. Through Water/Wastewater-2, *Increase Pump Efficiency*, the County will work with water agencies to maximize water pump efficiency to achieve a 20% reduction in water pumping energy use by 2020.

The County has identified one strategy to reduce wastewater generation. Water conservation efforts can greatly decrease the need for wastewater treatment. Accordingly, Water/Wastewater-3, *Reduce Wastewater Generation,* endeavors to reduce residential and nonresidential wastewater generation by 10–15% by 2020. This would be supported by water conservation measures that seek to reduce indoor water use in buildings along with the County's Graywater Systems Ordinance. This program is also supported by a number of *Marin Countywide Plan* policies.

Agriculture

Agriculture is an important part of Marin County's economy, identity, and GHG emissions profile. Emissions from agriculture are a key part of the 2012 Community Inventory, representing 23% of GHG emissions in 2012—over 110,000 $MTCO_2e$. Emissions from agriculture are primarily from manure management and enteric fermentation of livestock, but also include fugitive emissions of nitrous oxide from fertilizer application.

The County has identified a number of strategies to address emissions from agriculture, but only one measure was quantified in the CAP Update. This strategy attempts to reduce direct emissions from livestock. Agriculture-1, *Methane Capture and Combustion at Dairies and Livestock Operations*, is a voluntary measure which encourages the installation of methane digesters to capture methane emissions from the decomposition of livestock manure. The methane could be used onsite as an alternative to natural gas in combustion, power production, or as a transportation fuel.[12]

In addition to Agriculture-1, the County has identified other actions to reduce emissions in this sector.

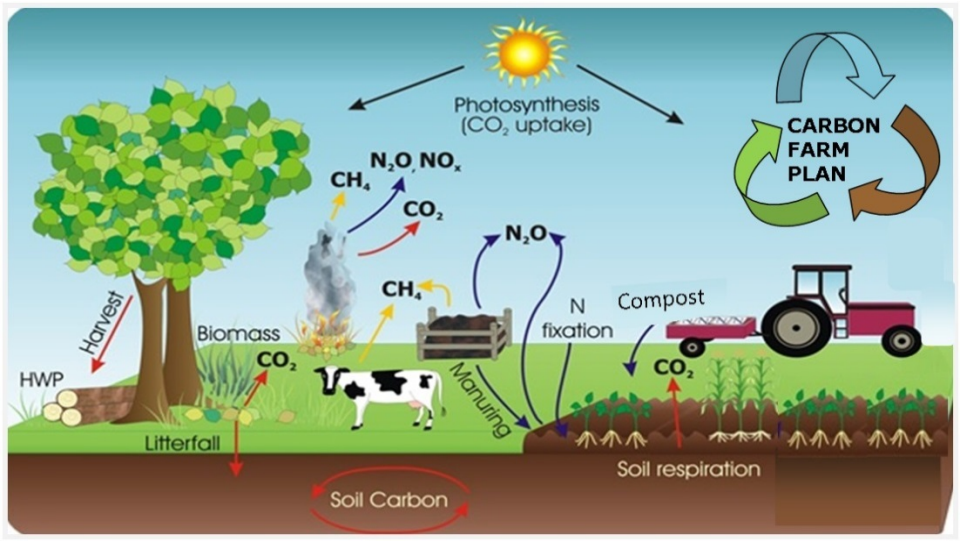
The Marin Carbon Project (MCP) is a consortium of the leading agricultural institutions and producers in Marin County, university researchers, county and federal agencies, and nonprofit organizations seeking to understand and demonstrate the potential of enhanced carbon sequestration in Marin's agricultural and rangelands soils (Marin Carbon Project 2013). MCP seeks to enhance carbon sequestration in rangeland, agricultural, and forest soils through applied research, demonstration and implementation. It will promote enhanced carbon sequestration in the county's agricultural and rangeland soils and facilitate development of a carbon market that supports soil carbon sequestration efforts on agricultural, forest, and range lands in Marin County and globally.

MCP involves the process of carbon farming, which includes agricultural practices that are known to improve the rate at which CO_2 is removed from the atmosphere and converted to plant material

[12] Individual project proponents could also sell GHG credits associated with these installations on the voluntary carbon market. GHG credits are used to offset GHG emissions due to other activities. Thus, even though there might be reductions in local emissions, there would be no net reduction in emissions globally. Thus, to the extent that project proponents sell GHG credits into carbon markets, this may not be taken as "credit" in reducing local GHG emissions.

and/or soil organic matter. Carbon farming works when carbon gains resulting from enhanced land management and/or conservation practices exceed carbon losses. MCP has launched a soil carbon program in the County, starting on three farms, and is securing the policy and economic supports necessary to support adoption of carbon-beneficial practices at scale in Marin County. The farms, Stemple Creek Ranch (700 acres), Straus Dairy (500 acres), and Corda Ranch (in the San Antonio Creek watershed), have already applied nearly 4,000 cubic yards of compost to their rangelands. The farms will continue to work with MCP and the local Natural Resources Conservation Service (NRCS) office to identify farm management practices to compliment compost application build soil carbon and soil health and improve productivity and forage. Each farm will develop a comprehensive carbon farm plan; these plans will include known climate-beneficial practices such as windbreaks, riparian and range management improvements, and grass, plant and tree establishment. Figure 4-3 illustrates the cycle of GHGs for carbon farming.

Figure 4-3. Carbon Farming



Source: Intergovernmental Panel on Climate Change via Marin Carbon Project, 2013.

Since MCP is exploring obtaining carbon credits related to the work being done by Marin farmers for potential sale in the California cap and trade or other carbon markets, this CAP does not include any specific reduction "credit" for MCP, as one cannot qualify as a valid offset credit if the reductions can be claimed under an existing reduction scheme. Thus, to avoid any double-counting of reductions and to avoid creating any impediment to MCP and local farmer's effort to potentially obtain economic incentives through sale of offset credits, the MCP reductions are not presumed in this CAP. That said, the County supports MCP as its efforts and the efforts of Marin farmers to find more sustainable ways of farming that can also help to address greenhouse gas emissions is consistent with County policies found in the Countywide Plan and other County directives.

The County also supports voluntary best management practices for agriculture. This may include adding compost from local community waste to the soil, using no-till and reduced-till practices, using organic fertilizers, reducing fossil fuel use in agricultural equipment, using cover crops on vineyards, using biochar in soils, planting hedgerows, and conserving or restoring natural vegetation. The County will also encourage the conversion of land grazed full-time to land with

grazing managed to maximize environmental benefits. This program is supported by a number of *Marin Countywide Plan* policies. These measures are detailed in Appendix C.

Greenhouse Gas Performance Standard for New Development

New development in the county has the potential to be an important contributor to the County's GHG emissions reductions efforts. Through ensuring quantification of GHG emissions associated with new projects and the development of reduction measures to reduce these emissions, the GHG Performance Standard for New Development would result in reductions of GHG emissions by 2020.

The County's Performance Standard for New Development (PS) would provide a streamlined and flexible program for new residential and nonresidential projects to reduce their emissions. The PS would include performance standards for new private developments as part of the discretionary approval process under CEQA. Under the PS, new projects would be required to quantify project-generated GHG emissions and adopt feasible reduction measures to reduce project emissions to 30% below BAU project emissions. The PS does not require that project applicants implement a predetermined set of measures. Rather, project applicants are encouraged to choose the most appropriate measures for achieving the percent reduction goal, while taking into consideration cost, environmental or economic benefits, schedule, and other project requirements.

Chapter 5
Municipal Greenhouse Gas Reduction Goals and Measures

Photo: Golden Gate Transit District

Chapter 5

Municipal Greenhouse Gas Reduction Goals and Measures

5.1 Introduction

The CAP Update includes a variety of strategies that will reduce emissions from municipal operations. Several of the CAP Update strategies build on existing County programs and actions, whereas others provide new opportunities to address climate change. Statewide sustainability effort will have a substantial impact on future GHG emissions. Local strategies adopted by the County will supplement these State programs and achieve additional GHG emissions reductions for municipal operations.

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

5.2 Marin County Greenhouse Gas Reduction Goals

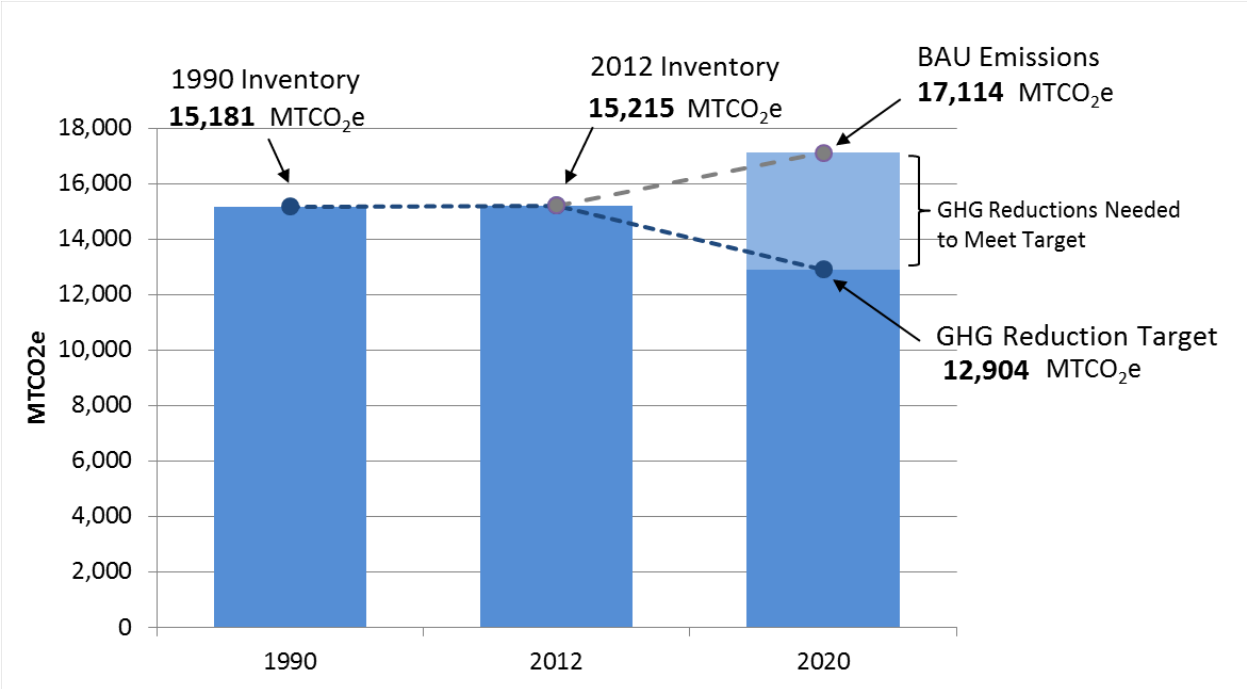
In the 2006 GHG Reduction Plan, the County adopted an emissions reduction target for municipal emissions of 15% below 1990 levels by 2020. From 1990 to 2012, municipal emissions have increased slightly (0.2% greater than 1990 levels). It should be noted that 1990 municipal emissions are not completely consistent with the 2012 emissions in terms of sectors, data, and methods. There were some significant data gaps in the 1990 municipal inventory which makes comparisons between years difficult (see section 3.2.3, *Previous Inventories*, for additional discussion). This CAP Update retains the current emissions target of 15% below 1990 levels by 2020. The 2020 Municipal Emissions Reduction Target reflects the County's continued commitment to implement achievable emissions reductions at the municipal level. The major obstacle to increasing the stringency of this target is that the target is based on the 1990 inventory, which had significant data gaps and technical issues as discussed above. If a more accurate and complete 1990 inventory of emissions was available, the County could potentially be on track to meet the current target and could consider a more aggressive target for the year 2020.

Meeting the target will depend on a combination of State and local policies. Achieving this goal would avoid the generation of approximately 4,200 $MTCO_2e$ and reduce 2020 Municipal GHG emissions to approximately 13,000 $MTCO_2e$. The strategies outlined in this chapter represent a combination of local and State initiatives that will collectively lower future municipal GHG emissions in the county consistent with the County's reduction target (see Figure 5-1).

The County's 2020 Municipal Emissions Reduction Target aligns with and exceeds 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 (2008), which is roughly equivalent to 1990 emission levels. Since the County's 2012 municipal emissions are already about equal to 1990 levels, and the County's 2020 Municipal Emissions Reduction Target is 15% below 1990 levels by 2020, the Municipal Emissions Reduction Target is more aggressive than the AB 32 scoping plan recommended target for local governments with this complementary reduction goal.

Figure 5-1. Marin County 2020 Municipal Emissions Reduction Goal



Municipal Emissions Reductions in Context

Implementation of the CAP Update would avoid the generation of more than 4,500 $MTCO_2e$ for the County government, which is equivalent to the following actions (U.S. Environmental Protection Agency 2014):

- Removing more than 1,000 passenger vehicles from the road each year;
- Reducing gasoline consumption by more than 500,000 gallons per year; and
- Providing renewable energy to power over 450 homes each year.

5.3 Climate Action Plan Framework

5.3.1 Reduction Measures

The CAP Update comprises a variety of State and local actions to reduce GHG emissions associated with municipal operations. As for community emissions, statewide efforts to reduce GHG emissions are an important part of the County's strategy to reduce municipal emissions. For example, the State's Pavley vehicle fleet regulations will improve the fuel efficiency of vehicles throughout the state, including those used by Marin County employees to commute to work and those vehicles

within the County's municipal vehicle fleet. Vehicle emissions will therefore be reduced much more than if Pavley had not been established. The CAP Update includes the local impact of four State actions to reduce GHG emissions, as discussed further in Section 5.5.1.

The County has identified eight local municipal actions to supplement the statewide initiatives. Although identified individually in the CAP Update, these actions will be implemented together as part of a comprehensive GHG emissions reduction program. Coordinating GHG reduction programs will streamline CAP implementation and potentially boost GHG reduction outcomes through synergies created among measures.

Together, the CAP Update actions will improve building energy efficiency and renewable energy production, increase alternative modes of transportation for municipal employees, reduce emissions from County-owned vehicles, and reduce water consumption and waste generation. The actions were selected following a comprehensive review of candidate strategies recommended by the California Attorney General, CAPCOA, existing CAPs throughout California, and the *Marin Countywide Plan*.

A number of the actions build on existing County programs, whereas others provide new opportunities to address climate change. Successful implementation of these actions will require commitment and dedication from the County and its various departments. As discussed in Chapter 6, *Greenhouse Gas Reduction Measure Implementation Program*, the County will adaptively manage the implementation of the CAP Update to maximize GHG reductions and operational efficiency for each action. Accordingly, the County may revise actions or add new actions to ensure that the County achieves its 2020 Municipal Emissions Reduction Target. If adopted and implemented prior to 2020, new federal programs that achieve local GHG reductions beyond State and local mandates may also be added to the County's CAP.

5.3.2 Emissions Reductions

Emissions reductions achieved in 2020 are estimated for a range of State and local strategies. Strategies that do not currently support a quantitative reduction analysis are provided as supporting measures that strengthen the quantified measures (see Appendix C). Although emissions reductions have not been quantified for these strategies, they are still a key part of the CAP Update 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 in the future. Please refer to Appendix C for additional information on emission reduction quantification methods.

5.3.3 Cost–Benefit Analysis

A cost–benefit analysis was not performed for municipal measures.

5.3.4 Co-Benefits

Municipal GHG reduction measures will result in environmental and community benefits that supplement the expected GHG emission reductions. As for the community measures, many of the municipal actions will reduce criteria air pollutants in the county, including ozone, carbon monoxide, and fine particulates, which will improve public health. The co-benefits for municipal measures are very similar to those for community measures, which include the conservation of

natural resources, reducing dependence on foreign oil supplies, reducing material consumption and the need for landfill space, and reducing the need for potable water resources.

The combined implementation of the CAP Update actions provides an opportunity to lower carbon emissions and achieve a diverse suite of community co-benefits. Table 5-2 provides additional information on the relevant co-benefits for each municipal CAP strategy area.

5.4 Meeting Marin County's Greenhouse Gas Reduction Goals

Combined, the State and local strategies included in the CAP Update are expected to reduce 2020 municipal GHG emissions by 4,676 $MTCO_2e$, which exceeds the 2020 Municipal Emissions Reduction Target by 466 $MTCO_2e$. This is equivalent to removing nearly 1,000 passenger vehicles from the road each year (U.S. Environmental Protection Agency 2014). As shown in Table 5-1, the majority (70%) of emissions reductions are achieved by State programs, such as the Pavley standards and RPS, which is typical of other CAPs throughout California. Local strategies implemented by the County 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 Update.

Table 5-1. Achieving Marin County's 2020 Municipal Greenhouse Gas Reduction Target—Sector View

Parameter	Emissions ($MTCO_2e$)
2020 BAU Community GHG Emissions Forecast	17,114
2020 Municipal Emissions Reduction Target (15% below 1990 levels)[a]	12,904
Total$_1$ Reductions Needed to Reach Target	***4,210***
2020 Emissions Reductions from State Strategies	3,245
2020 Emissions Reductions from Local Strategies	1,431
Building Energy	517
Streetlights and Traffic Signals	11
Vehicle Fleet	59
Employee Commute	781
Off-Road Vehicles and Equipment	3
Solid Waste Generation	34
Water Conveyance[b]	4
Wastewater Treatment	21
Stationary Sources	0
Refrigerants	0
Total$_2$ Emissions Reductions Achieved by the CAP Update	***4,676***
Emissions Reductions in Excess of Target (Total$_2$ minus Total$_1$)	466

Notes:
BAU = business as usual.
$MTCO_2e$ = metric tons of carbon dioxide equivalent.
[a] Total GHG emissions in 1990 were 15,181 $MTCO_2e$; a 15% reduction equals 12,904 $MTCO_2e$.
[b] Water conveyance measures result in water efficiency improvements to 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. As such, these reductions are included in the Energy Efficiency and Renewable Energy strategy area. The 4 $MTCO_2e$ of reductions listed for this sector represent reduced energy use for pumping and treatment of water only.

Table 5-2 summarizes the municipal CAP Update strategies, including their estimated GHG reduction in 2020. Many of the local strategies are also cost effective, particularly those that target energy efficiency and renewable energy (see Appendix C for details). 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 5-2. Summary of 2020 GHG Emissions Reductions by Municipal Measure ($MTCO_2e$)

State Strategy		2020 GHG Reduction	% Total of Reductions	Co-Benefits[a]
State-1. Renewables Portfolio Standard		403	9%	
State-2. Pavley and Low Carbon Fuel Standard		2,653	57%	
State-3. Advanced Clean Cars		161	3%	
State-4. Assembly Bill 32 Vehicle Efficiency Measures		29	0.6%	
Strategy Area	**Local Strategy**	**2020 GHG Reduction**	**% Total of Reductions**	
ENERGY EFFICIENCY AND RENEWABLE ENERGY	Energy-1. Energy Efficiency	341	7%	
	Energy-2. Solar Power	111	2%	
VEHICLE FLEET AND EMPLOYEE COMMUTE	Trans-1. New Vehicles	62	1%	
	Trans-2. Alternative Transportation	1	0.02%	
	Trans-3. Trip Reduction	781	17%	
WASTE REDUCTION, REUSE, AND RECYCLING	Waste-1. Increase Recycling at County Facilities	34	0.7%	
WATER CONSERVATION AND WASTEWATER TREATMENT	Water-1. Water Conservation	101	2%	
	Water-2. Recycled Water	0.04	0.0%	

Notes:
See Figure 4-2 for the key to the co-benefits symbols.

5.5 Measures to Reduce GHG Emissions

5.5.1 State Programs

Just like for community emissions, programs and initiatives undertaken by the State will contribute to local municipal emissions reductions. For example, the State's Pavley vehicle standards will

increase the fuel efficiency of the cars that County employees drive to work in the future. More fuel-efficient vehicles use less fuel and produce fewer GHG emissions, so emissions from employee commutes will decrease as a result of the Pavley regulations.

The County quantified four statewide initiatives that will contribute to municipal emissions reductions. The majority of emissions reductions are gained from mandates for renewable energy generation and vehicle standards. Specifically, the State's RPS will increase the amount of electricity generated by renewable resources, reducing GHG emissions from electricity consumption. GHG reductions will also be achieved by statewide initiatives to improve vehicle engine efficiency and reduce the carbon intensity of transportation fuels.

5.5.2 Local Measures

Energy Efficiency and Renewable Energy

County-owned buildings along with streetlights and traffic signals consumed enough electricity and natural gas in 2012 to emit nearly 5,600 $MTCO_2e$, representing 37% of total municipal emissions in 2012. These emissions are anticipated to grow by 22% to over 6,700 $MTCO_2e$ in 2020, due to the construction of the new emergency operations facility. The CAP Update includes two major strategies to reduce emissions in the building energy sector, including energy conservation and solar power.

The first strategy, Energy-1, *Energy Efficiency*, includes wide variety of actions that the County will implement to reduce energy consumption in County facilities. This strategy includes energy efficiency measures at the new emergency operations facility that will reduce electricity use by 1.17 million kilowatt-hours and natural gas use by more than 800 therms. Under Energy-1, the County will conduct energy efficiency retrofits of some existing County buildings to improve building-wide energy efficiency by at least 20%. By 2020, the County plans to replace traditional desktops and laptops with tablet computers, which use significantly less energy. The County plans to use software to manage computer energy use and to require employees to turn off computers before they go home. Shade trees will also be planted to reduce the heating and cooling load of buildings. To reduce energy use from streetlights and traffic signals, the County will ensure that all streetlights use LED bulbs.

The second strategy, Energy-2, *Solar Power*, aims to replace utility-supplied electricity with energy generated by solar photovoltaic panels on County roofs. The County will require, where feasible, new or major rehabilitation of County-owned buildings are constructed to allow for easy, cost-effective installation of solar energy systems in the future. The County also plans to install solar panels on unused over carports and parking areas.

Vehicle Fleet and Employee Commute

The County operates a vehicle fleet including gasoline and diesel cars, trucks, vans, and buses. In 2012 these vehicles consumed nearly 300,000 gallons of gasoline and diesel fuels, contributing nearly 3,000 $MTCO_2e$ to the 2012 Municipal Inventory (17%). On-road vehicle emissions from employee commutes also contribute to municipal emissions. In 2012, County employees traveled over 17 million miles, emitting almost 7,000 $MTCO_2e$. This represents over 40% of the 2012 Municipal Inventory, and is the largest sector of the inventory in terms of emissions. Together, vehicle fleet and employee commute emissions compose 58% of total municipal emissions in 2012.

Consequently, there is a major opportunity to reduce municipal GHG emissions by implementing programs that target the fuel efficiency of County-owned vehicles and the commuting habits of employees.

Trans-1, *New Vehicles*, attempts to reduce emissions through vehicle technology. While certain vehicles used in County services such as emergency vehicles or heavy duty equipment are not suited for replacement, many County vehicles can be replaced with hybrid vehicles or electric vehicles, both of which produce fewer GHGs than traditional vehicles (i.e., vehicles fueled with gasoline or diesel). Through Trans-1, the County plans to expand on the fuel-efficient fleet vehicles program by purchasing at least 25 new hybrid vehicles and 20 new electric vehicles by 2020 to replace conventional gasoline and diesel vehicles.

In addition to vehicle technology, the CAP Update will reduce GHG emissions through the use of alternative transportation by employees. Trans-2, *Alternative Transportation*, will institute a Guaranteed Ride Home program, which would provide a free shuttle or taxi ride home to employees in case of an emergency (illness, family crisis, unscheduled overtime). This program would be offered to any employee who uses any alternative to driving alone to work (public transit, carpooling, vanpooling, biking, or walking) on the day of the emergency, further encouraging alternative modes of transportation. Trans-2 would also reestablish the Green Commute Program, which could include allowing County employees to purchase public transit fares with pre-tax dollars up to IRS limits, providing employees with low-cost monthly transit passes and/or providing direct incentives to employees that take commute alternatives.

Finally, the County plans to reduce employee commute emissions by encouraging trip reduction. Trans-3, *Trip Reduction*, encourages employees to telecommute and implements a Municipal Parking Management Program to discourage private vehicle use. These programs will reduce the number of trips that employees take to commute to work.

Waste Reduction, Reuse, and Recycling

County employees generate waste through their daily activities and facility operations. Some portion of this waste ultimately is placed in a landfill where it decays and releases methane. In 2012, GHG emissions related to municipal waste generation were estimated at 50 $MTCO_2e$, a small part of the County's municipal emissions (less than 1%). Although the total GHG savings potential in this sector is small, there are ample opportunities to reduce these emissions because the waste diversion rate at many County facilities is less than the community diversion rate for the County as a whole.

Waste-1, *Increase Recycling at County Facilities*, will expand County recycling efforts and include the addition of food scrap recycling where feasible. This strategy aims to increase the diversion rate at many County facilities, including Civic Center, the County Jail, 120 North Redwood, and the Kerner Campus to over 80%. It also sets a target diversion rate of 95% for the Marin County Fair and the Marin Home Show. These actions will reduce the amount of waste going to landfill, along with the GHG emissions associated with this landfilled waste.

Water Conservation and Wastewater Treatment

The County serves as a consumer of water, just like the many residents and businesses in the county. In 2012, the County consumed more than 78 million gallons of water. In 2012, emissions associated with providing water for municipal uses resulted in 32 $MTCO_2e$ (less than 1% of total emissions). The County will already be working with the water agencies to maintain the pumps for maximum

efficiency and to upgrade equipment as needed for maximum energy efficiency (see Section 4.5.2 above).

Emissions are generated when wastewater produced by municipal operations is treated at wastewater treatment plants; these emissions account for 1% of the 2012 Municipal Inventory. The most direct way to reduce these emissions is to reduce wastewater generation, which is primarily accomplished through water conservation efforts aimed at reducing potable water use. If less potable water is used in kitchens and bathrooms, then less wastewater is generated and less wastewater needs to be treated.

As a water consumer, the County can save energy and avoid future GHG emissions by reducing its overall water consumption. Although the total GHG savings potential in this sector is small, the County is committed to a regionally sustainable water supply and can serve as a leader to other jurisdictions and its citizens in this regard.

The CAP Update has one strategy to reduce water use and associated GHG emissions. Water-1, *Water Conservation*, aims to reduce water use through a number of actions. The County will promote site appropriate, low-water use, and drought tolerant native plants in public facilities. Water-1 also involves water conservation for both existing and new buildings by reducing water use by 30–40%, consistent with CALGREEN Tier 1 Voluntary standards for non-residential development. The County will consider installing and or using a water monitoring and management system for all of the County's irrigation needs. This could be accomplished by participation in the California Irrigation Management Information System (CIMIS), such as by installation of a climate station in the county or by using CIMIS irrigation scheduling tools. The County also plans to develop a master plan of County facilities to address water efficient landscape, irrigation and maintenance practices.

The County is also using as much recycled water as the water districts can supply for landscaping water use and other non-potable water uses. While not quantified in the CAP update, the County's current use of recycled water contributes to energy and emission reductions in the water and wastewater sector by offsetting more energy intensive sources of potable water.

Water-1 will also reduce emissions in the wastewater sector, because using less water also means generating less wastewater.

Chapter 6
Greenhouse Gas Reduction Measure Implementation Program

Photo: Marin Community Development Agency

Chapter 6

Greenhouse Gas Reduction Measure Implementation Program

6.1 Introduction

This chapter describes the objectives, milestones, timeline, and processes for implementation of the GHG emissions reduction strategies (please refer to Chapter 7*, Climate Change Adaptation*, for implementation details related to climate change adaptation). Establishing a robust management program is necessary to ensure the CAP Update 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.

6.2 Marin County Sustainability Team

The Marin County Sustainability Team, a division of the Community Development Agency, will be responsible for leading and coordinating the County's efforts on implementation, monitoring, and management of the emissions reduction strategies. The Sustainability Team will coordinate with and provide support to representatives from several County departments as they implement the measures of the Plan.

The Sustainability Team's main objective will be to maintain the strategy implementation schedules and ensure emissions reductions are achieved in a cost-effective manner. Sustainability Team representatives will provide guidance and support to County staff on financial, programmatic, and technical matters. The Sustainability Team will develop and manage protocols for monitoring, verifying, and reporting emissions reductions. The 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 Sustainability Team will serve as the external communication hub to climate change organizations and members of the community.

The Sustainability Team will coordinate with applicable department representatives to undertake the following general implementation steps to 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 Appendix C, *Reduction Measure Methods*. 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**. The Sustainability Team will support efforts by specific County departments to prepare amendments to the Marin County Code that implement some emissions reduction strategies.
- **Establish Partnerships**. Some of the emissions reduction strategies will require new program partnerships, both internal to the County 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 County will pursue these and other emerging funding sources as a part of implementation efforts. The County 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 County will identify monitoring and tracking procedures.
- **Engage the Community and Stakeholders**. The County will engage and educate the public and stakeholder groups in the implementation of each emissions reduction strategy. The County 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.

6.3 Implementation Actions

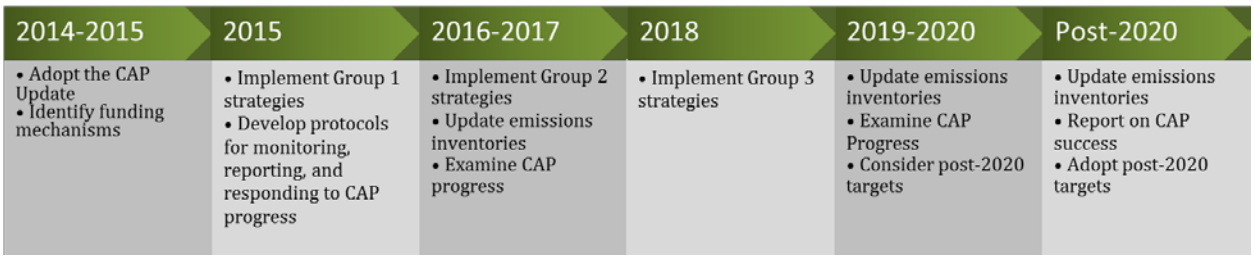
Successful implementation of the emissions reduction strategies requires the identification of key action items, known obstacles, and resources. While comprehensive implementation plans for each strategy will be developed over time, primary actions that the County will undertake to achieve the strategy objectives can be identified now. These actions are related to the general implementation steps listed above but are specific to individual strategies. Appendix C provides a list of these primary actions, and summarizes 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.

6.4 Implementation Schedule

Swift implementation of the emissions reduction strategies will occur following adoption of the CAP Update to ensure the County's community and municipal targets are achieved by 2020. The Sustainability Team 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 6-1, with strategy implementation occurring in phases: Group 1 strategies are those that need to be developed early in order to achieve reduction targets by 2020 and/or that require long lead times; Group 2 strategies are those that don't need to be online immediately but need time to

develop in order to meet 2020 reduction targets; Group 3 strategies are those that only need to be online by 2020 and which can be started later in the decade. Beginning in 2015, strategies will begin to be implemented, and strategy prioritization will be based on several factors including cost effectiveness, emissions reduction efficacy, and general benefits to the community as well as timing necessary to support meeting the 2020 target. The three groups are meant to organize implementation based on the prioritization for each GHG reduction measure.

Figure 6-1. Implementation Timeline for the Greenhouse Gas Reduction Measures



Implementation of the individual emissions reduction strategies will be led by the specific County divisions shown in Table 6-1 (community) and 6-2 (municipal), with support from the Sustainability Team. Private and other regional entities (e.g., Marin Transit) may be responsible for implementing specific projects under each strategy. The entity responsible for the primary implementation of each strategy is also shown in Tables 6-1 and 6-2. The County 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 Community and Municipal Emissions Reduction Targets?
- **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 6-1. Implementation Timeline for the Community GHG Reduction Measures

	Strategy	Implementation Group	Responsible Entity
 ENERGY EFFICIENCY AND RENEWABLE ENERGY	Energy-1. Community Choice Aggregation	Group 1 (2015)	MCE
	Energy-2. Energy Efficiency	Group 1 (2015)	CDA, MCE
	Energy-3. Solar Energy	Group 1 (2015)	CDA, MCE
	Energy-4. Additional Renewable Energy	Group 2 (2017)	CDA, MCE
 LAND USE AND TRANSPORTATION	Trans-1. Land Use Design and VMT Reduction	Group 1 (2015)	CDA, TAM
	Trans-2. Public Transportation	Group 2 (2017)	TAM
	Trans-3. Off-Road Equipment	Group 3 (2018)	CDA
 WASTE REDUCTION, REUSE, AND RECYCLING	Waste-1. Zero Waste by 2025	Group 1 (2015)	DPW
 WATER CONSERVATION AND WASTEWATER TREATMENT	Water/Wastewater-1. Water Conservation	Group 2 (2017)	CDA
	Water/Wastewater-2. Increase Pump Efficiency	Group 3 (2018)	CDA, MCE
	Wastewater/Wastewater-3. Reduce Wastewater Generation	Group 2 (2017)	CDA
 AGRICULTURE	Agriculture-1. Methane Capture and Combustion at Dairies and Livestock Operations	Group 2 (2017)	Agriculture, CDA, MCE
 GHG PERFORMANCE STANDARD	PS-1. GHG Performance Standard for New Development (PS)	Group 1 (2015)	CDA

MCE = Marin Clean Energy; CDA = Community Development Agency; TAM = Transportation Authority of Marin; DPW = Department of Public Works

Table 6-2. Implementation Timeline for the Municipal GHG Reduction Measures

	Strategy	Implementation Group	Responsible Entity
ENERGY EFFICIENCY AND RENEWABLE ENERGY	Energy-1. Energy Efficiency	Group 1 (2015)	DPW, CDA, IST, Parks
	Energy-2. Solar Power	Group 1 (2015)	CAO, DPW, CDA
LAND USE AND TRANSPORTATION	Trans-1. New Vehicles	Group 1 (2016)	DPW, Parks
	Trans-2. Alternative Transportation	Group 2 (2017)	DPW, DOF
	Trans-3. Trip Reduction	Group 1 (2016)	DPW, CAO, Board of Supervisors
WASTE REDUCTION, REUSE, AND RECYCLING	Waste-1. Increase Recycling at County Facilities	Group 1 (2016)	DPW, Cultural Services, Sheriff, H&HS
WATER CONSERVATION	Water-1. Water Conservation	Group 2 (2017)	DPW, Parks

IST = Information Services and Technology; CAO = County Administrator's Office; DPW = Department of Public Works; DOF = Department of Finance; H&HS = Health & Human Services

6.5 Funding Strategies

The County, 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 County 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.

6.5.1 County and CAP-Level Financing

Implementation of the CAP Update will require considerable investment from multiple entities. The following overall financing approach will help ensure the emissions reduction strategies are funded

and implemented efficiently and quickly. The County will develop a comprehensive funding program, including facility and capital improvement plans, over time.

- Pursue funding for strategies concurrently, whenever possible, to use funds most efficiently. Please refer to Appendix D for information on potential funding options that the County 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.

6.5.2 Community and Project-Level Financing

Implementation of the emissions reduction strategies will result in costs and saving for residents, businesses, and other members of the community (please refer to Appendix C). Since many of the strategies in the CAP Update 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. In other words, the entity making the upfront investment is not always the entity that experiences the reduction in utility bills or other savings. For example, developers may invest in energy efficiency measures during construction, but the homeowners will experience the reduction in utility bills. As another example, the water agencies may invest in water-conservation actions and education programs, but County residents will experience the reduction in water bills.

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 6-3 provides an overview of potential funding sources for each of the five actions. Please refer to Appendix D for additional information on specific funding and financing options available to the community.

Table 6-3. Overview of Potential Community Funding Sources by Strategy Area

Strategy Area	Potential Community Funding Sources
Energy Efficiency and Renewable Energy	• Utility rebates (e.g., PG&E, MCE, California Solar Initiative) • Federal tax credits for energy efficiency • Energy efficient mortgages and PACE • Power purchase agreements • Private equity funding
Land Use, Transportation, and Off-Road Equipment	• Federal and State transportation funds • State alternative transportation assistance • BAAQMD programs (i.e., Carl Moyer Program, Lawn Mower Exchange)
Waste Reduction, Reuse, and Recycling	• Private funds
Water Conservation and Wastewater Treatment	• Water service provider rebates
Land Conservation	• Federal or State grants, private funds

PACE = property assessed clean energy.

The private sector incentives and rebates identified in Appendix C can significantly improve the economics of individual projects. For example, incremental upfront costs for a new residential home to install rooftop solar under Energy-3, *Solar Energy*, are estimated to be around $20,000 (for a 4kW solar system installed through direct purchase, not through a power purchase agreement). Assuming eligibility requirements are met and incentives are available at the time of application, residents (or developers) could recoup around 30% of that upfront cost through the federal investment tax credit (ITC).

6.6 Outreach and Education

Community involvement is essential to successful implementation of the emissions reduction strategies, especially considering that many strategies depend on voluntary commitment, creativity, and participation. The County will collaborate with local businesses, community groups, residents, developers, and property owners to establish partnerships and encourage active involvement in the CAP Update. Periodic meetings will be held to provide information and inform the community on progress towards attaining the 2020 Community and Municipal Emissions Reduction Targets. These meetings will provide an opportunity for collaboration and a mechanism for the County 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.

6.7 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 County to make informed decisions on future priorities, funding, and scheduling. Moreover, monitoring provides concrete data to document the County'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 6-1, the County will update the Community and Municipal Inventories for comparison to the 2012 inventories and the 2020 Community and Municipal Emissions Reduction Targets. 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 and municipal emissions. The updated inventories will be submitted to the Board of Supervisors 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 County will 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 Sustainability Team will coordinate with internal County departments, PG&E, Marin Clean Energy, and other stakeholders to obtain and consolidate

information into a repository that can be used to evaluate the effectiveness of individual reduction measures. The Sustainability Team 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 County to adjust the local emissions reduction strategies, if needed, to ensure the 2020 Community and Municipal Emissions Reduction Targets are achieved.

Progress achieved by the State and local emissions reduction strategies will be reported to the Board of Supervisors. Where program tracking, inventory updates, or other information indicates that the emissions reduction strategies are not as effective as originally anticipated, the County will adaptively manage the CAP Update. At a minimum, the County 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.

6.8 Regional Collaboration

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

- **Bay Area Air Quality Management District (BAAQMD).** BAAQMD is the local agency responsible for developing and implementing air quality plans. BAAQMD also sponsors various air quality programs that may support implementation of several energy efficiency, transportation, and renewable energy strategies.
- **PG&E and Marin Clean Energy (MCE).** PG&E and MCE offer numerous incentives and rebate programs to encourage energy efficiency. Resources offered by PG&E and MCE may reduce program implementation and administration costs. MCE is a Community Choice Aggregation program which partners with PG&E to deliver additional renewable electricity to County homes and businesses. There may also be opportunities for cooperation on community-scale alternative energy installations (e.g., solar).
- **MTC, Golden Gate Transit, Marin Transit, and Sonoma-Marin Area Rail Transit (SMART).** To fully implement the local transportation strategies, collaboration with regional transportation agencies is necessary. It is essential that the County, MTC, Golden Gate Transit, Marin Transit, and SMART 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.
- **Marin Cities and Towns and Marin Climate and Energy Partnership (MCEP).** Cooperation with Marin County cities could help maximize efficiencies in implementing emissions reduction strategies. Staff from all cities, the County, water districts and MCE currently meet monthly and collaborate via MCEP. The County will continue coordinate with staff from these agencies to promote regional collaboration.
- **Domestic Water Providers**. The County is served by three domestic water providers—the Marin Municipal Water District, the North Marin Water District, and the Stinson Beach County Water District. The County 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.

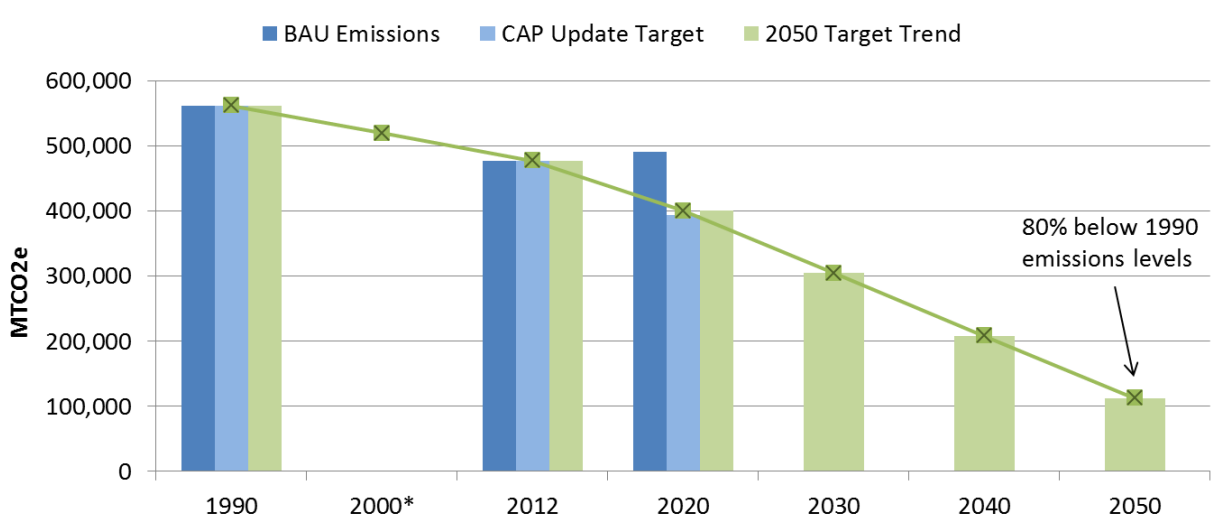
- **Wastewater Treatment Service Providers**. The County is served by eight wastewater treatment providers—Central Marin Sanitation Agency, Oceana Marin Sewer Service, Tomales Village Community Services District, Novato Sanitary District, Las Gallinas Valley Sanitary District, Sausalito-Marin City Sanitary District, Bolinas Sewage Services, and the Sewerage Agency of Southern Marin. The County is served by eight wastewater collection agencies as listed above. These agencies handle wastewater treatment and disposal in Marin County. Coordination among all agencies will be necessary to support implementation of community strategy Water/Wastewater-3 and municipal strategy Water-1.
- **Marin Hazardous and Solid Waste Joint Powers Authority.** The County contracts all solid waste collection and recycling services with the Marin Hazardous and Solid Waste JPA. The County will work with the collection agency to promote waste reduction, recycling, and composting, consistent with Waste-1. The County and the Marin Hazardous and Solid Waste JPA may also be able to share facilities, programs, and incentives to help ensure the 83% waste diversion goal is achieved by 2020, and the zero waste goal is achieved by 2025.

6.9 Beyond 2020

The emissions reduction strategies presented in the CAP Update were developed to reduce community emissions by 30% below 1990 levels by 2020. This goal is consistent with (and exceeds) 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 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.

In order to reach 80% below 1990 emissions levels by the year 2050, the County would need to reduce community emissions to 112,370 $MTCO_2e$, as illustrated in Figure 6-2. Based on population forecasts from ABAG, this is equivalent to 1.4 $MTCO_2e$ per capita or 1.1 $MTCO_2e$ per service population (population + employment). Current emissions in 2012 are 7.1 $MTCO_2e$ per capita and 5.7 $MTCO_2e$ per service population. This demonstrates the scale of the challenge to get to 2050 recommended levels. Because the County has adopted an aggressive target of 30% below 1990 levels by 2020, the County is currently on the right track to meet the 2050 target, and is ahead of the AB 32 goal for 2020 (1990 levels). The County's target is equivalent to 5.7 $MTCO_2e$ per capita or 4.5 $MTCO_2e$ per service population.

Figure 6-2. Achieving the 2050 Emissions Target of 80% below 1990 Levels



** The GHG inventory for the year 2000 is not comparable to the 1990, 2012 inventories and 2020 forecast (the sectors, methods and data sources differ), so emissions for 2000 were not displayed on the chart. The year 2000 is included on the axis in order to show a consistent timescale of 10-year segments.*

The AB 32 Scoping Plan Update recommends a minimum 40% reduction in community emissions from 1990 levels by 2030 and a minimum 60% reduction from 1990 levels by 2040 in order to avoid 450 parts per million of CO_2e.[14] The goal specified in this CAP Update for community emissions, 30% reduction from 1990 levels by 2020, puts the County on track to meet ARB's recommended target for 2030 and 2040.

As the year 2020 approaches, the County will need to develop reduction targets for years beyond 2020 to continue the commitment of reducing GHG emissions and providing a more sustainable future for Marin residents, businesses, and organizations. County staff will propose a 2030 target for both community and municipal operations for Board of Supervisor adoption sometime after 2020. The proposal will include an assessment of the potential impact on the community and of meeting this target (e.g., monetary costs; co-benefits), as well as on the County's internal resources. The strategies included in this CAP Update will help to put the County on a path to achieve more substantial reductions in the years after 2020. The County will also likely rely on further state and federal action to achieve post-2020 targets.

[14] According to the IPCC, "an increase in the global average temperature of 2°C (3.6°F) above pre-industrial levels, which is only 1.1°C (2.0°F) above present levels, poses severe risks to natural systems and human health and well-being." In order to avoid temperatures above those levels, we need to stabilize atmospheric GHG concentrations at 450 parts per million (California Air Resources Board 2014).

Chapter 7
Climate Change Adaptation

Photo: John Klingel

Chapter 7
Climate Change Adaptation

7.1 Introduction

Climate change planning can be divided into two distinct categories—mitigation and adaptation. *Mitigation* refers to minimizing the onset of climate change, primarily through adopting GHG reduction strategies. However, even with the adoption of aggressive mitigation actions, climate change cannot be completely avoided. *Adaptation* refers to reducing the impact of these unavoidable climate change effects.

Although Marin currently enjoys a relatively mild climate, climate change may exacerbate existing climate-related hazards in the county (such as increased incidence of flooding) or introduce new challenges (such as erosion or coastal flooding due to sea level rise). These climate change effects could have wide-ranging impacts across the county's various economic sectors. It is important that Marin County considers potential climate change vulnerabilities as it moves forward with other planning activities.

Marin County is a leader in climate change adaptation and has already taken great strides to begin to prepare the County for increased resilience to the likely impacts of climate change. A number of studies have been completed that evaluate various potential climate change impacts on Marin County, and some stakeholders are beginning to consider strategies for preparing for climate change. Although more work remains to be done, these efforts provide a strong foundation for making Marin County more resilient to climate change.

This section includes a discussion of the observed and anticipated effects of climate change in the county; a discussion of existing efforts and suggestions for how those efforts can be replicated in other sectors or expanded, and what additional efforts are needed; and a review of the sectors where potential impacts warrant an extensive vulnerability assessment to fully understand how specific assets are vulnerable and could benefit from adaptation actions. It provides the County with a summary of what is known about the anticipated future local climate, an overview of what is being done to address the impacts, and suggestions about next steps.

7.2 How the Climate May be Changing in Marin County

7.2.1 Observed and Projected Changes in Temperature, Precipitation, and Sea Level Rise

Current research efforts have shown that Marin County and the North Bay region have already experienced some changes in climate, including increases in temperature and precipitation. For example, minimum temperatures increased by 1.7°F between 1911 and 2000, while average maximum temperatures have increased only 1.0°F over the same period (United States Geologic

Survey 2011). Meanwhile, annual precipitation has also increased, with a 12% more rapid increase for the latter half of the century (Micheli, et al. 2012).[15]

Projections indicate that temperatures will continue to increase, and that the region will likely experience a shift to drier summers and wetter winters characterized by heavier rain events, and there could be a rise in local sea levels, as shown in Table 7-1. However, the North Bay region is situated in a transition zone between Washington and Oregon—where projections indicate a shift towards wetter and warmer conditions—and Southern California and Baja Mexico—where projections indicate a shift towards drier and warmer conditions. This geographic complexity increases the uncertainty regarding exactly how the county's climate may change in the future, particularly regarding precipitation projections, which are more sensitive to model assumptions than temperature projections. Precipitation projections for the region vary from decreases in precipitation to as much as a 15% shift towards a wetter climate (North Bay Climate Adaptation Initiative 2013a; Micheli, et al. 2012). Table 7-1 presents a summary of the projected shifts in ambient temperatures, changes in precipitation, and sea level rise for the North Bay, which includes Marin, Sonoma, and Napa Counties.

Table 7-1. Projected Climate Changes in the North Bay (including Marin County)

Climate Hazard	Projected Changes
Ambient Temperatures	• Average **maximum** temperatures are projected to increase between 2°F and 7°F by the end of the century (North Bay Climate Adaptation Initiative 2013a). • If current trends continue, the increase in **minimum** temperatures could exceed the increase in maximum temperatures.
Changes in Precipitation	• Precipitation projections vary between General Circulation Models (GCMs) and indicate that 21st-century precipitation projections indicate a 2–15% **increase** over the 20th-century average (Micheli et al. 2012). • Under some scenarios there could be a **decrease** in precipitation over the same period (North Bay Climate Adaptation Initiative 2013a). • Regardless of an overall increase or decrease, all scenarios project an increase in weather variability with a higher likelihood of an increase in frequency and intensity of extreme events, such as floods and droughts (Flint et. al. 2012; North Bay Climate Adaptation Initiative 2013a) • Watershed models project **shorter wet winters** and **longer, drier summers** (North Bay Climate Adaptation Initiative 2013a)**.** • Expect heavier rain events (North Bay Climate Adaptation Initiative 2013a).
Sea Level Rise	• Potential for a range of 1.4 to 5.5 foot increase by the end of the century (Cayan et al. 2008; Knowles 2010, State of California Ocean Protection Council 2013). • More frequent flood inundation of low-lying areas of the North San Francisco Bay Estuary (San Pablo Bay) shoreline and coastal regions (Cayan et al. 2008; Knowles 2010).

[15] It should be noted that coastal marine influences and topographic variation result in high spatial variability within these shifts. Throughout the County, microclimates may experience different shifts, which should be considered during further studies that investigate the specific vulnerabilities of sector assets.

7.2.2 Potential Effects of Projected Climate Change on Marin County

Increases in temperature, changes in precipitation, and sea level rise could result in the increased frequency or intensity of certain climate hazards, including shifts in the water supply and demand, wildfires, extreme heat, and inland flooding. These changes have been highlighted in various efforts that are underway or recently completed as discussed below in Section 7.3. Shifts in the energy supply and demand and changes in the agricultural growing season present additional potential impacts in the county. Based on the geographic location and projected changes listed in Table 7-1, Marin County may be exposed to the following potential impacts from climate change.

Extreme Heat

Although Marin County has a mild Mediterranean climate, increases in the average maximum temperature may be coupled with increases in extreme heat. Efforts to project changes in temperature, such as the data shown in Cal-Adapt, indicate that the number of "extreme heat" days in Marin could increase more than ten-fold by the end of the century (Cal-Adapt 2014a)[16]. Extreme heat in this historically temperate climate may threaten human health, cause heat stress in animals, and shorten the expected lifespan or increase the need for repairs in the built environment.

Inland Flooding

Increased intensity of winter storm events combined with sea-level rise is likely to cause more frequent flooding, especially in low-lying areas. An increase in the variability of rainfall could contribute to an increase in the likelihood of the frequency and intensity of extreme events such as floods in the North Bay (Flint et. al. 2012).

Sea Level Rise

Increased sea levels and elevation of storm surge could cause more area within the county to be temporarily or permanently inundated by salt and brackish waters. Land and structures in low-lying coastal areas may need to be reassessed to accommodate changes in the shoreline. Figure 7-1 shows areas in the county that may be in threat of inundation during a 100-year flood. Dark blue areas show the current potential threat; lighter areas show areas that could be at risk under 55 inches of sea level rise (Cal-Adapt. 2014b)[17].

[16] Data displayed in the Cal-Adapt Extreme Heat Tool have been provided by Scripps Institution of Oceanography.

[17] The map in Figure 7-1 does not account protective structures, such as levees.

Figure 7-1. Marin County Potential Inundation Risk to Extreme Flooding with Sea Level Rise Scenarios

Shift in Water Demand and Supply

A shift in precipitation patterns and extended periods of drought would limit the available supply of water. By the end of the 21st century, under either high- or low-rainfall scenarios, warming is projected to amplify late-season climatic water deficit by 8–21% (Micheli et al. 2012)[18]. To compound the impact, increased temperatures and low soil moisture increase the demand for water as people require more water for their gardens, agriculture, and other uses. Simultaneously, an increase in heavy rainfall events may elevate turbidity resulting in freshwater resources that require additional processing for residential and industrial uses.

Wildfires

Increased temperatures and shifts in precipitation patterns, which may include extended dry spells, could create conditions that may increase the risk of wildfire danger in Marin County. As wildfire risk is projected to increase moderately in Marin County by the end of the century, wild-urban interface fires can cause major damage to the build environment and natural heritage, as seen in the 1991 Oakland Hills fire and the 2008 Santa Rosa fire (Cal-Adapt. 2014c).

Change in Growing Season

Changes in habitats and ecosystems could result from changes in temperatures, precipitation, and the potential competition from colonizing species. The natural heritage and parks in the county may change. Projections suggest that future conditions may be more similar to the current conditions in Santa Barbara County, which could result in a significant transition in the local forests (North Bay Climate Adaptation Initiative 2013b).

Shift in Energy Demand and Supply

Increased temperatures and a decreased (or inconsistent) water supply could have a negative impact on the availability of energy. Some power plants require large amounts of water for cooling and higher temperatures could result in demand spikes that exceed production or available supply. Low-lying generation facilities and distribution equipment could be inundated with storm surges and sea level rise. Although there are no electric generation facilities in Marin County, changes in energy supply and demand could lead to higher energy prices, brownouts, or other impacts that affect Marin.

7.3 Status of Adaptation Efforts in Marin County

7.3.1 Efforts Underway

There are many adaptation efforts already underway in Marin County. The County has proven to be a leader in thinking about adaptation and taking action to increase resiliency of local resources. The *Marin County Climate Adaptation/Resilience Snapshot* that was compiled by the Bay Area Climate & Energy Resilience Project (BACERP) in March 2014 provides a summary of the efforts that are completed or underway (Bay Area Climate & Energy Resilience Project 2014). Additionally, the *Climate Adaptation—Sea Level Rise White Paper* prepared by the City of San Rafael in January 2014

[18] Late-season climatic water deficit is a measure of drought stress on soils.

provides a review of federal, State, and regional level efforts and legislation that address sea level rise (City of San Rafael 2014). It reviews the current and recently completed studies and strategies in the county and region. These reports contain a more comprehensive list of adaptation initiatives in Marin County, but some example adaptation initiatives include those listed below.

- Marin County's **"Collaboration: Sea-level Marin Adaptation Response Team" (C-SMART)** is an intergovernmental/public-private partnership that is working to develop an understanding of how sea level rise (SLR) may affect coastal area homes, schools, roads, public facilities, natural resources and habitat areas, when these impacts might occur, how they might change over time, and how to prepare for them.
- The County's **Southern Marin Sea Level Rise Pilot Project** addresses how the climate change impacts of sea level rise will affect the future of Southern Marin communities, infrastructure, ecosystems and economy, and what strategies the County can pursue to reduce and manage these risks. The project area encompasses the Richardson Bay shoreline, from the Sewerage Agency of Southern Marin treatment plant in Mill Valley to Marin City.
- The **Bay Conservation and Development Commission (BCDC)** is tasked with providing regulatory authority over the San Francisco Bay. BCDC has produced maps of sea level rise for informational purposes that are intended to encourage further and more detailed local study. In 2011, BCDC prepared a vulnerability assessment, *Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on the Shoreline* (San Francisco Bay Conservation and Development Commission 2011).
- **California Coastal Commission** is a state agency that provides planning and regulatory authority over the California coastline. The California Coastal Commission released *Draft Sea Level Guidance* in 2013 to provide local governments with recommendations on how to address sea level rise in Local Coastal Programs (California Coastal Commission 2013).
- The *Vegetation and Biodiversity Management Plan* (draft released in October 2013) is a prime example of how the County is incorporating climate change impacts and hazards into its long-range and comprehensive planning efforts (Marin County Parks and Marin County Open Space District 2013).
- The December 2012 publication of *San Francisco Estuary & Watershed Science* included a peer reviewed article by Elisabeth Micheli et al. (2012) titled, *Downscaling Future Climate Projections to the Watershed Scale: A North San Francisco Bay Case Study*. This study provides an in-depth discussion on the approaches and benefits of using downscaled data to predict temperature and precipitation changes.

7.3.2 Additional Efforts Needed

Although a large number of adaptation activities are underway, there has not been a consolidated look across sectors and climate change stressors, at the vulnerabilities of Marin County. A more comprehensive, county-wide vulnerability assessment would help highlight where resources should be focused under adaptation planning efforts. Furthermore, effective adaptation requires coordination across many different stakeholders within a county, and a "big picture" understanding of the sectors and geographic locations that are most vulnerable would help demonstrate where coordination and collaboration are most needed. The County and Marin's cities should jointly take the lead in establishing such a coordinated framework.

7.4 Potential Impacts of Climate Change on Marin County's Sectors and Potential Adaptation Actions

This section discusses the potential impacts of important sectors to the aforementioned climate hazards. Each sector is introduced by a brief overview of the relevant features of that sector in Marin County, highlights of the climate hazards with the highest potential to cause damage, a discussion of current activities, and which agencies or groups would be integral in developing and implementing specific adaptation actions. Table 7-2 provides a high-level list of potential adaptation actions for each sector; see Appendix A for additional detail. This list provides suggested actions to increase resiliency; however, this is not an exhaustive list and is only intended for guidance and to initiate a discussion with relevant stakeholders after a comprehensive vulnerability assessment is completed.

The review is intended to provide high level guidance for the County and not rate the relative potential impacts. The information does not state whether these impacts are likely to occur, and likelihood cannot be assessed given the inherent uncertainty of greenhouse gas projections, climate models, and the associated impacts on assets and services. The evaluation is based on research and professional expertise and provides a discussion of general sensitivities that may be a concern in the county. A detailed vulnerability assessment by sector would be required to identify where the county's specific vulnerabilities lay.

Table 7-2. Example Adaptation Actions by Sector[19]

Sector	Potential Adaptation Actions
Cross-Cutting	• Select set of climate projections upon which to base future planning decisions. • Conduct detailed vulnerability assessment by sector or geographic region within the County. • Evaluate vulnerability of planning decisions based on the selected climate projections. • Integrate adaptation actions into planning processes (i.e., wildfire preparedness, water management, hazard preparedness, comprehensive planning, etc.) and infrastructure decision-making (i.e., locating and designing roads). • Encourage zoning and planning decisions that limit building of infrastructure in areas at risk for sea level rise, flooding, or landslides. Also encourage planning decisions that increase redundancy of critical infrastructure types. • Work with other institutions to develop cost-effective, comprehensive arrangements for monitoring the changes in local climate factors such as precipitation, fog, heat patterns, storm frequency and severity, flood flows, areas inundated and sea level. • Begin monitoring climate- and weather-related damages and costs to help understand the costs of inaction.

[19] This table represents example adaptation measures that could be implemented by Marin County. A more complete list is presented in Appendix A. A more complete vulnerability and adaptation analysis is needed to determine which adaptation measures should be recommended.

Sector	Potential Adaptation Actions
Water	• Implement water conservation measures to mitigate demand. • Anticipate higher water treatment costs. • Incorporate design standards to slow surface water runoff. • Review and update coastal flood protection measures. • Introduce erosion control measures. • Review and update forest management practices.
Natural Heritage	• Monitor existing and emerging species. • Increase habitat connectivity and establish habitat corridors. • Increase the availability of shade and water at recreational facilities. • Acquire and protect areas where marsh can migrate upland as inundation increases. • Create "no-wake zones" to reduce erosion. • Consider water needs of plants when landscaping.
Transportation	• Develop plan to address worker safety with regards to extreme heat. • Review guidelines for materials and equipment to ensure they can withstand increased maximum temperatures. • Protect sensitive equipment and update maintenance schedule to address more rapid deterioration of materials. • Make Public Service Announcements about closures and plan for detours. • Reroute or elevate roads and improve drainage on existing roads. • Establish redundant routes. • Relocate marine facilities (e.g., ferry terminals). • Conduct post-event evaluation and maintenance to ensure all facilities are up to standard for safe operations and use after extreme events (i.e., fire, flood, heat wave, etc.).
Agriculture	• Adjust growing season and planting methods or select varieties of plants that are heat resistant. • Grow different varieties of plants and crops that are more tolerant to variability or projected climate conditions. • Develop plan for animal safety in the event of an extreme event such as a flood, storm surge, or extreme heat. • Use buffers to modify and reduce fertilizer and pesticide application to address potential increases in polluted agricultural runoff from floods, inundation, and erosion.
Energy	• Add peak generation, power storage capacity, and distributed generation. • Implement improved cooling flow technologies and procedures to reduce water needs. • Institute technologies and procedures to increase reliability of the energy supply during heat waves and/or drought years. • Reduce energy demand through energy efficiency.

Sector	Potential Adaptation Actions
Human Health	• Early warning systems for heat waves and unsafe swimming conditions. • Make cooling facilities available for residents. • Stagger activities like construction to cooler times of day. • Monitor air quality concentrations. • Monitor coastal conditions and reduce discharge of warm water and fertilizers upstream. • Educate public on preparedness for hazards. • Develop contingency plan at hospitals and for patients that receive care at home for situations with loss of power.
Built Environment	• Update building codes to require structural adaptations to withstand flood inundation • Support use of adaptable building construction types for remodels and new construction • Increase setbacks/elevations for beach and bluff-top development in coastal communities. • Develop managed realignment/relocation plans which could include transfer of development credits, simple acquisition and conservation easements. • Create natural protection systems in coastal areas which could include beach/dune restoration (addition of sand and vegetation) and offshore bio-beds (kelp, sea grass, oyster beds, etc.) • Construct structural coastal protections including seawalls, groins, emergent breakwaters, artificial reefs and perched beaches.

This section also notes the general coordination and research activities, and the likely actors to oversee those activities, that would need to be conducted to begin preparing for these changes. It is important to understand that this high-level coordination and research are important first steps for effectively and efficiently adapting. Specific adaptation strategies that are common to each sector are highlighted in Table 7-2 and detailed in Appendix A; however, more detailed analyses on specific vulnerabilities of Marin County, and potential costs and benefits of each adaptation measure, are needed to determine which actions should be implemented in Marin.

7.4.1 Water

The Marin Municipal Water District provides drinking water to 186,000 customers in central and southern Marin. Approximately 75% of the drinking water comes from the seven reservoirs that capture rainwater on 21,600 acres of protected watershed on Mt. Tamalpais. Additional water resources are imported from the Russian River in Sonoma County (Marin Municipal Water District 2014). The North Marin Water District provides service to approximately 1,700 customers in the city of Novato and several small improvement districts near the coast (North Marin Water District 2014). The Stinson Beach County Water District serves the residents of Stinson Beach. Additional small districts serve the communities along the Pacific coast.

Concerns regarding water are typically associated with three main and time-variable aspects: quantity, quality, and demand.

Increased temperatures and extreme heat could decrease water supplies as evapotranspiration and the demand for water increases. Secondary sources of water and conservation measures can help

offset these impacts. Additionally, temperature increases dissolved oxygen which can reduce water quality and require higher costs for treatment.

Flooding may cause shifts in peak water flows, shifting the quantity of water in streams and rivers. Water management practices that store water onsite (such as low-impact development) can help reduce these shifts in peak flows. Increased runoff and flooding may also move pollution into the waterways and require additional treatment costs. Similarly, sea level rise could impact quality of water and increase concerns related to saline intrusion.

Increased erosion from wildfires in the watershed and the use of chemicals from fighting fires may directly impact the water quality. Additionally, as energy prices increase, the cost of pumping and delivering water could also increase.

An assessment of the existing facilities, distribution networks, and land uses will be necessary to understand the extent to which the water supply in Marin County will be impacted by climate change impacts. The **Marin Municipal Water District, North Marin Water District,** and **Marin County Flood Control and Water Conservation District** will likely be the primary group interested in fully understanding the risks associated with climate change.

7.4.2 Natural Heritage

Marin County has a rich natural heritage with regional and community parks, neighborhood parks, 34 open space preserves that span 19,300 acres, and 190 miles of unpaved public trails (Marin County 2008a). These lands provide vital ecosystem services that clean the air and water; contribute to the quality of life of residents, employees, and visitors; and provide critical habitat for native plants and animals (Marin County 2008b). Currently the County is home to a variety of forests that include oaks, Douglas fir, the iconic redwoods, and a diverse mix of hardwoods typical of the Coast Range mountains (North Bay Climate Adaptation Initiative 2013b). Although riparian areas, including streams, creeks, and rivers, account for a small portion of the land area in the county, these areas provide critical services for plant and animal species (North Bay Climate Adaptation Initiative 2013c).

Slight shifts in the growing season, ambient air temperature, and water temperatures can have dramatic impacts on natural resources. For example, one of the most significant shifts projected for the area is that much of the woody forest vegetation that is characteristic of the county may be replaced by chaparral shrub cover that is more characteristic of coastal climates further south, such as Santa Barbara (North Bay Climate Adaptation Initiative 2013b). Shifts in conditions may provide environments that are more favorable for heat-tolerant invasive species. Inundation from flooding and sea level rise may destroy or damage habitats, marshes, beaches, and recreational areas. Droughts may limit the water available in lakes or streams that can be used by aquatic species and may cause a shift towards more drought tolerant tree and plant species. Wildfires may destroy critical habitats for species and damage recreational facilities.

The first step in many of the adaptation actions, identified in Appendix A, is to begin (or continue) species monitoring to understand precisely how the changes are impacting the natural heritage. As concerns about wildfires increase in the area, it will be important for the departments responsible for preserving open space work in coordination with the fire department.

The preliminary draft of the *Vegetation and Biodiversity Management Plan* (released October 29, 2013) responded to guidance from the 2007 *Marin Countywide Plan*, which promoted the keeping

the community safe from climate change (Marin County Parks and Marin County Open Space District 2013; Marin County Community Development Agency 2007). This current draft includes a section on management for climate change within chapter 3. The section on management of vegetation responses to climate change includes a plan to expand monitoring and adaptive management practices to respond to climate change and sea level rise (Marin County 2008b). The Marin County Watershed Program has identified tools such as Point Blue Conservation Science's sea level rise visualization tool which helps planners understand how changes will impact tidal marsh habitat and bird species over the next 100 years (Point Blue Conservation Science 2013).

Marin County Parks and Open Space District, and **Marin County Watershed Program** will likely be the primary groups responsible for implementing the appropriate adaptation options, based on the vulnerability assessment presented in the 2013 *Vegetation and Biodiversity Management Plan* (Marin County Parks and Marin County Open Space District 2013). Countywide plans may also include coordination with the **Community Development Agency**, **Marin County Fire Department, Marin Audubon Society, Marin County Flood Control and Water Conservation District,** and other groups that are active in preserving the county's natural heritage**.**

7.4.3 Transportation

The Marin County transportation network consists primarily of roads and bicycle and pedestrian facilities. Highway 101 is the main thoroughfare that runs North-South through the eastern portion of the County. Highway 1 is a scenic road that follows the Pacific Coast. In 2003 the Sonoma-Marin Area Rail Transit (SMART) district was established and will provide 70 miles of passenger rail service that will run from Cloverdale in Sonoma County to Larkspur Landing in Marin County. Phase 1 is scheduled to begin service in late 2016 (Sonoma Marin Area Rail Transit 2014). In addition to terrestrial transportation services, there are three ferry services that transport pedestrians (and cyclists) by boat. The Blue and Gold Fleet provide service between Tiburon, Sausalito, Angel Island, and San Francisco. Golden Gate Transit transports people between Larkspur, Sausalito, and San Francisco. The Angel Island Ferry operates between Tiburon and the state park on Angel Island (Marin County 2014).

The transportation network in Marin County could be affected by several climate impacts. Transportation infrastructure, such as roads, bridges, and rail, require significant capital investments and generally has long life expectancies; it is likely that these systems will be impacted by climate hazards. Extreme heat events, wildfires, flooding, and sea level rise may cause direct damage or destruction to the transportation network or temporarily disrupt services. Such extreme events may also introduce personal risk to workers or increase the need for maintenance and repairs. Changes in the cost of fuel may increase the demand for public transportation or alternative transportation options, such as walking and biking.

Transportation Authority of Marin (TAM) and **Transportation Planning (a division of Public Works)** will likely be the primary groups in the county that are most interested in understanding the specific vulnerabilities for transportation assets in the county. Countywide plans may also include coordination with the **Community Development Agency**, **Bicycle Advisory Group, SMART, Marin County Flood Control and Water Conservation District,** and **the ferry service providers.** Beyond the County, regional agencies, including the **Association of Bay Area Governments (ABAG)** and **Metropolitan Transportation Commission (MTC)** will likely be involved in the vulnerability assessment and resulting adaptation recommendations to understand how risks in Marin County's network will impact surrounding municipalities.

7.4.4 Agriculture

Livestock and dairy are the primary agricultural products in Marin County. The vast majority of the 167,000 acres of land that are zoned "Agricultural" (about 50% of the land area in the county) are used for seasonal grazing of dairy, cattle, and sheep (University of California Cooperative Extension, no date). There are 255 agricultural operations in the county, of which 191 are considered small or mini-farms (University of California Cooperative Extension, no date). Over 75% of the agricultural gross value comes from livestock-related production. The remaining production comes from approximately 12% in field crops, 5% in fruit and vegetable crops, 6% in aquaculture, and the remaining 1% in nursery crops (Marin County 2013).

Since the majority of agricultural activity in the county is related to livestock production, it will be particularly important to understand how climate hazards may impact the health and safety of cattle and sheep. Extreme heat may cause animals to experience heat exhaustion, stress, or death; increase their vulnerability to disease; reduce fertility; and limit milk production. Impacts on grazing crops could require ranchers to provide animals with more imported feed. To combat the impacts of extreme heat, individual farmers and ranchers may benefit from increasing ventilation in barns, expanding animal access to water, and providing additional areas that can provide shade and cooling. As temperatures and precipitation patterns change, new disease vectors may be introduced that further threaten the health of livestock. Monitoring and developing plans for addressing outbreaks could help halt the spread of any such diseases.

Flooding, sea level rise, and wildfires may cause direct impacts on cattle, agricultural lands, equipment, and water quality. While it may be possible to move cattle and equipment in the event of temporary inundation or a wildfire, these hazards could also result in permanent damage or destruction that could result in more permanent disruptions in the industry. Physical barriers and flood mitigation strategies can be used to minimize the impacts of extreme events. A plan to prevent and contain wildfires could help avoid the potential impacts of wildfires on agriculture.

Agricultural uses require large amounts of water that could be limited during a drought. During periods of limited resources, the cost of water may increase. A lack of access to water can result in dehydration for animals and reduced yields or plant death for crops.

To understand the specific vulnerabilities associated with climate impacts in Marin County, a comprehensive vulnerability assessment is necessary. The **County Department of Agriculture** and **independent farmers and ranchers** could take a lead on conducting a vulnerability assessment and identifying the appropriate adaptation options that are appropriate for the region. Collaboration with the **Marin Municipal Water District**, **Marin County Fire,** the **Community Development Agency,** and **Marin County Flood Control and Water Conservation District** could help to develop plans that are integrated into the county-wide plans.

7.4.5 Energy

While wildfires, sea level rise, and flooding in Marin County have the potential to disrupt energy distribution, significant changes in temperature and extreme heat events across the region could result in larger systematic problems such as brownouts. A significant increase in energy demand could decrease efficiency, increase overall costs, and disrupt service. Backup power generation, redundancy, and distributed energy production (i.e., solar panel installation) could help minimize peak loads.

PG&E and **Marin Clean Energy (MCE)** along with **independent energy consumers** may be the primary groups interested in understanding the local vulnerabilities and potential options for implementing adaptation actions. Countywide plans may also include coordination with the **Community Development Agency** and the **Marin Builders Association** who may play a significant role in influencing local energy efficiency standards and design requirements**. PG&E, MCE and the Marin Energy Watch Partnership** currently provide assistance and incentive funding to help residents and businesses reduce energy needs.

7.4.6 Human Health

Overall, County residents have generally good health (Marin County Health & Human Services 2014). The population in the county is aging, with approximately 18% being 65 years of age or older, compared to about 12% for the rest of California (United States Census 2014). Over 23% of the population over 5 years old speaks a language other than English at home, and the median household income exceeds that of the state (United States Census 2014). During the 2008–2012 reporting period, only about 7.5% of the population lived below the poverty level, compared to a 15.3% statewide average (United States Census 2014). The human health risks associated with climate change in the county are consistent with those in other areas of the country.

Although the residents of Marin County experience generally good health, extreme heat events could put additional stress on the healthcare network. Wildfires, flooding, sea level rise, and the availability of water may cause increases in physical injury and mental health stress. Local changes in the temperature and precipitation patterns are unlikely to have a major impact on the availability of food for the general public, since most food is imported from areas beyond the County. However, a statewide shift in the growing season could impact the cost and availability of some food in the county. Adaptation efforts may focus on ensuring that adequate services would be delivered if an extreme event were to occur in the county.

Currently Marin Grassroots is working with vulnerable communities to understand their primary concerns with regards to sea level rise. Across California, health advocates and the CalBRACE program are quantifying the climate benefits of various health strategies by forecasting exposures and population vulnerabilities at a local/regional level, conducting a health risk assessment, assessing interventions, and developing an implementation plan. These efforts will contribute to making the public health system more prepared for the impacts of climate change.

Marin Health and Human Services, local hospitals (including Marin General and Kaiser Permanente), and **health centers** could be the primary groups that may lead the implementation of the CalBRACE model in the county. Countywide plans may also include coordination with the **Community Development Agency**, **senior living facilities, community service centers,** and the **California Department of Public Health.**

7.5 Potential Barriers to Climate Change Adaptation

There are two often-cited barriers that will likely cut across each of the climate change hazards and each of the critical sectors outlined above: inter-agency collaboration and funding. In addition to these challenges, each adaptation action that is selected could introduce specific obstacles. Through building a coalition and identifying funding sources, the solutions to overcome those adaptation-specific barriers will be easier to identify. This section describes the threat of and possible solutions

to the collaboration and funding barriers. The discussion of overcoming specific adaptation-action barriers will evolve from a comprehensive vulnerability assessment and once the County has assessed the specific validity and application of adaptation actions, some of which are discussed previously in this chapter and in Appendix A.

7.5.1 Collaboration

To undertake this work, a broad range of groups that have an interest in the county will need to work together to identify and implement creative solutions. Under the discussion of each sector, the key stakeholders and agencies have been listed. These lists highlight the fact that there are many stakeholder groups with a vested interest in increasing the resiliency in various sectors. In addition to developing an approach that reaches across agencies within the county, it may be essential to engage businesses, municipal governments, residents, and regional agencies in developing a locally feasible implementation plan. Throughout the process of conducting a vulnerability analysis, assessing the sensitivity of systems, and developing an adaptation action plan, the relevant list of stakeholders should be reviewed and engaged.

As part of an effort to collaborate, the County and municipalities could benefit from agreeing to utilize the California sea level rise projections (as outlined in the *State of California Sea-Level Rise Guidance Document*) in long-range planning efforts (State of California Ocean Protection Council 2013). Although the state has not released similar guidance for temperature increases and precipitation changes, the County and municipalities could agree to adopt a set of local projections and commit to incorporate those projections into long-range planning efforts. In addition to selecting a set of projections, the government entities would also need to agree upon how to define "long-range" planning efforts.

7.5.2 Funding

Another significant challenge will be to identify funding sources for the vulnerability assessment, developing an adaptation plan, and implementing actions. By establishing buy-in across agencies, in the business community, and among residents, the County may be able to identify a broader range of funding sources. The County may seek opportunities for public-private partnerships, have enough buy-in to pass a ballot measure to collect revenue, or identify opportunities to integrate adaptation into existing efforts that have co-benefits such as turning an area with high risk of sea level rise related inundation into a scenic trail or park. Creative approaches to funding may help engage a larger community and identify opportunities for additional co-benefits.

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Photo: Marin Cultural Services Department

Chapter 8
References

8.1 Print and Web References

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8.2 Personal Communications

Wong, Hing. Senior Regional Planner, Association of Bay Area Governments (ABAG). December 5, 2013. Email communication with ICF International's Brian Schuster.

Appendix A
Summary of Adaptation Actions

Introduction

The following series of tables offer potential adaptation actions that could be applicable to the various impacts that may be a threat to sectors in Marin County. The sectors reflect those of importance in the County and the potential impacts are tailored to the climate hazards that may pose a risk to the County, based on the changes in temperature, precipitation, and sea level rise discussed in Chapter 7. This list provides suggested actions to increase resiliency; however, this is not an exhaustive list and is only intended for guidance and to initiate a discussion with relevant stakeholders after a comprehensive vulnerability assessment is completed.

Water

Climate Hazard	Potential Impacts	Adaptation Options
Extreme Heat	• Decrease in water supplies as evapotranspiration increases • Depletion of groundwater	• Invest in secondary sources of water
	• Decreased quality because higher temperature can exacerbate eutrophication (algae growth) which can result in low dissolved oxygen • Higher water temperatures can also increase pathogen levels • Higher pollutant concentrations from larger evaporation losses	• Anticipate higher water treatment costs
	• Increase in demand for water e.g., cooling water for industry, irrigation, watering lawns, etc.	• Implement water conservation measures to mitigate demand
Riverine Flooding	• Increase in peak water flows	• Establish water management practices • Incorporate low-impact development (LID), best management practices, and other design standards that promote on-site water retention that slows surface water runoff
	• May dilute pollutant concentrations or increase pollutant concentrations by introducing pollutants from land surface	• Anticipate higher water treatment costs

Climate Hazard	Potential Impacts	Adaptation Options
Sea Level Rise (permanent inundation and episodic flooding)	• Reduction in quality of groundwater by seawater intrusion, reducing the quantity available for consumption	• Review coastal flood protection measures • Install groundwater barriers
	• Increase in demand on other water resource supplies not affected by saline intrusion	• Develop alternative water supply resources
Wildfires	• Increased land erosion related to rainfall on denuded soils (sedimentation, suspended solids); increase of pollutants (chemicals from firefighting, nitrates from fire) • Disruption to reforestation/ revegetation	• Erosion control measures (e.g., hard structures and land use changes)
	• Increase of water pollutants (i.e., chemicals from firefighting, nitrates from fire)	• Enhanced water treatment
	• May result in changes of water flows e.g., peak flow increases related to denuded and hydrophobic soils	• Review water use policies (i.e., if using water for high quality uses, considering using water for other lower quality uses, e.g., industrious uses)
	• Decreased sub surface flow and evapotranspiration given denuded land and hydrophobic soils	• Review forest management practices
Shift in Energy Demand and Supply	• Increase in costs of pumping and delivering water as demand for energy increases	• Anticipate higher water treatment costs.

Natural Heritage

Climate Hazard	Potential Impacts	Adaptation Options
Extreme Heat	• Stress on threatened and endangered species (or any species)	• Species monitoring
	• Shifts in species habitat ranges with the possibility of increased human-wildlife interactions and increased stress on species who have nowhere to migrate	• Increase habitat connectivity or ensure habitat corridors established
	• Decline in number of days (or hours in the day) that visitors can comfortably and safely visit parks	• Increase the availability of shade and water • Consider offering alternative recreational activities
	• Emergence of new plant and animal communities	• Monitoring to track emergence and spread of new species (and determine if management interventions are necessary)
	• Rising water temperatures may stress species	• Cooling techniques (e.g., planting shade trees around small water bodies)
	• Increased threat from heat-tolerant invasive species	• Deploy best management practices to control and prevent spread of invasive species
Riverine Flooding	• Destruction of habitats due to flooding and landslides • Destruction of recreational areas due to flooding and landslides	• BMPs to improve flood protection • Review/revise land management plans and development codes • Public education to address preparedness for climate hazards and habitat restoration
Sea Level Rise (permanent inundation and episodic flooding)	• Decreasing extent of marsh habitat, affecting ability of species to feed, nest, etc. • Cliff and shoreline erosion • Combined flooding: where riverine flooding (flowing off the land) can be additive to increased water run-up from the sea (significant problem at Stinson Beach)	• Acquire and protect areas where marsh can migrate upland as inundation increases • Create "no-wake zones" to reduce erosion • Ensure adequate sediment supply to promote marsh accretion • Establish new setback requirements to reduce susceptibility to erosion risks and combined flooding impacts
	• Damage to or destruction of beaches used for recreation	• Consider offering alternative recreational activities
Shift in Water Demand/Supply	• Decreased lake levels, impacting species health	• Species monitoring
	• Decreased lake levels, decreasing recreational opportunities (e.g., boating, rafting)	• Consider offering alternative recreational activities
	• Shift toward more drought-tolerant species	• Consider water needs of plants when choosing new plants

Climate Hazard	Potential Impacts	Adaptation Options
	• Increased disease in trees due to droughts	• Measures to control the outbreak and spread of disease
Wildfires	• Destruction of habitat for threatened and endangered species (or any species) • Increased opportunities for establishment and spread of invasive species	• Species monitoring • Establish good plan to prevent fires from starting (e.g. fire management zones) • Deploy best management practices to control and prevent spread of invasive species
Change in Growing Season	• Changes in the timing of flowering • Mismatch in timing between blooms and pollinators or availability of food and species that rely upon it	• Consider shifts in growing season and likely survivability when selecting and planting new vegetation • Species monitoring

Transportation

Climate Hazard	Potential Impacts	Adaptation Options
Extreme Heat	• Transportation workers may be at risk of overheating during maintenance and operations of equipment. Interruptions in service may occur if unsafe conditions prevent workers from performing duties	• Develop plan to address worker safety with regards to extreme heat
	• May cause concrete pavement buckling and loss of non-concrete pavement integrity (e.g., asphalt melt) for roads and sidewalks. • Can lead to rail damage	• Review guidelines for materials to ensure those used can withstand increased maximum temperatures.
	• Increases in lightning activity poses threat to electronic equipment and interferes with operations	• Protect electronic equipment
	• Many types of vehicles can overheat, and tires will deteriorate more quickly	• Shorten maintenance schedule • Select equipment that can withstand higher temperatures
Riverine Flooding	• Heaving rain can cause standing water on runways, sidewalks, and roads, causing transportation delays	• Make Public Service Announcements to let drivers know about closures • Reroute or elevate roads • Improve drainage on existing roads • Establish redundant routes
Sea Level Rise (permanent inundation and episodic flooding)	• Sea level rise in combination with tidal actions and/or subsidence can inundate low-lying transportation systems in coastal areas • May disrupt marine transportation facilities	• Make Public Service Announcements to let drivers know about closures • Reroute or elevate roads • Establish redundant routes • Relocate marine facilities (e.g., ferry terminals)
Wildfires	• Post-wildfire debris flow can cause damage to bridge abutments and roads • Rail ties and tracks are susceptible to damage from wildfire heat. Wooden ties can combust when exposed to fire. Metal components can warp or melt if exposed to high temperatures. • Typical asphalt mixtures have the potential to ignite during tunnel fires •	• Establish good plan to prevent fires from starting (keep underbrush levels low, establish buffer between wild areas and transportation facilities to starve fire) • Provide water resources to put out fires • Conduct post-event evaluation and maintenance to ensure all facilities are up to standard for safe operations and use
Shift in Energy Demand and Supply	• Rising costs of transportation due to increase in fuel and energy prices, could place additional demand on public transportation services	• Monitor public transit ridership and shifts in demand

Agriculture

Climate Hazard	Potential Impacts	Adaptation Options
Extreme Heat	• Cattle and sheep may experience heat exhaustion, stress, or death that could result in increased vulnerability to disease, reduced fertility, and reduced milk production	• Identify and establish areas that can provide shade (e.g., trees and manmade structures) for animals to get out of the sun • Ensure that animals have consistent access to water to cool off • Increase ventilation in barns
	• Extreme heat may reduce yields or cause complete crop loss, depending on the timing of the heat spell during the growing season	• Adjust growing season or select varieties of plants that are heat resistant • Use innovative growing methods that reduce heat locally
Riverine Flooding	• Contamination of cattle drinking water may result in animal sickness	• Develop a plan for where to move animals in the event of a flood • Remove manure from areas that are likely to flood • Monitor animals for sickness • Monitor drinking water
	• Damage to barns, other infrastructure, and machinery	• Move buildings and critical infrastructure out of the floodplain and other low lying areas • Only keep movable machinery or structures that can withstand temporary inundation in the floodplain
	• Can result in oxidative stress of plants, which may reduce yields or kill plants, depending on extent and duration	• Develop a drainage system that can quickly move water away from crops (may want to move water into a location for future use to address flood-drought cycles)
	• All sensitivities mentioned above for animals and crops.	• Develop a watershed plan to mitigate flooding that is built off existing floodplains and takes into account potential for changes in precipitation patterns (e.g., heavier rainfall events). • Use buffers to modify and reduce fertilizer and pesticide application to address potential increases in polluted agricultural runoff.
Sea Level Rise (permanent inundation and episodic flooding)	• Salinization of soils from coastal inundation may create parcels that are no longer appropriate for growing plants for grazing or other types of food production. • Loss of land due to erosion	• Construct physical barriers or modify the landscape to protect land from inundation and erosion.

Climate Hazard	Potential Impacts	Adaptation Options
Shift in Water Demand/Supply	• Lack of access to water can result in dehydration and/or death of animals.	• Construct water reservoirs for animals to use if naturally occurring water sources are not as reliable as in past • Develop methods to collect water during times of drought (e.g., rain barrels, water storage ponds, etc.)
	• Lack of access to water can result in reduced yields or plant death depending on timing and duration.	• Add irrigation system for crops • Plant drought tolerant varieties of crops • Develop methods to collect water during times of drought (e.g., rain barrels, water storage ponds, etc.)
Wildfires	• Wildfires can burn/damage/kill cattle and agricultural. equipment/barns/etc. • Ruin grazing land for short to long term (depending on level of damage). • Damage farmland and fruit trees for production.	• Establish good plan to prevent fires from starting (keep underbrush levels low, establish buffer between wild areas and agricultural areas to starve fire). • Provide water resources to put out fires. • Establish plan to keep animals safe during a fire.
Change in Growing Season	• Increased temperatures and shifts in the precipitation and fog patterns could result in periods with insufficient plants for grazing. • Temperatures and water availability may reduce or eliminate crop yields depending on length and intensity of shift.	• Add new plants to the grazing fields that are seasonally insensitive, supplement cattle other food sources. • Shift planting timing based on weather forecasts and longer term trends in seasonality changes. • Grow different varieties that are more tolerant to variability or grow new types of plants that are more tolerant.
Warming, acidification of Bay and coastal waters	• Fishing and Mariculture: Warming waters may shift the distribution of target species in the ocean, affect the spawning and rearing of anadromous and stream species such as salmon, and potentially affect shellfish production.	• Monitor research developments and potential adaptation strategies

Energy

Climate Hazard	Potential Impacts	Adaptation Options
Extreme Heat	• Decreased energy system efficiency, due to increase in frequency of severity of very hot days and heat waves	• Diversify energy supply chain • • Build redundancy into facilities • Add peak generation, power storage capacity, and distributed generation • Add backup power supply for grid interruptions • • Insulate equipment for temperature extremes •
	• Overall increases in cost due to reduced oil, gas, and coal processes efficiency • Increased fuel extraction and processing costs	• Diversify supply chain • Increase energy system efficiency
	• Increased temperatures affect the transmission and distribution of energy (e.g., can lead to failure of power transformers; increased stress on transmission infrastructure and grid, leading to disruption of supply; increased sag of overhead line conductors) • Heat waves and higher temperatures reduce the longevity of production equipment through reductions in material strength or warping	• Utilities: o Improve reliability of grid systems through backup power supply, intelligent controls, and distributed generation o Increase transmission capacity between regions o Conduct annual review of network loadings to ensure adequate headroom on network o Annual review of network loadings to ensure adequate headroom on network o Proactive program replacement driven by monitoring the condition of assets. Condition information gathered through combination of thermal imaging, hi-res imaging, and periodic foot and helicopter patrols. • County/Utilities: Monitoring of vegetation and review of the vegetation management in place to maintain statutory clearances to overhead assets. This includes resilience against falling vegetation.
	• Increased energy demand for AC, refrigeration, and water	• Improve water distribution/reuse efficiency • Allow flexible work schedules to transfer energy use to off-peak hours • Expand capacity and encourage conservation • Set higher temperatures in buildings • Improve building energy use • Upgrade cooling system and manufacturing efficiencies • Employ demand-response capabilities (e.g., smart grid)

Climate Hazard	Potential Impacts	Adaptation Options
Riverine Flooding	• Can damage power lines and electricity distribution	• Move critical infrastructure out of the floodplain • Elevate or protect infrastructure that cannot be moved
	• Disruptions in railway, truck, and marine transportation that transport oil, gas, and coal	• Provide back-up power generation for critical systems that rely on the grid.
Sea Level Rise (permanent inundation and episodic flooding)	• Energy infrastructure located in low-lying coastal areas may be temporarily or permanently inundated. • Increased energy use for additional pumping requirements related to retention of runoff behind expanded levees.	• Move critical infrastructure out of low-lying coastal areas • Develop land use plans to reduce need for expanded levees
Shift in Water Demand/ Supply	• Many power plants can require large amounts of water for cooling. A limited water supply may restrict the amount of water available to the power plants.	• Seek alternative technology to minimize the reliance on water for cooling.
	• Drought may increase the need for energy-intensive methods of providing drinking and irrigation water that is pumped, transported, and treated.	• Seek alternative technology that requires less energy to pump, transport, and treat water. • Promote water conservation
Wildfires	• Energy infrastructure located in high wildfire risk areas may suffer disruptions or damage.	• Expand fire prevention plan to include climate projections.

Human Health

Climate Hazard	Potential Impacts	Adaptation Options
Extreme Heat	• Extreme heat may cause stress, heat stroke, and mortality.	• Early warning systems • Cooling facilities • Reduce outdoor activities • Stagger activities like construction to cooler times of day
	• Extreme heat degrades air quality with tropospheric ozone and particulate matter, including risks of cardiovascular disease, chronic and acute respiratory disease, lung cancer and preterm birth	• Early warning systems • Monitor air quality concentrations • Reduce exposure to outdoors, especially for children, elderly, and other sensitive populations
	• Algae growth along coastlines (e.g., red tide) due to warmer sea surface temperatures	• Monitor coastal conditions • Reduce discharge of warmer waters/fertilizers upstream if applicable • Announcements to alert public when the water is and is not safe for swimming and fishing
Riverine Flooding	• Mortality and injury due to flooding • Mental health and stress disorders due to geographic displacement and loss of loved ones	• Public education to address preparedness for climate hazards • Update building codes to require structural adaptations to withstand flood inundation • Develop managed realignment/relocation plans which could include transfer of development credits, simple acquisition and conservation easements. • Develop structural and non-structural adaptations to increased risk of flooding • Update zoning to discourage construction in flood-prone areas.
Sea Level Rise (permanent inundation and episodic flooding)	• Mortality and injury due to bigger waves, storm surges, and wave run-up • Mental health and stress disorders due to geographic displacement and loss of loved ones	• Public education to address preparedness for climate hazards • Update building codes to require structural adaptations to withstand flood inundation • Develop managed realignment/relocation plans which could include transfer of development credits, simple acquisition and conservation easements. • Develop structural and non-structural adaptations to increased risk of flooding • Update zoning to discourage construction in areas that are prone to inundation from sea level rise.

Climate Hazard	Potential Impacts	Adaptation Options
Wildfires	• Mortality and morbid impacts • Mental health and stress disorders due to geographic displacement and loss of loved ones	• Public education to address preparedness for climate hazards • Establish good plan to prevent fires from starting (e.g. fire management zones)
Change in Growing Season	• Food security as availability and costs may change	• Diversify food supply chain – ensure that multiple food source options existing, including local sources
	• Shift in the timing of outdoor allergens such as pollen	• Public announcements to alert the public
Shift in Energy Demand/Supply	• Brownouts could impact the availability of energy for critical health needs, such as air conditioning for sensitive populations during extreme heat events.	• Develop contingency plan at hospitals and for patients that receive care at home for situations with loss of power.

Appendix B
Inventory and Forecast Details

Appendix B
Inventory and Forecast Details

Introduction

This appendix summarizes the data sources and general methods that were used to develop the community and municipal greenhouse gas (GHG) inventory and forecast updates for the Unincorporated Marin County (County) Climate Action Plan 2014 Update (CAP Update). This will be referred to as the "inventory" in this appendix.

This appendix describes the general methods for developing the community and municipal GHG emissions for each emissions sector. It also provides the approach used to develop the "business as usual" (BAU) forecast for 2020 for both community and municipal emissions.

GHG Inventory Structure and Definitions

Community Inventory. The Community Inventory includes GHG emissions associated with community activities occurring within the geographic or jurisdictional boundaries of the County and generally consist of sources of emissions that the County's community can influence or control. The boundaries of the community inventory are geographic; emissions included, or activities that result in emissions, must occur inside of the jurisdictional boundary of the County. Marin's cities/towns are separately responsible for calculating the emissions from their own jurisdictions.

Municipal Inventory. The Municipal Inventory includes GHG emissions associated with municipal activities and County government operations as it provides services to the public. This inventory includes emissions associated with municipal facilities and municipal activities. The boundaries of the municipal inventory are organizational; emissions included, or activities associated with emissions, must be under the control of the County.

Direct/Indirect Emissions. For direct emissions (such as natural gas combustion in buildings), if the County can have a substantial effect on those emissions by influencing energy use (such as through green building codes), then the direct emissions are included in the inventory. For indirect emissions (such as solid waste disposed outside of the County), if the County can have a substantial effect on those indirect emissions by influencing demand (such as waste minimization and diversion programs), then they are included in the inventory. By including emissions that are controlled by or subject to the influence of the County, the inventory can form the basis for local climate action planning.

GHG Emission Sectors. Community emissions are divided into the following ten sectors: building energy use, on-road transportation, off-road vehicles and equipment, water conveyance, wastewater generation, waste generation, stationary sources, agriculture, forestry, and carbon stock. Municipal emissions are divided into the following nine sectors: building energy use, vehicle fleet, employee commute, off-road vehicles and equipment, water conveyance, wastewater generation, solid waste generation, stationary sources, and refrigerants. The following table maps the community and municipal sectors:

Community Sector	Municipal Sector
Building Energy Use	Building Energy Use
	Streetlights and Traffic Signals
On-Road Transportation	Vehicle Fleet
	Employee Commute
Off-Road Vehicles and Equipment	Off-Road Vehicles and Equipment
Solid Waste Generation	Solid Waste Generation
Water Conveyance	Water Conveyance
Wastewater Generation	Wastewater Generation
Stationary Sources	Stationary Sources
Agriculture	N/A
Forestry	N/A
Rangeland Soil Carbon Stock	N/A
Aboveground Carbon Stock	N/A
N/A	Refrigerants

Municipal emissions are largely, but not exclusively, a subset of community emissions. For example, emissions related to natural gas and electricity consumption in municipal buildings are contained within the community building energy use sector, because this energy use was included in the utility data for the community. Because the municipal inventory uses an operational boundary as opposed to a geographic boundary, it may sometimes include emissions outside or not completely aligned with the community's boundary. For example, emissions from County vehicles (such as police cars or fire trucks) traveling outside of County boundaries (such as within an incorporated city) would be included in the municipal inventory. As another example, vehicle emissions from employees commuting from outside the County to work at a municipal office within the County would also be included in the municipal inventory. Caution should be taken when examining the two inventories as they are related but the municipal inventory is not always a complete subset, and should therefore never be added to or subtracted from community emissions.

Previous Inventories

Marin County assessed community and municipal GHG emissions for a number of years as part of its 2006 GHG Reduction Plan. Emissions were estimated for the years 1990, 1995, 2000, and 2005. Community emissions included emissions for the entire County, including both the cities and the unincorporated areas. The municipal emissions included activities associated with local government operations. These inventories used slightly different methods and data sources from those used in the inventory for this CAP Update, as data sources have expanded and improved, and methods for calculating emissions have grown more robust.

The previous community inventories included emissions for building energy (residential, commercial, and industrial), transportation, waste, and agriculture. The previous municipal inventories included emissions for buildings, streetlights, vehicle fleet, employee commute, and waste. The new inventories contained in this CAP Update include additional emissions sectors to encompass more sources of emissions and provide a more comprehensive picture of emissions associated with the county.

Inventory Update Year - 2012

The inventory update year for the GHG inventory is 2012. The year 2012 was chosen because complete or nearly complete activity data was available for the year 2012 for all sectors to support inventory preparation. Socioeconomic data for 2012 (including population, employment, and housing) was derived from a combination of data from the Association of Bay Area Governments (ABAG) and the U.S. Census. For sectors where 2012 data is not available, appropriate scaling methodologies were developed to project activity data to the year 2012. Any measures or programs (such as those designed to reduce emissions) implemented prior to the base year (2012) are accounted for in the inventory.

2020 Business as Usual Forecast

The inventory also supports development of the 2020 BAU Community 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. A BAU projection is an estimate of future emissions; it does not include the effects of *any* new federal, State, or local measures. The CAP Update 2020 BAU Community Forecast is similar to a BAU projection but differs slightly because 1) the data used to forecast 2020 emissions include General Plan socioeconomic assumptions and 2) the transportation emissions forecast accounts for future planned highway and transit network improvements (including the launch of SMART). Local actions and all other State regulations (e.g., AB 32) are not included in the forecast.

The BAU forecasts for 2020 used socioeconomic metrics which scaled the base year data. A unified set of socioeconomic data (population, jobs, and households) was developed through coordination with ABAG and the Metropolitan Transportation Commission (MTC).

Additional methods of forecasting 2012 activity and emissions data to 2020 were used depending on the sector and availability of data. For example, some water consumption projections were already available in Urban Water Management Plans (UWMPs) for the County's water suppliers.

Updated Community GHG Emissions for 1990

To facilitate comparison to 2012 and 2020 emissions, and to provide a more accurate GHG reduction target for community emissions, a revised GHG emissions inventory for the year 1990 was conducted for the community (1990 municipal emissions were not updated as part of this effort). The data sources used for 1990 are consistent with the data sources used for 2012. The revised 1990 community emissions inventory is consistent with the latest GHG protocols and the 2012 Community GHG inventory and 2020 Community BAU forecast. This is important because the 2020 GHG reduction target is based on 1990 emissions, so consistent GHG accounting across all years of analysis is necessary.

The 1990 municipal emissions are not completely consistent with the 2012 emissions in terms of sectors, data, and methods. There were some significant data gaps in the 1990 Municipal Inventory, which makes comparisons between years difficult. These data gaps include missing utility data for certain buildings (including some fire stations and the fairgrounds), missing electricity consumption

data for some streetlights and traffic signals, over-reported solid waste diversion, fuel sold to other agencies not controlled by the County in the vehicle fleet sector, and a lack of data for water use, wastewater treatment, stationary sources, and refrigerants. Because of these data gaps, comparing municipal emissions in 1990 with emissions in 2012 (or 2020) should be done with care.

Inventory Protocol

The ICLEI - Local Governments for Sustainability (ICLEI) *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions* (October 2012) was used to quantify community emissions for 2012 wherever applicable and appropriate. For some sectors, like land use sequestration, the ICLEI 2012 Community Protocol provides no guidance and alternative protocols were consulted including the Association of Environmental Professionals white paper on baseline community inventories and IPCC methodologies. The California Air Resources Board's *Local Governments Operations Protocol* (LGOP) was used to develop the municipal inventory for 2012 (California Air Resources Board et. al. 2010).

Emission Sectors

The following section includes detailed methods and supporting information for the inventory. This section is organized by sector. For each sector, the following information is provided:

- Overview: a brief description of the emission calculation(s).
- Methods Used in Previous Inventory: a brief description of the methods used in the County's 2005 GHG inventory (Marin County Community Development Agency 2007).
- Data and Models: a list of data and models that were used to calculate emissions.
- Inventory Methods: the detailed methodology for calculating emissions for both the community and municipal inventories for 2012.
- Forecast Methods: the detailed methodology for forecasting emissions for the community and municipal inventories to 2020.

Building Energy (Community and Municipal) and Streetlights and Traffic Signals (Municipal)

Overview

This sector includes GHG emissions from electricity and natural gas consumption for residential, commercial, industrial, institutional, and municipal buildings in the County.

Methods Used in Previous Inventory

The County's previous inventory for the year 2005 included four building energy sectors: two community sectors (Residential and Commercial/Industrial) and two municipal sectors (Street lighting/traffic signals and buildings). Residential, commercial, and industrial building energy emissions were determined using ICLEI's Cities for Climate Protection (CCP) software, which incorporates energy consumption data (electricity and natural gas) from Pacific Gas and Electric

(PG&E) and electricity GHG emission factors based on California's fuel mix. Similarly, municipal building energy emissions from 20 County-owned buildings were determined using PG&E data and the California energy generation emission factors. Emissions from municipal street lighting and traffic signals were determined using the same methods as described above. 1990 emissions only included traffic signals and not streetlights.

Data and Models

- Electricity consumption (kWh) provided by PG&E for residential, commercial, industrial, institutional, and municipal buildings and by Marin Clean Energy (MCE) for customers they serve (Armanino pers. comm.; Kudo pers. comm.).
- Natural Gas consumption (therms) provided by PG&E for residential, commercial, industrial, institutional, and municipal buildings (Armanino pers. comm.).
- Utility specific electricity GHG emission factors for PG&E (year 2012 data) and regional average emission factors from the U.S. Environmental Protection Agency (USEPA) for methane (CH_4) and nitrous oxide (N_2O) (year 2010 data) (Pacific Gas and Electric 2014; USEPA 2014). Marin Clean Energy emission factor for 2012 (Kudo pers. comm.).
- GHG emission factors for natural gas for 2012 (Pacific Gas and Electric 2013).
- Socioeconomic data for 2012 and 2020, including population, square footage of commercial and industrial establishments, employment by sector, and number of households (Wong pers. comm.).
- Municipal building construction information.
- Municipal employment data and projections for 2012 and 2020.

Inventory Methods

Community and Municipal: The County estimated CO_2 emissions from electricity provided by PG&E by multiplying electricity use by the utility-specific CO_2 emission factor for PG&E-delivered electricity for 2012. The 2012 emission factor (445 lbs CO_2e/MWh) represents all emissions related to electricity deliveries in 2012, including owned and purchased power.[1] Methane (CH_4) and nitrous oxide (N_2O) emissions for both utilities were calculated using USEPA eGRID year 2010 emission factors for the CAMX/WECC region (this region represents electricity primarily generated in California; 2010 is the latest year available). Similarly, emissions associated with power provided by MCE were estimated using emissions factors. The inventory update includes community emissions for residential, commercial, and industrial buildings and municipal emissions for municipal buildings and street lighting/traffic signals. Water-related energy use was subtracted from the building energy sector to avoid double-counting.

Transmission and distribution (T&D) electricity losses which occur between the points of generation and the points of consumption were also included in the building energy sector. The T&D loss value used in the inventory was 6.84% (USEPA 2014). The CAMX/WECC emission factors cited above were used to estimate GHG emissions for this electricity.

[2] ICF acknowledges the goals of the State's renewable energy, which will likely impact the electricity emissions in future years, however, the impact of the State's goals is quantified under the reduction measures and is not counted toward BAU estimates.

GHG emissions from natural gas consumption were calculated by multiplying the natural gas consumption statistics by emission factors from PG&E and ICLEI (Armanino pers. comm.; ICLEI – Local Governments for Sustainability USA 2012).

Forecast Method

Community: 2020 BAU building energy consumption was estimated by projecting 2012 data using the socioeconomic forecasts. Residential energy use was forecasted using the projected number of single-family and multi-family homes in 2020 and commercial and industrial energy use was forecasted using employment projections[2]. A future PG&E emission factor was calculated by taking a running average of emission factors for the past five years (2008-2012) to partially neutralize the large annual variability in utility emission factors. PG&E has published future emissions factors out to 2020 but those take into account Renewable Portfolio Standard (RPS) advancement, whereas the BAU forecast will not take into account future activities. For MCE power, usage was held constant; increases in MCE participation is part of the CAP strategies to reduce GHG emissions.

Municipal – Building energy emissions resulting from energy consumption in County-owned facilities and equipment in 2020 was estimated by projecting the 2012 municipal building energy emissions using building expansion/construction projections provided by the County.

On-Road Transportation (Community); Vehicle Fleet and Employee Commute (Municipal)

Overview

This sector includes GHG emissions from fuel combusted by on-road vehicles. For the municipal inventory, this includes County vehicle fleet emissions and employee commutes.

Methods Used in Previous Inventory

Community: The County's previous GHG inventory estimated transportation emissions by using County Vehicle Miles Traveled (VMT) data from the Caltrans Highway Inventory &Performance Branch database (HPMS Database), the Caltrans Motor Vehicle Stock, Travel, and Fuel Forecast (MVSTAFF) reports for 2005, and transportation GHG- emission factors embedded in the ICLEI Cities for Climate Protection (CCP) software.

Municipal: The County's municipal on-road transportation emissions, which includes employee commute and vehicle fleet emissions, were determined using employee commute survey data from the Employee Transportation Survey and vehicle fleet fuel consumption data from the Department of Public Works' fleet accounting software. Emissions were likely estimated using the ICLEI CCP software, but the County's Inventory Report does not specify.

Data and Models

- Traffic model results provided by MTC for 2012 and 2020. The MTC model was run for the years 2010 and 2020. 2012 VMT values were interpolated using methods from MTC. The MTC outputs

[2] ICF acknowledges the goals of the State's renewable energy, which will likely impact the electricity emissions in future years, however, the impact of the State's goals is quantified under the reduction measures and is not counted toward BAU estimates.

will include VMT for the County aggregated by origin/destination (inbound, outbound, or intra-city) and speed increments ("speed bins") of 5 miles per hour from 0 to 65 mph) (Brazil pers. comm.).

- EMFAC2011 model emission factors.
- Employee commute survey data for 2012.
- Fuel consumption for County-owned vehicles for 2012.
- Municipal employment data and projections for 2012 and 2020.

Inventory Methods

Community: Quantification of on-road transportation emissions followed the 2012 ICLEI Community Protocol. Community VMT data was provided by MTC for 2012 (interpolated using an MTC-derived interpolation factor). The MTC model uses the latest Association of Bay Area Governments (ABAG) (Plan Bay Area) forecasts.

To determine passenger VMT for the County, MTC apportioned one-half of the trip distance for any trip with an origin or destination within the County. This eliminates apportioning through-trips on freeways or major arterials to the County, while adding regional traffic burden to land uses generating trips on a 50/50 split. This is the current recommended approach of the State's Regional Targets Advisory Committee (RTAC) and provides a better accounting of VMT associated with land use jurisdiction than approaches that apportion VMT on a pro-rata share or on the basis of VMT that occurs within the boundaries of a jurisdiction. This approach can also help to reveal potential differences in VMT generation that can be useful during future land use and GHG reduction planning. VMT by speed bin and the corresponding speeds were used as inputs into the EMFAC2011[3] model to determine emission factors that were used to quantify the GHG emissions for passenger vehicles.

VMT and GHG emissions for commercial and other vehicles was supplied at the countywide level and apportioned to the unincorporated County using apportionment factors developed by MTC.

Municipal: Municipal GHG emissions include employee commute and vehicle fleet emissions. Employee commute emissions were estimated using the most recent employee commute survey data from the County. Employee commute VMT were then multiplied by the appropriate emission factors from the EMFAC model.

Vehicle fleet emissions were estimated using the County's most recent fuel consumption data, mileage data, and other vehicle fleet data, provided by the County. Fuel consumption data was multiplied by the appropriate emission factors from the Climate Registry (Climate Registry 2014).

Forecast Methods

Community: VMT data was provided by MTC for 2020. Similar to the inventory methods, the forecast methods used the 2020 VMT data and corresponding emission factors from the EMFAC model to determine community on-road GHG emissions in 2020.

[3] The Emissions Factor (EMFAC) model is a transportation model issued by the California Air Resources Board. It includes a set of emission factors that represent the local vehicle fleet, speeds, and environmental conditions that can be useful in performing project-level air quality modeling.

Municipal: The County's 2020 employee commute emissions were projected using the 2012 employee commute emissions and municipal employment projections provided by the County. Municipal vehicle fleet emissions were projected using municipal employment projections provided by the County.

Off-Road Vehicles and Equipment (Community and Municipal)

Overview

This sector includes GHG emissions from small off-road equipment (e.g., recreational, harbor craft, rail yard, private airport, lawn and garden, agricultural, commercial, and industrial equipment), and County-owned off-road equipment.

Methods Used in Previous Inventory

Off-road vehicles and equipment emissions were not included in the County's previous GHG inventory.

Data and Models

- The California Air Resources Board (CARB) OFFROAD model.
- CARB's Diesel Off-road On-line Reporting System.
- Socioeconomic data for 2012 and 2020, including population, employment by sector, and number of households (Wong pers. comm.).
- Municipal employment data and projections for 2012 and 2020.

Inventory Methods

Community: For quantification of off-road emissions, The County used the 2012 ICLEI Community Protocol as a guide. The 2012 ICLEI Community Protocol recommends using the USEPA's NONROAD model, but this analysis will use CARB's OFFROAD model because it is more specific to California communities than the NONROAD model.

CARB's OFFROAD model provides estimates for emissions at the county level for a variety of off-road equipment types, including construction equipment, lawn and garden equipment, airport ground support equipment, and recreational equipment. The County obtained county-level data from the OFFROAD model or CARB's Diesel Off-road On-line Reporting System (DOORS). This analysis was based on the model's default assumption of annual hours of operation for all equipment in the county.

Emissions resulting from the use of agricultural equipment were included under this sector.

Municipal: A list of County-owned off-road equipment and fuel consumption data for 2012 was used. The fuel consumption data and fuel-GHG emissions factors from the Climate Registry were used to estimate emissions from the County-owned equipment (Climate Registry 2014).

Forecast Methods

Community - 2020 BAU off-road emissions were estimated using 2012 off-road emissions and socioeconomic forecast data (population, housing and jobs). The type of socioeconomic data that

was used depends on the off-road equipment type (e.g. landscaping equipment was projected using housing forecast projections for 2020; industrial equipment was projected using employment projections for 2020).

Municipal – Off-road emissions resulting from County-owned equipment in 2020 were estimated by projecting the 2012 municipal off-road emissions using municipal employment projections provided by the County.

Solid Waste Generation (Community and Municipal)

Overview

This sector includes GHG emissions associated with the decomposition of waste generated by the County.

Methods Used in Previous Inventory

Community: The County's previous community GHG inventory used waste disposal data from the California Integrated Waste Management Board (CalRecycle) and ICLEI's Cities for Climate Protection software.

Municipal: The County's previous municipal GHG inventory used data provided by the Department of Public Works and the ICLEI software.

Data and Models

- Tons of waste sent to landfills in 2012 from the California Department of Resources Recycling and Recovery (CalRecycle) (CalRecycle 2013).
- Landfill characteristics for the Redwood landfill (Waste Management 2014).
- Waste emission factors from the 2012 ICLEI Community Protocol (ICLEI – Local Governments for Sustainability USA 2012).
- Municipal employment data and projections for 2012 and 2020.
- Socioeconomic data for 2012 and 2020, including population, and employment by sector (Wong pers. comm.).
- Municipal waste generation from the County's Department of Public Works.

Inventory Methods

Community: Consistent with the 2012 ICLEI Community Protocol solid waste emissions calculation methods, the County evaluated emissions from solid waste management by considering future indirect emissions resulting from solid waste deposited in the inventory year, as reported by CalRecycle[4], regardless of where that waste is disposed.

Per the 2012 ICLEI Community Protocol for indirect future emissions from community-generated waste during the inventory year, total tons of waste (residential and commercial) sent to landfills in

[4] CalRecycle is California's leading authority on recycling, waste reduction, and product reuse. Officially known as the Department of Resources Recycling and Recovery, CalRecycle plays an important role in the stewardship of California's vast resources and promotes innovation in technology to encourage economic and environmental sustainability.

2012 and waste profile data was combined with equations from ICLEI. Redwood Landfill accepts County waste and has a 90% methane collection rate, which is higher than the industry standard 75% rate. This capture rate was used in place of the default ICLEI capture value to calculate emissions for the County. The ICLEI emission factors for waste cover a variety of waste types (glass, plastic, wood, etc.). These emission factors were multiplied by the corresponding waste amounts (by waste type) generated in the County in 2012 to calculate future indirect emissions. Since the generation-based estimates can identify opportunities for waste reduction measures through source reduction, recycling, or composting, the indirect method results were incorporated into the inventory.

Emissions from composting and combustion of solid waste were not included in the inventory due to data availability issues, as CalRecycle does not provide this data. These sources are likely minor emissions sources.

Municipal: The County's municipal waste emissions were estimated using waste generation data from County facilities provided by the Department of Public Works and the ICLEI equations described above for the Community inventory (Marin County Civil Grand Jury 2014). The county does not own and operate any landfills, so direct site-based landfill emissions were not included.

Forecast Methods

Community: 2020 community solid waste emissions were estimated by projecting 2012 waste generation using population and employment forecast data for residential and commercial waste, respectively.

Municipal: Solid waste emissions resulting from municipal operations in 2020 were estimated by projecting 2012 municipal waste generation using municipal employment projections provided by the County.

Water Conveyance (Community and Municipal)

Water consumption-related emissions originate from energy used to transport, treat, and pump of water to the County, including water consumed at County-owned facilities. Emissions from water conveyance were estimated for the following sources: 1) the energy associated with water usage *inside* the County (such as local pumps distributing water within the County) and 2) energy associated with water transport from *outside* the County (such as regional pumps delivering water from the Russian River in Sonoma County to the County's borders). Electricity used to treat and distribute water locally is captured within the building energy sector; all attempts were made to avoid any double-counting of this energy use and resulting emissions.

Overview

This sector includes GHG emissions associated with water consumption in the County.

Methods Used in Previous Inventory

Water consumption emissions were not included in the County's previous GHG inventory.

Data and Models

- Water consumption (gallons) in (2012) provided by MMWD, NMWD and Stinson Beach County Water District (Armanino pers. comm.).
- Electricity and natural gas use for water treatment and pumping in 2012 provided by MMWD, NMWD and Stinson Beach County Water District (Armanino pers. comm.).
- Water consumption at County-owned facilities in 2012 provided by MMWD and NMWD (Armanino pers. comm.).
- Water supply sources for the County.
- Utility specific electricity GHG emission factors for PG&E (year 2012 data) and regional average emission factors from the U.S. EPA for methane (CH_4) and nitrous oxide (N_2O) (year 2010 data) (USEPA 2014). Marin Clean Energy emission factor for 2012 (Kudo pers. comm.).
- GHG emission factors for natural gas for 2012 (Pacific Gas and Electric 2013).
- Socioeconomic data for 2012 and 2020, including population and jobs (Wong pers. comm.).
- Municipal employment data and projections for 2012 and 2020.

Inventory Methods

Community: Water is provided to the County by the Marin Municipal Water District (MMWD), the North Marin Water District (NMWD), and the Stinson Beach County Water District (SBWD). Actual electricity and natural gas use for water treatment and pumping in the County (provided by MMWD, NMWD, and SBWD) was used to develop emissions. County-wide energy use was apportioned to the Unincorporated County using service population figures. Water-related energy use was subtracted from the building energy sector to avoid double-counting. T&D losses associated with water-related electricity were also included in this sector (details provided in the building energy sector section). Emissions calculations were based on electricity emission factors as described in the building energy sector.

Municipal: Municipal water consumption was provided by the water districts. Total gallons of water were multiplied by energy intensity factors derived from the community-level data provided by the water districts, as listed above (on a per gallon basis). T&D losses associated with water-related electricity were also included in this sector (details provided in the building energy sector section). Emissions calculations were based on electricity emission factors as described in the building energy sector.

Forecast Methods

Community: 2020 BAU water consumption estimates were developed using population growth.

Municipal: 2020 BAU municipal water consumption emissions were projected from 2012 municipal water consumption emissions using municipal employment projections provided by the County.

Wastewater Treatment (Community and Municipal)

Overview

This sector includes GHG emissions from the treatment of industrial, residential, commercial, and municipal wastewater produced within the County.

Methods Used in Previous Inventory

Wastewater treatment emissions were not included in the County's previous GHG inventory.

Data and Models

- 2012 ICLEI Community Protocol equations for emissions calculations (ICLEI – Local Governments for Sustainability USA 2012).
- Wastewater treatment data from the sanitation districts who operate wastewater treatment plants (WWTPs) in the County (Armanino pers. comm.).
- Wastewater flow projections for 2020 from the sanitation districts (Armanino pers. comm.).
- Urban Water Management Plans for the County (MMWD 2010; NMWD 2010).
- Socioeconomic data for 2012 and 2020, including population and jobs (Wong pers. comm.).
- Municipal employment data and projections for 2012 and 2020.

Inventory Methods

Community: The County is served by the following wastewater treatment plants:

- Bolinas Community Public Utility District
- Central Marin Sanitary Agency
- Las Gallinas Valley Sanitary District
- North Marin Water District (provides treatment services to Dillon Beach area)
- Novato Sanitary District
- Sausalito-Marin City Sanitary District
- Sewerage Agency of Southern Marin
- Tomales Village Community Services District

The energy consumed to operate any WWTP that is located within the County's borders was included in the building energy sector. GHG emissions from electricity and natural gas consumption at wastewater treatment plants were calculated according to the 2012 ICLEI Community Protocol, as described above in the building energy sector.

Fugitive emissions from wastewater treatment were calculated following the 2012 ICLEI Community Protocol based on actual WWTP characteristics, provided by the wastewater treatment agencies. This information includes population served, cubic feet of digester gas produced and

combusted per day, fraction of methane in digester gas, BOD5 load[5], the fraction of BOD5 removed during treatment, gallons of wastewater treated per day, and information regarding any existing methane capture, combustion, or energy conversion programs. GHG emissions from septic systems were estimated and based on the county's inventory of septic tanks and general septic tank characteristics.

Municipal: To estimate wastewater emissions resulting from municipal operations, the 2012 ICLEI Community Protocol as described above was used to calculate emissions from wastewater generated by municipal facilities. This sector only includes emissions resulting from municipal wastewater generation.

Forecast Methods

Community: 2020 BAU wastewater emissions were estimated by collecting wastewater projection estimates (including projected wastewater flows) from the WWTPs serving the County, where available. Where this data was not available, 2012 year data was projected using population forecasts.

Municipal: 2020 BAU municipal wastewater emissions were projected from 2012 municipal wastewater emissions using municipal employment projections provided by the County.

Stationary Sources (Community and Municipal)

Industrial/Commercial/Municipal

Overview

This sector includes GHG emissions from nonresidential stationary (typically industrial) combustion of fossil fuels of any type *except* natural gas (accounted for in the building energy use sector) and fugitive emissions from industrial processes in the County.

Methods Used in Previous Inventory

Stationary Sources emissions were not included in the County's previous GHG inventory.

Data and Models

- GHG emissions for fuel consumption from the Bay Area Air Quality Management District (BAAQMD) by facility.
- GHG emissions data from USEPA MRR database and CARB's online GHG Emissions Reporting Tool.
- Emission factors from the CalEEMod model (South Coast Air Quality Management District 2013).
- Emission factors from the USEPA, CARB, the 2012 ICLEI Community Protocol, and Climate Registry protocols.
- Fuel consumption in 2012 for all County-owned stationary sources from the County Department of Public Works (e.g. emergency generators) (Armanino pers. comm.).

[5] Biochemical oxygen demand of wastewater during decomposition occurring over a 5-day period

- Socioeconomic data for 2012 and 2020, including square footage of commercial and industrial establishments, and employment by sector (Wong pers. comm.).
- Municipal employment data and projections for 2012 and 2020.

Inventory Methods

Community: The methods used to quantify GHG emission from stationary sources were consistent with the 2012 ICLEI Community Protocol. GHG emissions data for all facilities in Marin County under BAAQMD's jurisdiction was provided by the BAAQMD. This data was supplemented by emissions data from the USEPA MRR database and from CARB's online GHG Emissions Reporting Tool for large facilities, as necessary.

Municipal: Characteristics for all stationary sources owned by the County (such as Emergency Stand-By Generator, and diesel pumps), including horsepower, engine type, fuel type, and hours of operation were used to develop emissions. Emission factors from the CalEEMod model for the appropriate equipment type were used to calculate GHG emissions from municipal stationary source equipment (South Coast Air Quality Management District 2013).

Forecast Methods

Community: 2020 BAU stationary source emissions were estimated by projecting 2012 year data using total employment estimated in 2020.

Municipal: 2020 BAU municipal stationary source emissions were projected from 2012 municipal stationary source emissions using municipal employment projections provided by the County.

Residential (Community)

Overview

Calculation of GHG emissions from residential combustion of fossil fuels of any type *except* natural gas (accounted for in the building energy use sector). This includes fuel oil, propane, kerosene, and wood.

Data and Models

- U.S. Census data from the American Community Survey (ACS) (U.S. Census. 2012).
- Energy Information Administration's (EIA) Residential Energy Consumption Survey dataset (Energy Information Administration 2013a).
- EIA State Energy Data System (SEDS) (Energy Information Administration 2013b).
- Emission factors from the USEPA, CARB, the 2012 ICLEI Community Protocol, and Climate Registry protocols.
- Socioeconomic data for 2012 and 2020, including population, employment by sector, and number of households (Wong pers. comm.).

Inventory Methods

The County used quantification methods consistent with the 2012 ICLEI Community Protocol to quantify GHG emissions from residential fuel combustion. The number of households in the County

that use each type of fuel was determined using information from the EIA and the ACS. Fuel consumption for each fuel type was calculated using state-level fuel use from the EIA SEDS. This fuel use was multiplied by emission factors from the USEPA, CARB, the 2012 ICLEI Community Protocol, and Climate Registry protocols (as appropriate) to determine emissions.

Forecast Methods

2020 BAU residential fuel use emissions were estimated by projecting 2012 year data using housing forecasts.

Refrigerants (Municipal)

Overview

This sector includes GHG emissions from the leakage of refrigerants that contain or consist of HFC compounds which contribute to global warming. These chemicals are used in refrigeration, fire suppression equipment, air conditioners, and chillers. Through the installation, use, and disposal of these systems and products, leaks are likely to occur. Although the leaks are generally small, emissions may be significant because these chemicals typically have high GWPs.

Methods Used in Previous Inventory

Refrigerant emissions were not included in the County's previous GHG inventory.

Data and Models

- Refrigerant purchases and usage.
- GPWs from the LGOP and the IPCC (California Air Resources Board et. al. 2010; Intergovernmental Panel on Climate Change 2013).
- Municipal building construction information.

Inventory Methods

The 2012 ICLEI Community Protocol and the LGOP were used to quantify emissions from refrigerant use. Total refrigerant purchases by refrigerant type and by weight from 2011-2013 were used to estimate refrigerant emissions. Refrigerant replacement and leakage values were not available, so it was assumed that the purchases roughly equal the amount of refrigerant leakage. Three years of refrigerant purchase data was used to calculate an average annual refrigerant usage rate, which was assumed to be equal to the refrigerant leakage rate.

The County uses the following refrigerants: R-22, R-410A (GWP = 1,725), R-407C (GWP = 1,526), R-134a (GWP = 1,300), and R-404 (GWP = 3,620). R-22 is currently being phased out under the Montreal Protocol and is not classified as GHG under the Kyoto Protocol; as such, the LGOP recommends that R-22 should not be included in any emissions inventory and R-22 was therefore not included in the inventory for the County.

Total annual purchases of each refrigerant were multiplied by the corresponding GWPs to estimate emissions from refrigerants.

Forecast Methods

2020 BAU refrigerant emissions were projected using the growth in municipal building energy use (see building energy sector above). Building energy use represents a reasonable proxy for the amount of refrigerants used in buildings.

Agriculture (Community Only)

Overview

This sector includes GHG emissions from manure management (fugitive emissions of methane and nitrous oxide), enteric fermentation (fugitive emissions of methane and nitrous oxide), and fertilizer use (fugitive emissions of nitrous oxide).

Data and Models

- Marin County Crop Report for 2012 (Marin County Department of Agriculture 2013)
- United States Department of Agriculture (USDA) Census of Agriculture (U.S. Department of Agriculture n.d.).
- Standard emissions factors from USEPA, CARB, and ICLEI (USEPA 2014; CARB 2011; ICLEI – Local Governments for Sustainability USA 2012).
- *A Low-Cost, High-Benefit Approach to Climate Change Mitigation* (Silver and Ryals 2009)
- CropScape GIS database from the National Agricultural Statistics Service (NASS) (U.S. Department of Agriculture 2013).

Methods Used in Previous Inventory

The County's previous inventory calculated livestock-related agricultural emissions using livestock population data from the U.S. Department of Agriculture's National Agriculture Statistics Service. Methane and N_2O emissions from livestock were calculated using the EPA's 1999 Emission Inventory Improvement Program handbook. Only livestock-related emissions were estimated for this sector.

Inventory Methods

Emissions from agricultural vehicles were based on county-wide activity levels of these vehicles, based on the OFFROAD model outputs (these emissions were included in the Off-Road Transportation and Equipment sector). It should be noted that the 2012 ICLEI Community Protocol does not include agricultural vehicle-related emissions with other agricultural emissions.

Manure management emissions were calculated using livestock population numbers from the Agriculture Commissioner and the United States Department of Agriculture (USDA) agriculture census. Standard emissions factors from USEPA and CARB, and 2012 ICLEI Community Protocol equations specific to manure management were used to estimate emissions resulting from manure use for the livestock population in the county. Similarly, emissions resulting from enteric fermentation were calculated using livestock population numbers from the Agriculture Commissioner or USDA's agriculture census, standard emissions factors from CARB and USEPA, and 2012 ICLEI Community Protocol equations specific to enteric fermentation.

Emissions resulting from fertilizer use were calculated using the number of acres treated with fertilizers from the USDA's agriculture census for the years 2000 through 2010 (U.S. Department of Agriculture n.d.). Standard fertilizer use emission factors from CARB will also be used in estimating fertilizer emissions.

Forecast Methods

Manure management and enteric fermentation emissions were not forecast due to uncertainty regarding future change in land cover types and livestock numbers in the County.

Fertilizer emissions were forecast using an estimate of acres by crop type in 2020 by using historical trends from 2008 to 2012. Fertilizer rates from the 2009 USDA survey data were applied to the 2020 forecasted crop acreages.

Community Emissions Sectors for Informational Purposes Only

The following sectors are presented as informational items but were not added to the emissions total for the community inventory or forecast.

Forestry

Overview

Calculation of GHG emissions sinks from carbon sequestration from outside the agricultural sector in forest, timberland, scrubland, non-rangeland grasslands and wetlands as well as urban forests.

Data and Models

- CropScape GIS database from NASS (U.S. Department of Agriculture 2013)
- Carbon stock values from the California Energy Commission (CEC) (Brown et. al. 2004)
- *Carbon Sequestration in California Agriculture, 1980-2000* (Kroodsma and Field 2006)

Methods Used in Previous Inventory

Forestry emissions were not included in the County's previous GHG inventory.

Inventory Methods

Urban forests and rural non-agricultural land covers (such as forests) can be long-term emissions sinks, depending on management since these natural areas actively sequester atmospheric carbon dioxide during their growth cycle. Rural lands that are not developed or used for agriculture can include conservation areas, state and national forests, private forests and timberland[6], scrubland,

[6] Timberland may or may not be a long-term sink, at least in terms of woody biomass. Depending on the harvesting schedule, timberland can be a source of net emissions (if there is a declining amount of biomass) or a net sink of emissions (if there is an increasing amount of biomass).

grassland, wetlands, and other covers. "Urban forests" refers to trees planted within developed areas, including residential trees, urban city parks, median trees, etc.

Calculating sequestration from rural land covers and urban forestry is often highly speculative due to lack of data and the inherent uncertainties associated with vegetation-based carbon accounting. As such, the inventory includes a qualitative evaluation of data sources and methods for calculating these emissions; quantification can be challenging depending on the data availability.

The majority of calculations were performed using regional estimates of sequestration potentials and carbon stock values. Annual sequestration rates from the CEC for deciduous forest, mixed forest, and evergreen forest were used to calculate emission sinks (Brown et. al. 2004). Forest land, scrub lands, and grasslands typically occur throughout large, contiguous areas. Consequently, sequestration rates were roughly estimated on a landscape level because the acreage of each land cover type is known.

Acreage data by land cover type for the unincorporated County was obtained from the National Agricultural Statistics Service (NASS), which has broad land cover data based on aerial photography for 2012. Acres for each land type were multiplied by the sequestration values to determine GHG emission sinks in the forestry sector.

Forecast Methods

A forecast of forestry sequestration was not conducted due to uncertainty regarding future change in land cover types in the County.

Rangeland Soil Carbon Stock

Overview

Carbon storage in rangeland soils represents total storage and not sequestration or GHG flux. Units presented in the inventory and forecast are in metric tons of carbon, not carbon dioxide equivalent (note: carbon storage in non-rangeland soils was not included due to lack of data).

Data and Models

- *A Low-Cost, High-Benefit Approach to Climate Change Mitigation* (Silver and Ryals 2009)
- Acreage values from the Marin County 2012 Crop Report (Marin County Department of Agriculture 2013).

Methods Used in Previous Inventory

Rangeland soil carbon was not included in the County's previous GHG inventory.

Inventory Methods

Rangeland acreage for 2012 as defined in the Marin County Crop Report for 2012 was multiplied by Marin/Sonoma soil carbon values to determine the amount of carbon stored in County rangelands. The soil carbon values (in MG C/ha) for a depth of 1 meter were obtained from the report *Soil Carbon Sequestration: A Low-Cost, High-Benefit Approach to Climate Change Mitigation* (Silver and Ryals 2009).

Forecast Methods

A forecast of soil carbon stock was not conducted due to uncertainty regarding future change in land cover types in the County.

Aboveground Carbon Stock

Overview

This sector represents carbon stock in aboveground biomass in the County. This is not a source or sink of GHG emissions; it represents the total amount of carbon storage in biomass in 2012. Units presented are in metric tons of carbon, not carbon dioxide equivalent.

Data and Models

- CropScape GIS database from NASS (U.S. Department of Agriculture 2013)
- Carbon stock values from the USEPA and the CEC (USEPA 2010; Brown et. al. 2004)

Methods Used in Previous Inventory

Aboveground carbon stock was not included in the County's previous GHG inventory.

Inventory Methods

Acreage data by land cover type for the unincorporated County in 2012 was obtained from NASS. Land cover types used in this analysis include coniferous forest, croplands (not vineyards or rangeland/pastureland), rangeland/pasture, oak woodlands/riparian woodlands, shrublands, and vineyards. Acres for each land type were multiplied by carbon stock factors from the USEPA and the CEC to determine total aboveground carbon stock (USEPA 2010; Brown et. al. 2004).

Forecast Methods

A forecast of aboveground carbon stock was not conducted due to uncertainty regarding future change in land cover types in the County.

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Armanino, D. Planner, Sustainability Team, Marin County Community Development Agency. San Rafael, California. October 23, 2013. Email message to Brian Schuster (ICF International) with Marin County municipal recycling data, employee commute data, water use data, and fuel use data.

Brazil, H. Planner, Metropolitan Transportation Commission. Oakland, California. October 29, 2013. Email message to Brian Schuster (ICF International) with Marin County vehicle miles traveled data.

Kudo, J. Account Manager II, Marin Clean Energy. San Rafael, California. November 5, 2013. Email message to Brian Schuster (ICF International) with Marin County electricity use data.

Kudo, J. Account Manager II, Marin Clean Energy. San Rafael, California. April 22, 2014. Email message to Brian Schuster (ICF International) with MCE emission factor data.

Wong, H. Senior Regional Planner, Association of Bay Area Governments (ABAG). Oakland, California. December 5, 2013. Email message to Brian Schuster (ICF International) with Marin County socioeconomic data.

Appendix C
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 Unincorporated Marin County (County) Climate Action Plan 2014 Update (CAP Update). Both community and municipal reduction measures are detailed in this appendix. 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 County, 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.

Summary of Community GHG Reductions and Costs

Table C-1 summarizes community GHG reductions, costs, and savings, as available. Estimated costs and savings would be incurred by the private sector (e.g., County residents and businesses). County costs associated with CAP implementation are not included in the analysis, but are discussed qualitatively in Chapter 6, *Greenhouse Gas Reduction Measure Implementation Program*.

Table C-1. Summary of GHG Reductions, Costs, Savings, and Benefits Associated with Local Community Emissions Reduction Strategies

Strategy Area	Local Strategy	2020 GHG Reduction	Saving (cost) per MT Reduced	Net Present Value (cost)[a]	Payback (years)
ENERGY EFFICIENCY & RENEWABLE ENERGY	Energy-1. Community Choice Aggregation	2,744	Not estimated	Not estimated	Not estimated
	Energy-2.1. Community Energy Efficiency Retrofits	1,925	Not estimated	Not estimated	Not estimated
	Energy-2.2. Expand Community Energy Efficiency Retrofits Program	5,601	$340-$480	$22,000,000-$31,000,000	2-5
	Energy-2.3. Tree Planting	23	Not estimated	Not estimated	Not estimated
	Energy-3.1. Solar Installations for New Residential Development[b]	34	$23–$196 (DP); $160-$320 (PPA)	$11,000-$93,000 (DP) $74,000-$149,000 (PPA)	13-15 (DP); 0 (PPA)
	Energy-3.2. Solar Installations for New Nonresidential Development[b]	23	$27–$396 (DP); $150–$300 (PPA)	$8,700-$130,000 (DP) $49,000-$97,000 (PPA)	10-15 (DP) 0 (PPA)
	Energy-3.3. Solar Installations for Existing Residential Development[b]	3,950	$21–$179 (DP); $137–$280 (PPA)	$1,000,000-$10,000,000 (DP) $7,000,000-$15,000,000 (PPA)	13-15 (DP); 0 (PPA)
	Energy-3.4. Solar Installations for Existing Nonresidential Development[b]	3,086	$25–$502 (DP); $123–$247 (PPA)	$1,000,000-$22,000,000 (DP) $5,000,000-$10,000,000 (PPA)	10-15 (DP); 0 (PPA)
LAND USE & TRANSPORTATION	Trans-1.1 Promote Mixed Use, Infill, and Transit-Oriented Developments	44	Not estimated	Not estimated	Not estimated
	Trans-1.2. Support Regional Carpool and Vanpool Programs	0	Not estimated	Not estimated	Not estimated
	Trans-1.3. VMT Reduction Monitoring and Implementation and Transportation Demand Management Program	76	Not estimated	Not estimated	Not estimated
	Trans-1.4. Support Alternate Work Schedules and Telecommute Programs	0	Not estimated	Not estimated	Not estimated
	Trans-1.5. Transportation Marketing	2,715	Not estimated	Not estimated	Not estimated
	Trans-2.1. Expand Transit Service	183	Not estimated	Not estimated	Not estimated
	Trans-3.1. Electric-Powered Electric Landscaping Equipment	84	Not estimated	Net Saving[c]	Not estimated[d]
WASTE	Waste-1. Zero Waste by 2025	2,995	Not estimated	Not estimated	Not estimated

Strategy Area	Local Strategy	2020 GHG Reduction	Saving (cost) per MT Reduced	Net Present Value (cost)[a]	Payback (years)
REDUCTION, REUSE, AND RECYCLING					
 WATER CONSERVATION AND WASTEWATER TREATMENT	Water/Wastewater-1.1. Senate Bill X7-7	946	Not estimated	Not estimated	Not estimated
	Water/Wastewater-1.2. Additional Water Conservation for New Construction	134	Not estimated	Not estimated	Not estimated
	Water/Wastewater-1.3. Additional Water Conservation for Existing Buildings	134	Not estimated	Not estimated	Not estimated
	Water/Wastewater-2. Increase Pump Efficiency	109	Not estimated	Not estimated	Not estimated
	Water/Wastewater-3. Reduce Wastewater Generation	1,898	Not estimated	Not estimated	Not estimated
 AGRICULTURE	Agriculture-1. Methane Capture and Combustion at Dairies and Livestock Operations	4,638	Not estimated	Not estimated	Not estimated
 GHG PERFORMANCE STANDARD	PS-1. GHG Performance Standard for New Development	1,920	Not estimated	Not estimated	Not estimated

Notes:

DP = direst purchase; Not estimated = strategies that do not currently support a quantitative cost and savings analysis, even though the strategy has been evaluated from an emissions reduction standpoint; PPA = power purchase agreement.

[a] Net Present Value is defined as the difference between the present value of cash inflows and the present value of cash outflows. A positive NPV means the reduction measure will save money over the project lifetime, and a negative NPV means the measure will have a cost.

[b] The cost analysis considered two financing scenarios:

Direct Purchase**:** The purchasing entity (e.g., homeowner for Energy-3.1, business owner for Energy-3.2) is assumed to directly purchase, install and maintain the solar photovoltaic (PV) system.

Power Purchase Agreement: The purchasing entity enters into a PPA with a local company who owns and maintains the solar panels.

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

[d] 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.

Table C-2 summarizes the total upfront costs, annual savings/costs, and entities incurring the costs/savings for all quantified strategies. While Table C-1 above presents metrics of cost-effectiveness (e.g., cost per $MTCO_2e$, net present value, and payback periods), Table C-2 reflects the total upfront and annual costs and savings that would be incurred to achieve the community emissions reduction target.

Table C-2. Total Upfront Costs and Annual Savings/Costs Associated with CAP Implementation

Strategy Area	Local Strategy	Upfront (One-Time Cost)		Annual	
		Cost[a]	Incurring Entity	Saving (Cost)[a]	Incurring Entity
ENERGY EFFICIENCY & RENEWABLE ENERGY	Energy-1. Community Choice Aggregation	Not estimated	• Marin Clean Energy	Not estimated	• Homeowners • Tenants
	Energy-2.1. Community Energy Efficiency Retrofits	$6,000,000-$15,000,000	• Building Owners	$3,000,000	• Building Owners • Tenants
	Energy-2.2. Expand Community Energy Efficiency Retrofits Program	Not estimated	• Building Owners	Not estimated	• Building Owners • Tenants
	Energy-2.3. Tree Planting	Not estimated	• Marin County • Developers (due to tree planting requirements for new development)	Not estimated	
	Energy-3.1. Solar Installations for New Residential Development[b]	$570,000-650,000	• Building Owners • Developers	$46,000 (DP); $4,900–$9,800 (PPA)	• Building Owners • Tenants
	Energy-3.2. Solar Installations for New Nonresidential Development[b]	$340,000–$420,000	• Building Owners • Developers	$30,000-$36,000 (DP); $3,200–$6,400 (PPA)	• Building Owners • Tenants
	Energy-3.3. Solar Installations for Existing Residential Development[b]	$61,000,000–$70,000,000	• Building Owners	$4,900,000 (DP); $526,000–$1,000,000 (PPA)	• Building Owners • Tenants
	Energy-3.4. Solar Installations for Existing Nonresidential Development[b]	$43,000,000–$53,000,000	• Building Owners	$3,700,000–$4,500,000 (DP); $400,000–$800,000 (PPA)	• Building Owners • Tenants
LAND USE & TRANSPORTATION	Trans-1.1 Promote Mixed Use, Infill, and Transit-Oriented Developments	Not estimated	• Marin County • Developers	Not estimated	• Developers • Residents • Business owners
	Trans-1.2. Support Regional Carpool and Vanpool Programs	Not estimated		Not estimated	
	Trans-1.3. VMT Reduction Monitoring and Implementation and Transportation Demand Management Program	Not estimated	• Marin County • Businesses	Not estimated	• Marin County • Vehicle owners • Businesses

Strategy Area	Local Strategy	Upfront (One-Time Cost)		Annual	
		Cost[a]	Incurring Entity	Saving (Cost)[a]	Incurring Entity
	Trans-1.4. Support Alternate Work Schedules and Telecommute Programs	Not estimated	• Marin County • TAM • Businesses	Not estimated	• Marin County • Vehicle owners • Businesses
	Trans-1.5. Transportation Marketing	Not estimated	• Marin County • Businesses	Not estimated	• Vehicle owners • Businesses
	Trans-2.1. Expand Transit Service	Not estimated	• Marin County • Marin Transit	Not estimated	• Residents • Business owners
	Trans-3.1. Electric-Powered Electric 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, assuming 960 hours of operation.	• Equipment owners/renters
WASTE REDUCTION, REUSE, AND RECYCLING	Waste-1. Zero Waste by 2025	Not estimated	N/A	Not estimated	• Marin County • Waste haulers
WATER CONSERVATION AND WASTEWATER TREATMENT	Water/Wastewater-1.1. Senate Bill X7-7	Not estimated	• Water Agencies • Homeowners • Building owners	Not estimated	• Homeowners, • Building owners • Tenants
	Water/Wastewater-1.2. Additional Water Conservation for New Construction	Not estimated	• Homeowners • Developers	Not estimated	• Homeowners, • Building owners • Tenants
	Water/Wastewater-1.3. Additional Water Conservation for Existing Buildings	Not estimated	• Homeowners • Building owners	Not estimated	• Homeowners, • Building owners • Tenants
	Water/Wastewater-2. Increase Pump Efficiency	Not estimated	• Water Agencies •	Not estimated	• Water Agencies

Strategy Area	Local Strategy	Upfront (One-Time Cost)		Annual	
		Cost[a]	Incurring Entity	Saving (Cost)[a]	Incurring Entity
	Water/Wastewater-3. Reduce Wastewater Generation	Not estimated	• Water Agencies • Homeowners • Building owners	Not estimated	• Homeowners, • Building owners • Tenants
 AGRICULTURE	Agriculture-1. Methane Capture and Combustion at Dairies and Livestock Operations	Not estimated	• Dairies and Livestock facility operators	Not estimated	• Dairies and Livestock facility operators
 GHG PERFORMANCE STANDARD	PS-1. GHG Performance Standard for New Development	Not estimated	• Developers	Not estimated	• Homeowners, • Building owners • Tenants

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 Energy-3.1, business owner for Energy-3.2) is assumed to directly purchase and install the solar photovoltaic (PV) system. Power Purchase Agreement (PPA): The purchasing entity enters into a PPA with a local company who owns and maintains the solar panels.

Table C-3 highlights costs and savings at the project-level for several community 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 5 years.

Table C-3. Example Project-Level Costs and Savings for Community Measures

Measure	Action	Project Details	Upfront Cost	Annual Costs/Savings	Net Lifetime Costs/Savings[a]	Payback (years)
Energy-2.3. Expand Community Energy Efficiency Retrofits Program	Achieve the following residential energy efficiency retrofit goals by 2020 for a 4-unit, Multi-Family Home	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.	$10,170	$2,200	$16,300	5
Energy-3.1. Solar Installations for New Residential Development	Direct Purchase Solar Installation on Residential Homes	Install a 4kW solar photovoltaic system on residential roof-top, fixed tilt.	$13,960-$15,960	$1,100	$300-$2,300	13-15
	Power Purchase Agreement (PPA) Solar Installation on Residential Homes	Install a 4kW solar photovoltaic system on residential roof-top, fixed tilt.	—[b]	$120-$240	$1,700-$3,500	0
Energy-3.2. Solar Installations for New Non-Residential Development	Direct Purchase Solar Installation on Nonresidential buildings	Install a 40kW solar photovoltaic system on an existing commercial building roof-top, fixed tilt.	$120,400-$148,400	$10,400-$12,600	$3,000-$45,800	10-15
	Power Purchase Agreement (PPA) Solar Installation on Nonresidential buildings	Install a 40kW solar photovoltaic system on an existing commercial building roof-top, fixed tilt.	—[b]	$1,100-$2,200	$16,300-$32,500	0
Energy-3.3. Solar Installations for Existing Residential Development	Direct Purchase Solar Installation on Residential Homes	Install a 4kW solar photovoltaic system on residential roof-top, fixed tilt.	$13,960-$15,960	$1,100	$300-$2,300	13-15
	Power Purchase Agreement (PPA) Solar Installation on Residential Homes	Install a 4kW solar photovoltaic system on residential roof-top, fixed tilt.	—[b]	$120-$240	$1,700-$3,500	0
Energy-3.4. Solar Installations for Existing Non-Residential Development	Direct Purchase Solar Installation on Nonresidential buildings	Install a 40kW solar photovoltaic system on an existing commercial building roof-top, fixed tilt.	$120,400-$148,400	$10,400-$12,600	$3,000-$45,800	10-15
	Power Purchase Agreement (PPA) Solar Installation on Nonresidential buildings	Install a 40kW solar photovoltaic system on an existing commercial building roof-top, fixed tilt.	—[b]	$1,123-$2,246	$16,271-$32,543	0

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.

Summary of Municipal GHG Reductions and Costs

Table C-4 summarizes municipal GHG reductions, costs, and savings, as available for each local measure. Estimated costs and savings would be incurred by the County. County costs associated with CAP implementation, including staff time to prepare ordinances, develop new programs, or other staff costs associated with strategy development or implementation are not included in the analysis, but are discussed qualitatively in Chapter 6, *Greenhouse Gas Reduction Measure Implementation Program*.

Table C-4. Summary of GHG Reductions, Costs, Savings, and Benefits Associated with Local Municipal Emissions Reduction Strategies

Strategy Area	Local Strategy	2020 GHG Reduction	Saving (cost) per MT Reduced	Net Present Value (cost)[a]	Payback (years)
ENERGY EFFICIENCY AND RENEWABLE ENERGY	Energy-1.1. Energy Efficiency Measures for the new Emergency Operations Facility	222	Not estimated	Not estimated	Not estimated
	Energy-1.2. Existing Building Retrofit Program	55	($2,200)-($1,300)	($1,400,000)-($800,000)	30-44
	Energy-1.3. Energy Efficiency Measures for County-Owned Computers and Printers	6	$336-$2,368	$9,000-$64,000	Net saving
	Energy-1.4. Computer Energy Management	46	$1,083	$538,000	1
	Energy-1.5. Shade Tree Planting	1	$846-$2,077	($846) – ($2,000)	Net cost
	Energy-1.6. Install energy-efficient street lights	11	Not estimated	Not estimated	Not estimated
	Energy-2.1. Install solar panels on municipal facilities	42	$10-$214 (DP); $117-$234 (PPA)	$5,900-$127,000 (DP); $70,000-$139,000 (PPA)	12-15 (DP); 0 (PPA)
	Energy-2.2. Solar Panel Carports and Parking Areas[b]	68	$10-$214 (DP); $117-$234 (PPA)	$9,600-$205,000 (DP); $113,000-$225,000 (PPA)	12-15 (DP); 0 (PPA)
VEHICLE FLEET AND EMPLOYEE COMMUTE	Trans-1.1. Purchase fuel efficient (e.g., hybrid) and/or smaller fleet vehicles to replace existing fleet vehicles	17	Not estimated	Not estimated	Not estimated
	Trans-1.2. Electric Vehicles	42	Not estimated	Not estimated	Not estimated
	Trans-1.3. Electric Landscaping Equipment	3	Not estimated	Not estimated	Net Saving
	Trans-2.1. Guaranteed Ride Home	1	Not estimated	Not estimated	Not estimated
	Trans-2.2. Green Commute Program	342	Not estimated	Not estimated	Not estimated
	Trans-3.1. Encourage telecommuting by municipal employees	51	Not estimated	Not estimated	Not estimated
	Trans-3.2. Municipal Parking Management	388	Not estimated	Not estimated	Not estimated
WASTE REDUCTION, REUSE, AND RECYCLING	Waste-1. Increase Recycling at County Facilities	35	Not estimated	Not estimated	Not estimated

Strategy Area	Local Strategy	2020 GHG Reduction	Saving (cost) per MT Reduced	Net Present Value (cost)[a]	Payback (years)
 WATER CONSERVATION AND WASTEWATER TREATMENT	Water/Wastewater-1.1. Water Conservation for Existing Buildings	100	Not estimated	Not estimated	Not estimated
	Water/Wastewater-1.2. Irrigation Monitoring and Management System	1	Not estimated	Not estimated	Not estimated

Notes:

DP = direst purchase; Not estimated = strategies that do not currently support a quantitative cost and savings analysis, even though the strategy has been evaluated from an emissions reduction standpoint; PPA = power purchase agreement.

[a] Net Present Value is defined as the difference between the present value of cash inflows and the present value of cash outflows. A positive NPV means the reduction measure will save money, and a negative NPV means the measure will have a cost.

[b] The cost analysis considered two financing scenarios:

Direct Purchase (DP)**:** The purchasing entity (the County) is assumed to directly purchase and install the solar photovoltaic (PV) system.

Power Purchase Agreement (PPA): The purchasing entity enters into a PPA with a local company who owns and maintains the solar panels.

Table C-5 summarizes the total upfront costs, annual savings/costs, and entities incurring the costs/savings for all quantified strategies. While Table C-4 above presents metrics of cost-effectiveness (e.g., cost per $MTCO_2e$, net present value, and payback periods), Table C-5 reflects the total upfront and annual costs and savings that would be incurred to achieve the municipal emissions reduction target.

Table C-5. Total Upfront Costs and Annual Savings/Costs Associated with CAP Implementation

Strategy Area	Local Strategy	Upfront (One-Time Cost)		Annual	
		Cost	Incurring Entity	Saving (Cost)[a]	Incurring Entity
ENERGY EFFICIENCY AND RENEWABLE ENERGY	Energy-1.1. Energy Efficiency Measures for the new Emergency Operations Facility	Not estimated	Marin County	Not estimated	Marin County
	Energy-1.2. Existing Building Retrofit Program	$1,400,000-$2,000,000	Marin County	$45,000	Marin County
	Energy-1.3. Energy Efficiency Measures for County-Owned Computers and Printers	$15,000-$70,000	Marin County	$7,500	Marin County
	Energy-1.4. Computer Energy Management	$52,000	Marin County	$55,000	Marin County
	Energy-1.5. Shade Tree Planting	$8,000	Marin County	($800)-($2,000)	Marin County
	Energy-1.6. Install energy-efficient street lights	Not estimated	Marin County	Not estimated	Marin County
	Energy-2.1. Install solar panels on municipal facilities	$520,000-$640,000 (DP); $0 (PPA)	Marin County	$45,000 (DP); $4,800-$9,600 (PPA)	Marin County
	Energy-2.2. Solar Panel Carports and Parking Areas[b]	$840,000-$1,000,000 (DP); $0 (PPA)	Marin County	$72,000 (DP); $7,800-$15,500 (PPA)	Marin County
VEHICLE FLEET AND EMPLOYEE COMMUTE	Trans-1.1. Purchase fuel efficient (e.g., hybrid) and/or smaller fleet vehicles to replace existing fleet vehicles	Not estimated	Marin County	Not estimated	Marin County
	Trans-1.2. Electric Vehicles	Not estimated	Marin County	Not estimated	Marin County
	Trans-1.3. Electric Landscaping Equipment	Total costs not quantified. Upfront cost assumed to be negligible; equipment costs vary significantly based on other features besides energy source.	Marin County	Annual cost savings associated with an electric leafblower or chainsaw estimated at between $500-$600 per unit, assuming 960 hours of operation.	Marin County
	Trans-2.1. Guaranteed Ride Home	Not estimated	Marin County	Not estimated	Marin County
	Trans-2.2. Green Commute Program	Not estimated	Marin County	Not estimated	Marin County
	Trans-3.1. Encourage telecommuting by municipal employees	Not estimated	Marin County	Not estimated	Marin County
	Trans-3.2. Municipal Parking Management	Not estimated	Marin County	Not estimated	Marin County

Strategy Area	Local Strategy	Upfront (One-Time Cost)		Annual	
		Cost	Incurring Entity	Saving (Cost)[a]	Incurring Entity
 WASTE REDUCTION, REUSE, AND RECYCLING	Waste-1. Increase Recycling at County Facilities	Not estimated	Marin County	Not estimated	Marin County
 WATER CONSERVATION AND WASTEWATER TREATMENT	Water/Wastewater-1.1. Water Conservation for Existing Buildings	Not estimated	Marin County	Not estimated	Marin County
	Water/Wastewater-1.2. Irrigation Monitoring and Management System	Not estimated	Marin County	Not estimated	Marin County
	Water/Wastewater-2. Recycled Water	Not estimated	Marin County	Not estimated	Marin County

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 (the County) is assumed to directly purchase and install the solar photovoltaic (PV) system. Power Purchase Agreement (PPA): The purchasing entity enters into a PPA with a local company who owns and maintains the solar panels.

Table C-6 highlights costs and savings at the project-level for several municipal emissions reduction strategies. All projects would require upfront costs, but ultimately result in cost savings over the lifetime of the improvement. Solar Installations on Carports and Parking Areas is anticipated to be one of the most cost-effective strategies, with a payback period of 0 years.

Table C-6. Example Project-Level Costs and Savings for Municipal Measures

Measure	Action	Project Details	Upfront Cost	Annual Costs/Savings	Net Lifetime Costs/Savings[a]	Payback (years)
Energy-1.2. Existing Building Retrofit Program	Objective: Conduct energy efficiency retrofits of existing County buildings. 2012 electricity use will be reduced by 5% by 2020 through retrofits of existing County buildings. Require these retrofits to improve building-wide energy efficiency by 20%. Retrofits should target lighting, heating and air conditioning units, and overall building energy use. In addition, the County will require that newly leased buildings improve energy consumption by 20% over 2012 levels.	Existing municipal building of 10,000 sf (1-story office building) improves building-wide energy efficiency by 20%.	$4,800-$15,100	$1,975-$4,886	$10,517-$58,576	1-8
Energy-2.2. Solar Panel Carports and Parking Areas	Direct Purchase Solar Installation on Carports and Parking Areas	Install a 1.4kW solar photovoltaic system over each parking space in existing parking lots	$4,214-$5,194	$361	$48-$1,028	12-15
	Power Purchase Agreement (PPA) Solar Installation on Carports and Parking Areas	Install a 1.4kW solar photovoltaic system over each parking space in existing parking lots	—[b]	$39-$78	$564-$1,127	0

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.

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 six community action areas discussed in Chapter 4 and by the four municipal action areas discussed in Chapter 5. The Following information is provided for all strategies, as available:

1. Objective: Describes the intent and overall goal for each strategy.
2. Summary Metrics: Summarizes the GHG reductions, costs, savings, and/or other quantified metrics.
3. Assumptions: Identifies assumptions used in calculating emission reductions and cost. Table C-7 includes a master list of assumptions for reference.
4. 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.
5. Implementation Information: Provides a summary of implementation actions that are associated with each strategy.
6. Supporting Marin Countywide Plan Policies: Identifies policies in the Marin Countywide Plan that support the strategy.

As noted in Table C-7 below, many of the same assumptions are used to evaluate emissions reductions and costs for multiple strategies.

Table C-7. Master List of Quantification Assumptions for the Marin County CAP Update

Parameter	Value	Unit	Source
GWPs			
CO_2	1	-	IPCC 2013
CH_4	28	-	IPCC 2013
N_2O	265	-	IPCC 2013
CONVERSIONS			
Days per year	365	days/year	Standard conversion
Pounds per metric ton	2,204.62	pounds/MT	Standard conversion
Kilograms per metric ton	1,000	kilograms/MT	Standard conversion
Grams per metric ton	1,000,000	grams/MT	Standard conversion
Grams per kilogram	1,000	grams/kilograms	Standard conversion
Therms per million British thermal units (MMBtu)	10	therms/MMBtu	Standard conversion
Energy use ratio: Single Family: Multi-family housing—Electricity	1.97	-	EIA 2009
Energy use ratio: Single Family: Multi-family housing—Natural gas	2.27	-	EIA 2009
Kilowatt-hour (kWh) per megawatt-hour (MWh)	1,000.00	kWh/MWh	Standard conversion
Minutes per hour	60.00	minutes/hour	Standard conversion
metric ton per ton	0.91	MT/ton	Standard conversion
Million gallons per gallon	0.0000010	million gallons/gallon	Standard conversion
watts per kilowatt	1,000	W/kW	Standard conversion
Energy Ratio for gasoline	33.4	kWh/gallon-gasoline	CAPCOA 2010, VT-3, Page 310
Energy Ratio for diesel	37.7	kWh/gallon-gasoline	CAPCOA 2010, VT-3, Page 310
gallons per acre-foot	325,851	gal/ac-ft	Standard conversion
ENERGY			
2012 Community			
Residential Electricity - PG&E Regular	98,116,686	Kilowatt-hours	Armanino pers. comm.
Estimated Single Family	89,941,155	Kilowatt-hours	Scaled based on EIA data
Estimated Multi Family	8,175,531	Kilowatt-hours	Scaled based on EIA data
Residential Electricity - MCE Light Green	83,465,980	Kilowatt-hours	Kudo pers. comm.
Estimated Single Family	76,511,213	Kilowatt-hours	Scaled based on EIA data

Parameter	Value	Unit	Source
Estimated Multi Family	6,954,767	Kilowatt-hours	Scaled based on EIA data
Residential Electricity - MCE Deep Green	2,291,069	Kilowatt-hours	Kudo pers. comm.
Estimated Single Family	2,100,167	Kilowatt-hours	Scaled based on EIA data
Estimated Multi Family	190,902	Kilowatt-hours	Scaled based on EIA data
Commercial/Industrial Electricity - PG&E Regular	61,400,824	Kilowatt-hours	Armanino pers. comm.
Commercial/Industrial Electricity - MCE Light Green	63,340,839	Kilowatt-hours	Kudo pers. comm.
Commercial/Industrial Electricity - MCE Deep Green	2,395,977	Kilowatt-hours	Kudo pers. comm.
Commercial/Industrial Electricity - MCE Unspecified	821,307	Kilowatt-hours	Kudo pers. comm.
Commercial/Industrial Electricity - Direct Access	13,912,478	Kilowatt-hours	Armanino pers. comm.
Water Electricity - MCE Light Green	5,799,073	Kilowatt-hours	Armanino pers. comm.
Total PG&E Delivered Electricity	159,517,510	*kWh*	Calculated from Above
Total DA Delivered Electricity	13,912,478	*kWh*	Calculated from Above
Total MCE Light Green Delivered Electricity	152,605,892	*kWh*	Calculated from Above
Total MCE Deep Green Delivered Electricity	4,687,046	*kWh*	Calculated from Above
Total MCE Unspecified Delivered Electricity	821,307	*kWh*	Calculated from Above
Residential Natural Gas	13,841,199	therms	Armanino pers. comm.
Estimated Single Family	12,829,789	therms	Scaled based on EIA data
Estimated Multi Family	1,011,410	therms	Scaled based on EIA data
Commercial/Industrial Natural Gas	4,716,296	therms	Armanino pers. comm.
Water Natural Gas	7,591	therms	Armanino pers. comm.
Marin County Total Energy Use (all jurisdictions)			
Residential Electricity - PG&E	377,226,628	*kWh*	Calculated from Above
NonResidential Electricity - PG&E	344,000,478	*kWh*	Calculated from Above
NonResidential Electricity - Direct Access	31,548,026	*kWh*	Calculated from Above
Residential Natural Gas	55,460,031	*therms*	Calculated from Above
Non Residential Natural Gas	21,065,818	*therms*	Calculated from Above
2012 Municipal			
Municipal Building Energy - PG&E	4,223,088	kWh	Armanino pers. comm.
Municipal Building Energy - MCE Light Green	12,403,836	kWh	Armanino pers. comm.
Municipal Building Energy - MCE Deep Green	71,400	kWh	Armanino pers. comm.

Parameter	Value	Unit	Source
Municipal Building Energy - Natural Gas	410,642	therms	Armanino pers. comm.
Municipal Streetlights - PG&E	11,043	kWh	Armanino pers. comm.
Municipal Streetlights - MCE Light Green	454,346	kWh	Armanino pers. comm.
Municipal Traffic Signals - PG&E	4,853	kWh	Armanino pers. comm.
Municipal Traffic Signals - MCE Light Green	34,119	kWh	Armanino pers. comm.
2020 Community			
Residential Electricity - PG&E Regular	100,906,731	kWh	Calculated by ICF
Estimated Single Family	92,498,722	kWh	Scaled based on EIA data
Estimated Multi Family	8,408,010	kWh	Scaled based on EIA data
Residential Electricity - MCE Light Green	83,465,980	kWh	Calculated by ICF
Estimated Single Family	76,511,213	kWh	Scaled based on EIA data
Estimated Multi Family	6,954,767	kWh	Scaled based on EIA data
Residential Electricity - MCE Deep Green	2,291,069	kWh	Calculated by ICF
Estimated Single Family	2,100,167	kWh	Scaled based on EIA data
Estimated Multi Family	190,902	kWh	Scaled based on EIA data
Residential Electricity - MCE Unspecified	-	kWh	Calculated by ICF
Estimated Single Family	-	kWh	Scaled based on EIA data
Estimated Multi Family	-	kWh	Scaled based on EIA data
Commercial/Industrial Electricity - PG&E Regular	71,196,172	kWh	Calculated by ICF
Commercial/Industrial Electricity - MCE Light Green	63,175,309	kWh	Calculated by ICF
Commercial/Industrial Electricity - MCE Deep Green	2,395,977	kWh	Calculated by ICF
Commercial/Industrial Electricity - MCE Unspecified	821,307	kWh	Calculated by ICF
Commercial/Industrial Electricity - Direct Access	14,920,532	kWh	Calculated by ICF
Water Electricity - MCE Light Green	5,990,138	kWh	Calculated by ICF
Total PG&E Delivered Electricity	172,102,904	*kWh*	Calculated by ICF
Total DA Delivered Electricity	14,920,532	*kWh*	Calculated by ICF
Total MCE Light Green Delivered Electricity	152,631,427	*kWh*	Calculated by ICF
Total MCE Deep Green Delivered Electricity	4,687,046	*kWh*	Calculated by ICF
Total MCE Unspecified Delivered Electricity	821,307	*kWh*	Calculated by ICF
Residential Natural Gas	14,048,167	therms	Calculated by ICF

Parameter	Value	Unit	Source
Estimated Single Family	13,021,323	MMBtu	Calculated by ICF
Estimated Multi Family	1,026,509	MMBtu	Calculated by ICF
Commercial/Industrial Natural Gas	5,058,056	therms	Calculated by ICF
Water Natural Gas	7,841	therms	Calculated by ICF
2020 Municipal			
Municipal Building Energy - PG&E	4,223,088	kWh	Calculated by ICF
Municipal Building Energy - MCE Light Green	17,302,971	kWh	Calculated by ICF
Municipal Building Energy - MCE Deep Green	71,400	kWh	Calculated by ICF
Municipal Building Energy - Natural Gas	440,571	therms	Calculated by ICF
Municipal Streetlights - PG&E	11,043	kWh	Calculated by ICF
Municipal Streetlights - MCE Light Green	457,053	kWh	Calculated by ICF
Municipal Traffic Signals - PG&E	4,853	kWh	Calculated by ICF
Municipal Traffic Signals - MCE Light Green	35,891	kWh	Calculated by ICF
ONROAD TRANSPORTATION			
2012 Passenger VMT	349,061,299	annual VMT	Brazil pers. comm.
2012 Commercial VMT	21,181,227	annual VMT	Brazil pers. comm.
2012 Other VMT	11,402,411	annual VMT	Brazil pers. comm.
2020 Passenger VMT	346,165,126	annual VMT	Brazil pers. comm.
2020 Passenger VMT	23,485,423	annual VMT	Brazil pers. comm.
2020 Other VMT	11,785,886	annual VMT	Brazil pers. comm.
2012 Percent VMT due to commuting	70.7%	percent	Brazil pers. comm.
2020 Percent VMT due to commuting	74.2%	percent	Brazil pers. comm.
WASTE			
Community			
Waste disposal 2012	46,231	tons	Calculated by ICF
Waste disposal 2020	47,754	tons	Calculated by ICF
Municipal	623	tons	Armanino pers. comm.
Waste disposal 2012	669	tons	Calculated by ICF
Waste disposal 2020			
WATER			

Parameter	Value	Unit	Source
Community			
2012 Water Use	3,297,582,139	gallons/year	Calculated by ICF
2020 Water Use	3,406,229,102	gallons/year	Calculated by ICF
Growth	1.03	-	Calculated by ICF
2012 Water Use (unincorporated county)			
MMWD	2,322,952,455	gallons/year	Calculated by ICF
NMWD	929,629,684	gallons/year	Calculated by ICF
SBWD	45,000,000	gallons/year	Calculated by ICF
2012 Water Use (agency-wide)			
MMWD	8,830,247,089	gallons/year	Armanino pers. comm.
NMWD	3,533,804,486	gallons/year	Armanino pers. comm.
SBWD	45,000,000	gallons/year	Armanino pers. comm.
2020 Water Use (unincorporated county)			
MMWD	2,399,487,843	gallons/year	Calculated by ICF
NMWD	960,258,622	gallons/year	Calculated by ICF
SBWD	46,482,636	gallons/year	Calculated by ICF
2020 Water Use (agency-wide)			
MMWD	9,121,181,321	gallons/year	Calculated by ICF
NMWD	3,650,234,376	gallons/year	Calculated by ICF
SBWD	46,482,636	gallons/year	Calculated by ICF
2012 Service Area Population			
MMWD	190,600	persons	MMWD 2010
NMWD	60,423	persons	NMWD 2010
SBWD	632	persons	City-Data 2014
2020 Electricity Use by Agency (unincorporated county)			
MMWD	5,189,576	kWh	Armanino pers. comm.
NMWD	621,356	kWh	Armanino pers. comm.
SBWD	179,206	kWh	Armanino pers. comm.
2020 Natural Gas Use by Agency (unincorporated county)			
MMWD	6,888	therms	Armanino pers. comm.

Parameter	Value	Unit	Source
NMWD	953	therms	Armanino pers. comm.
SBWD	-	therms	Armanino pers. comm.
Percentage of Residential Outdoor Water Use	57%	-	ConSol 2010
Percentage of Residential Indoor Water Use	43%	-	ConSol 2010
Percentage of Nonresidential Outdoor Water Use	35%	-	Yudelson 2010
Percentage of Nonresidential Indoor Water Use	65%	-	Yudelson 2010
Percent Hot Water Heating (residential)	33%	-	AquaCraft 2014
Percent Hot Water Heating (commercial)	22%	-	Calculated from Yudelson, 2010 and Aquacraft 2014
Electricity Use to Heat Gallon of Hot Water	0.18	kWh/gallon	EPA 2010
Percent of Commercial Buildings with Electric Water Heaters	39.89%	-	EIA 2003 (Pacific Region, table B32)
Natural Gas Use to Heat Gallon of Hot Water (therms)	0.009	therm/gallon	EPA 2010
Percent of Commercial Buildings with Nat Gas Water Heaters	60.11%	-	EIA 2003 (Pacific Region, table B32)
Residential Indoor Water Use by End Use			
Toilet	33%	percent	CAPCOA 2010 (Table WUW-1.1)
Showerhead	22%	percent	CAPCOA 2010 (Table WUW-1.1)
Bathroom / Kitchen Faucet	18%	percent	CAPCOA 2010 (Table WUW-1.1)
Standard /Compact Dishwasher	1%	percent	CAPCOA 2010 (Table WUW-1.1)
Top/Front-Loading Clothes washer	14%	percent	CAPCOA 2010 (Table WUW-1.1)
Leaks, other	12%	percent	CAPCOA 2010 (Table WUW-1.1)
NonResidential Indoor Water Use by End Use			
Toilet	48%		CAPCOA 2010 (Table WUW-1.2 – Office)
Urinals	11%		CAPCOA 2010 (Table WUW-1.2 – Office)
Bathroom Faucet	3%		CAPCOA 2010 (Table WUW-1.2 – Office)
Showers	5%		CAPCOA 2010 (Table WUW-1.2 – Office)
Kitchen Faucet	4%		CAPCOA 2010 (Table WUW-1.2 – Office)
Dishwashers	2%		CAPCOA 2010 (Table WUW-1.2 – Office)
Ice	1%		CAPCOA 2010 (Table WUW-1.2 – Office)
Laundry	0%		CAPCOA 2010 (Table WUW-1.2 – Office)
Other	26%		CAPCOA 2010 (Table WUW-1.2 – Office)

Parameter	Value	Unit	Source
Municipal			
2012 Water Use			
MMWD	64,696,016	gallons/year	Armanino pers. comm.
Dedicated Landscaping	15,147,748	gallons/year	Armanino pers. comm.
Potable, Mixed Use	17,350,608	gallons/year	Armanino pers. comm.
Recycled Water	32,197,660	gallons/year	Armanino pers. comm.
NMWD	13,961,420	gallons/year	Armanino pers. comm.
Unknown	258,060	gallons/year	Armanino pers. comm.
Irrigation	12,816,232	gallons/year	Armanino pers. comm.
Park Facilities	422,620	gallons/year	Armanino pers. comm.
Airport Facilities	80,036	gallons/year	Armanino pers. comm.
Temp Hydrant	22,440	gallons/year	Armanino pers. comm.
Fire Station	175,780	gallons/year	Armanino pers. comm.
Medical Clinic	186,252	gallons/year	Armanino pers. comm.
SBWD	0	gallons/year	Armanino pers. comm.
2012-2020 growth factor	1.07		
2020 Water Use			
MMWD	69,479,455	gallons/year	Calculated by ICF
Dedicated Landscaping	16,267,729	gallons/year	Calculated by ICF
Potable, Mixed Use	18,633,463	gallons/year	Calculated by ICF
Recycled Water	34,578,263	gallons/year	Calculated by ICF
NMWD	14,993,688	gallons/year	Calculated by ICF
Unknown	277,140	gallons/year	Calculated by ICF
Irrigation	13,763,828	gallons/year	Calculated by ICF
Park Facilities	453,867	gallons/year	Calculated by ICF
Airport Facilities	85,954	gallons/year	Calculated by ICF
Temp Hydrant	24,099	gallons/year	Calculated by ICF
Fire Station	188,777	gallons/year	Calculated by ICF
Medical Clinic	200,023	gallons/year	Calculated by ICF
SBWD	0	gallons/year	Calculated by ICF

Parameter	Value	Unit	Source
EMISSION FACTORS			
2012 Energy			
CO_2 (PG&E)	0.445	Pounds/kilowatt-hour	PG&E 2014
CO_2e (MCE Light Green)	0.380	Pounds/ kilowatt - hour	Kudo pers. comm.
CO_2e (MCE Deep Green)	0	Pounds/ kilowatt - hour	Kudo pers. comm.
CO_2e (MCE Unspecified)	0.190	Pounds/ kilowatt - hour	Calculated by ICF (average of light and deep green)
CO_2 (eGRID – Direct Access)	0.611	Pounds/kilowatt-hour	U.S. EPA 2014
CH_4	0.0000285	Pounds/kilowatt-hour	U.S. EPA 2014
N_2O	0.0000060	Pounds/kilowatt-hour	U.S. EPA 2014
CO_2 (natural gas)	11.7	Pounds/therm	PG&E 2014
CH_4 (natural gas)	0.005	Kilograms/MMBtu	ICLEI – Local Governments for Sustainability USA. 2012 (Table B.3)
N_2O (natural gas)	0.0001	Kilograms/MMBtu	ICLEI – Local Governments for Sustainability USA. 2012 (Table B.3)
2020 Energy			
CO_2 (PG&E BAU)	0.4998	Pounds/kilowatt-hour	Calculated by ICF
CO_2 (PG&E RPS-adjusted)	0.290	Pounds/kilowatt-hour	PG&E 2013
CO_2 (eGRID RPS-adjusted)	0.451	Pounds/kilowatt-hour	Calculated by ICF
CH_4 (PG&E and eGRID RPS-adjusted)	0.000021	Pounds/kilowatt-hour	Calculated by ICF
N_2O (PG&E and eGRID RPS-adjusted)	0.0000045	Pounds/kilowatt-hour	Calculated by ICF
T&D losses	6.84%	per kilowatt-hour	U.S. EPA 2014
OFFROAD			
CO_2 (gasoline)	8.78	Kilograms/gallons	Climate Registry 2014
CO_2 (diesel)	10.21	Kilograms/gallons	Climate Registry 2014
SOCIOECONOMIC DATA			
Population			
2012 Marin Unincorporated	67,380	persons	California DOF 2014
2012 Marin County Total	253,374	persons	California DOF 2014

Parameter	Value	Unit	Source
2020 Marin Unincorporated	69,600	persons	Wong pers. comm.
2020 Marin County Total	261,100	persons	Wong pers. comm.
Households			
2012 Marin Unincorporated	26,258	Occupied dwellings	California DOF 2014
2012 Marin County Total	103,336	Occupied dwellings	California DOF 2014
Single Family Homes - 2012	21,848	Occupied dwellings	California DOF 2014
Multi Family Homes - 2012	3,906	Occupied dwellings	California DOF 2014
Mobile Homes - 2012	504	Occupied dwellings	California DOF 2014
2020 Marin Unincorporated	26,650	Occupied dwellings	Wong pers. comm.
2020 Marin County Total	106,170	Occupied dwellings	Wong pers. comm.
Single Family Homes - 2020	22,174	Occupied dwellings	Calculated by ICF
Multi Family Homes - 2020	3,964	Occupied dwellings	Calculated by ICF
Mobile Homes - 2020	512	Occupied dwellings	Calculated by ICF
Persons per Household - 2012	2.57	Persons per household	
Persons per Household - 2020	2.61	Persons per household	
Employment			
2012 Marin Unincorporated	16,672	jobs	California DOF 2014
2012 Marin County Total	112,526	jobs	California DOF 2014
2020 Marin Unincorporated	17,880	jobs	Wong pers. comm.
2020 Marin County Total	119,990	jobs	Wong pers. comm.
Marin County Total Employees - 2012	2,164	employees	Armanino pers. comm.
Marin County Full Time Employees - 2012	1,964	employees	Armanino pers. comm.
Marin County Total Employees - 2020	2,324	employees	Armanino pers. comm.
Marin County Full Time Employees - 2020	2,109	employees	Armanino pers. comm.
OTHER			
Percentage GHG reduction from electrified G4 equipment by horsepower			
Less than 25	64.1%	-	CAPCOA 2010
25–50	80.3%	-	CAPCOA 2010

Parameter	Value	Unit	Source
50–120	80.1%	-	CAPCOA 2010
120–175	79.5%	-	CAPCOA 2010
Greater than 175	78.9%	-	CAPCOA 2010
Diesel	72.9%	-	CAPCOA 2010
Gasoline (G2)	64.1%	-	CAPCOA 2010
PG&E and MCE average bundled residential electricity rate, which includes: • 53.4% PGE residential electricity rate ($0.2097) • 45.4% Light Green residential electricity rate ($0.2088) • 1.3% Deep Green residential electricity rate ($0.2190)	$0.20942	$ per kWh in 2016	CEC 2014 and Marin Clean Energy 2014
PG&E and MCE average bundled commercial electricity rate, which includes: • 53.1% PGE commercial electricity rate ($0.1993) • 45.2% Light Green commercial electricity rate ($0.1927) • 1.7% Deep Green commercial electricity rate ($0.2029)	$0.1964	$ per kWh in 2016	CEC 2014 and Marin Clean Energy 2014
PG&E average bundled residential natural gas rate	$1.0907	$ per therm in 2016	CEC 2014
PG&E average bundled commercial/municipal natural gas rate	$1.1056	$ per therm in 2016	CEC 2014
PG&E and MCE average bundled municipal rate, which includes: • 24.6% PGE commercial electricity rate ($0.1993) • 74.9% Light Green commercial electricity rate ($0.1927) • 0.4% Deep Green commercial electricity rate ($0.2029)	$0.19436	$ per kWh in 2016	CEC 2014 and Marin Clean Energy 2014
Utility rate escalator	1%	Each year	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

State-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:

Community or Municipal	2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Community	17,512	16.8%	24.6%	-[c]	-[c]	-[c]
Municipal	403	8.7%	12.4%	-[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 C-7.

Analysis Method: Both PG&E and Marin Clean Energy (MCE) provide electricity to County residents. GHG emissions generated by PG&E-delivered electricity in the 2020 business-as-usual (BAU) community emissions forecast (2020 BAU Community Forecast) and the 2020 BAU Municipal Forecast were quantified using the utility's BAU CO_2e intensity. MCE already meets the requirements of the RPS, so no additional reductions were attributed for MCE-provided electricity relative to the RPS. Some electricity is provided through direct-access service; GHG emissions generated by direct-access electricity were quantified using the statewide average emissions intensities (using the EPA eGRID CAMX region factors). Achievement of the RPS will reduce PG&E's and statewide average BAU carbon intensities. GHG emissions that would be generated by community and municipal 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 direct-access. The difference in emissions between the 2020 BAU and 2020 RPS scenarios represents the emissions reductions achieved by this State action.

State-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:

Community or Municipal	2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Community	1,362	1.3%	1.9%	-[c]	-[c]	-[c]
Municipal	-[d]	-[d]	-[d]	-[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.

[d] The only new municipal facility is the Emergency Operations Facility, which will already comply with Title 24 standards.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- State action would apply to new buildings constructed between 2012 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 2012 community emissions inventory (2012 Community 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 (14% of electricity subject to the 2008 code [year 2013], 43% of electricity subject to the 2014 code [years 2014-2016], and 43% of electricity subject to the 2017 code [years 2017-2019]). Emissions reductions achieved by the strategy were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

State-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:

Community or Municipal	2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Community	6,419	6.1%	9.0%	-[c]	-[c]	-[c]
Municipal	-[d]	-[d]	-[d]	-[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.
[d] All municipal facilities already comply with AB 1109.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- State action would apply to buildings constructed before 2012.
- 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).
- 29.3% 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 2012 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.

State-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:

Community or Municipal	2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Community	178	0.2%	0.3%	-[c]	-[c]	-[c]
Municipal	-[d]	-[d]	-[d]	-[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.
[d] This measure does not apply to municipal facilities.

Assumptions: In addition to assumptions listed in Table C-7, 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 the County. GHG emissions reductions achieved by the strategy were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

State-5. Pavley Emissions Standards for Passenger Vehicles and the 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 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:

Community or Municipal	2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Community	42,920	41.1%	60.3%	-[c]	-[c]	-[c]
Municipal	2,653	57.5%	81.7%	-[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 C-7 and contained within the EMFAC2011 model.

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 County were multiplied by the EMFAC2011 emission factors to obtain GHG emissions assuming implementation of Pavley and LCFS. 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.

State-6. Advanced Clean Cars

Objective: 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.

Summary Metrics:

Community or Municipal	2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Community	2,194	2.1%	3.1%	-[c]	-[c]	-[c]
Municipal	161	3.5%	4.9%	-[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 C-7, 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 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 County 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 Marin 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:

Community or Municipal	2020 GHG Reduction[a]	% of All Reductions[b]	% of State Reductions	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
Community	569	0.5%	0.8%	-[c]	-[c]	-[c]
Municipal	29	0.6%	0.9%	-[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 C-7, 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 - Community

Energy Efficiency and Renewable Energy

Energy-1. Community Choice Aggregation

Objective: Marin Clean Energy (MCE), launched in 2010, is a community choice aggregation program and electricity provider that works with PG&E to provide their customers between 50-100% renewable energy. This measure includes the potential to increase participation in the Deep Green program from 1% to 5% by 2020.

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.

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)
2,744	2.6%	8.2%	15.7%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- The participation rate in MCE's Deep Green energy service would increase from 1% in 2012 to 5% in 2020 (MCE 2013).

Analysis Method: New MCE Deep Green customers were assumed to be previous PG&E customers (not MCE Light Green customers). The increase in participation from 1% to 5% represents a fivefold increase in Deep Green customers, and an associated fivefold increase in Deep Green electricity service. The increase in Deep Green electricity is equal to a decrease in PG&E electricity. GHG emission reductions were calculated by multiplying the new Deep Green electricity use by the 2020 RPS-adjusted emission factors for PG&E.

Energy-2. Energy Efficiency

The following sub-measures are part of the County's Energy Efficiency action strategy.

Energy-2.1. Community Energy Efficiency Retrofits

Objective: This measure encompasses all existing programs to improve the energy efficiency of community buildings (including homes and businesses) through retrofits which occurred from 2013-2014. Existing energy retrofit programs include the Marin Energy Watch Partnership and MCE Clean Energy retrofits[2].

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)
1,925	1.8%	5.8%	11.0%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.

[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- The proportion of energy consumption in the unincorporated County compared to the County as a whole is: 48.7% of residential electricity, 37.8% of nonresidential electricity, 25.0% of residential natural gas, and 22.4% of nonresidential natural gas.
- Marin Energy Watch Partnership energy savings goals for the 2013-2014 program cycle for the entire County (including the incorporated cities) were 250,000 kWh for residential and 4,800,000 kWh for nonresidential.
- MCE Clean Energy savings goals for the 2013-2014 program cycle for the entire County (including the incorporated cities) were 7,006,181 kWh and 42,239 therms for residential and 6,080,000 kWh and 520,364 therms for nonresidential.

Analysis Method: Energy savings goals associated with the Marin Energy Watch Partnership and MCE Clean Energy retrofits for the entire County (including the incorporated cities) for the years 2013 and 2014 was apportioned to the unincorporated County using the proportion of energy consumed in the unincorporated County compared to the County as a whole. GHG emissions reductions achieved by the strategy were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

Implementation Information: N/A

Supporting Marin Countywide Plan policies: EN-1.d Explore energy efficiency standards for existing buildings, EN-1.h Support low income weatherization, EN-1.i Reduce energy use in processing operations.

[2] The Bay Area Regional Energy Network (BayREN) program also resulted in energy savings in Marin County, but the data available was only for the 9-county Bay Area region and it was too speculative to apportion these savings to unincorporated Marin County.

Energy-2.2. Expand Community Energy Efficiency Retrofits Program

Objective: Promote energy efficiency in existing residential buildings and commercial buildings, and remove funding barriers for energy efficiency improvements. Achieve the voluntary residential and nonresidential energy efficiency retrofit goals outlined in Table C-2 by 2020. Providing a variety of retrofit packages allows homeowners to select and customize retrofit options that meet their needs.

Energy efficiency upgrades at residential, 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.

Table C-2. Voluntary Residential Energy Efficiency Retrofit Goals

Retrofit Level	Implementation Goal	Minimum Retrofits
Basic	12% of existing single-family homes	• Replace interior high use incandescent lamps with LEDs • Seal air leaks
Advanced	5% 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	3% 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	20% 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.
Nonresidential	15% of existing nonresidential buildings	• Will vary on a case-by-case basis. Retrofits should reduce energy consumption (electricity and natural gas) by at least 20%, relative to existing conditions.

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)
5,601	5.4%	16.8%	32.1%	$340-$480	$6.3-$14.9 million	$3 million

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Strategy goals would apply to residential and nonresidential buildings constructed before 2015.
- Energy reductions achieved by the basic retrofit level would be 997 kWh and 91 therms per single-family house (U.S. Department of Energy 2013a).

- Energy reductions achieved by the advanced retrofit level would be 1,143 kWh and 171 therms per single-family house (U.S. Department of Energy 2013a).
- Energy reductions achieved by the premium retrofit level would be 2,106 kWh and 268 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).
- 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 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 C-2) and the estimated number of homes in 2015 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.

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 2015. 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 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 County 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.

Upfront costs for nonresidential buildings 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.

Implementation Actions: Actions may include: Implementing a low-income weatherization program, expanding energy efficiency outreach/education campaigns targeted at residents and businesses, promoting the smart grid, funding and scheduling energy efficiency tune-ups, promoting energy efficiency management services for large energy users and promoting energy efficiency financing tools.

Supporting Marin Countywide Plan policies: EN-1.d Explore energy efficiency standards for existing buildings, EN-1.h Support low income weatherization, EN-1.i Reduce energy use in processing operations.

Energy-2.3. Tree Planting

Objective: Plant at least 310 trees per year within the County beginning in 2015. This measure will reduce energy consumption and associated GHG emissions in the building energy sector by reducing the heat island effect.

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)
23	0.02%	0.1%	0.1%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Strategy requirements would take effect in 2015.
- 310 shade trees per year would be planted by developers and the County adjacent to buildings, to provide shade for those buildings.
- Average tree planting age is 1 year and 96% of planted trees would survive.
- Trees would be a mix of maple, ash, pine, oak, and redwood.

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. All 310 trees planted per year were assumed to be planted 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.

Although a cost analysis was not performed for this measure, the County or developers would incur upfront costs to plant, stake, and mulch trees. Maintenance costs would also occur. Cost savings for benefits such as air quality, health, property value, or intrinsic value improvements would likely occur; some studies show a net benefit for trees when these co-benefits are monetized.

Implementation Information: The County already requires accounting for trees removed and planted as part of new construction. Additional implementation mechanisms might include establishing goals and funding sources for new trees planted on County property.

Supporting Marin Countywide Plan policies: Air-4.j Acquire and restore natural resource systems, Air-4.k Encourage the planting of trees and the following implementing programs, AIR-4.k - Encourage the Planting of Trees, BIO-4.I - Preserve Agricultural Lands, DES-3.e - Encourage Small-Scale Green Spaces.

Energy-3. Solar Energy

The following sub-measures are part of the County's Solar Energy action strategy.

Energy-3.1. Solar Installations for New Residential Development

Objective: Implement solar energy installation requirements for new residential buildings to increase renewable energy generation. This is a mandatory measure to install solar on 20% of new residential buildings.

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)
34	0.03%	0.1%	0.2%	$23–$196 (direct); $160-$320 (PPA)	$572,000-$654,000 (direct)	$46,000 (direct); $4,900–$9,800 (PPA)

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

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- There would be an estimated 204 new single-family homes constructed between 2015 and 2020, based on a linear interpolation of 21,848 homes in 2012 and 22,174 homes 2020.
- 20% of new housing units would participate in this measure, for a total of 41 single-family houses.
- Each 4 kW residential solar system would generate 5,606 kWh per year, which represents a typical residential system (U.S. Department of Energy 2013b).
- 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).
- Solar systems would have a 25-year lifetime (U.S. Department of Energy 2013b).

Analysis Method: 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 2015 and 2020 to determine total residential energy reductions achieved by the strategy. 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, install and maintain 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 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 higher residential cost does not include a CSI rebate, since more than 99% of CSI the budget allotted for residential incentives had already been spent, as of May 2014 (California Energy Commission et. al. 2014). 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 (GreenZU 2014).

Implementation Information: This could be implemented through discretionary approvals and permitting for new projects. Form partnerships with PG&E and other private sector funding sources including SunRun, SolarCity, and other solar lease or PPA companies to encourage solar installations. Funds may be provided through the Marin Clean Energy Solar Rebate program or the Property Assessed Clean Energy (PACE) financing program.

Energy-3.2. Solar Installations for New Nonresidential Development

Objective: Implement solar energy installation requirements for new nonresidential buildings to increase renewable energy generation. This is a mandatory measure to install solar on 20% of new nonresidential buildings.

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)
23	0.02%	0.07%	0.1%	$27–$396 (direct); $150–$300 (PPA)	$344,000–$424,000 (direct)	$30,000-$36,000 (direct); $3,200–$6,400 (PPA)

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- 20% of nonresidential buildings constructed between 2015 and 2020 would be required to incorporate onsite solar energy generation to provide 100% of the project's energy needs.
- Electricity use for nonresidential buildings constructed between 2015 and 2020 was estimated using a linear interpolation of 2012 electricity use and 2020 electricity use.
- 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).

Analysis Method:

Nonresidential energy reductions were calculated by multiplying the forecasted electricity consumption for buildings constructed after 2015 by a 10% participation rate. 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 $4.3 to $5.3 per watt installed. 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. 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.

Implementation Information: This could be implemented through discretionary approvals and permitting for new projects. Form partnerships with PG&E and other private sector funding sources including SunRun, SolarCity, and other solar lease or PPA companies to encourage solar installations. Funds may be provided through the Marin Clean Energy Solar Rebate program.

Supporting Marin Countywide Plan policies: N/A

Energy-3.3. Solar Installations for Existing Residential Development

Objective: Achieve the following voluntary solar installation goals for existing development.

- 20% of existing single-family residences install solar photovoltaic (PV).

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)
3,950	3.8%	11.8%	22.7%	$21–$179 (direct); $137–$280 (PPA)	$61,000,000–$70,000,000 (direct)	$4,900,000 (direct); $526,000–$1,000,000 (PPA)

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Strategy goals would apply to residential buildings constructed before 2015. This is estimated to be 21,970 single family homes, based on a linear interpolation of 21,848 homes in 2012 and 22,174 homes 2020.
- Each 4 kW residential solar system would generate 5,606 kWh per year, which represents a typical residential system (U.S. Department of Energy 2013b).

Analysis Method: The approach for calculating electricity, emissions reductions, and costs is similar to what is described for Energy-3.1, *Solar Installations for New Residential Development*. However, the strategy was assumed to apply to existing developments constructed before 2015, as specified in the strategy objective.

Implementation Information: This could be implemented through permitting for major remodels. Form partnerships with PG&E and other private sector funding sources including SunRun, SolarCity, and other solar lease or PPA companies to encourage solar installations. Funds may be provided through the Marin Clean Energy Solar Rebate program or the PACE financing program.

Supporting Marin Countywide Plan policies: N/A

Energy-3.4. Solar Installations for Existing Nonresidential Development

Objective: Achieve the following voluntary solar installation goals for existing development.

- 15% of existing nonresidential developments install solar PV to provide 100% of the building's energy needs.

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)
3,086	3.0%	9.2%	17.7%	$25–$502 (direct); $123–$247 (PPA)	$43,000,000–$53,000,000 (direct)	$3,700,000–$4,500,000 (direct); $400,000–$800,000 (PPA)

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Strategy goals (see above) would apply to nonresidential buildings constructed before 2015.
- Electricity use for nonresidential buildings constructed before 2015 was estimated using a linear interpolation of 2012 electricity use and 2020 electricity use.
- The average system size is 40 kW.

Analysis Method: The approach for calculating electricity, emissions reductions, and costs is similar to what is described for Energy-3.2, *Solar Installations for New Nonresidential Development*. However, the strategy was assumed to apply to existing developments constructed before 2015, as specified in the strategy objective.

Implementation Information: This could be implemented through discretionary approvals and permitting for new projects. Form partnerships with PG&E and other private sector funding sources including SunRun, SolarCity, and other solar lease or PPA companies to encourage solar installations. Funds may be provided through the Marin Clean Energy Solar Rebate program.

Supporting Marin Countywide Plan policies: N/A

Land Use, Transportation, and Offroad

Trans-1. Land Use Design and VMT Reduction

The following sub-measures are part of the County's Land Use Design and VMT Reduction action strategy.

Trans-1.1. Promote Mixed Use, Infill, and Transit-Oriented Developments

Objective: The County would promote longstanding Countywide Plan growth control strategy of focusing new development in the city center corridor via mixed-use, infill, and transit-oriented developments in downtown neighborhoods, transit-hubs, and transit corridors for the unincorporated County. Development with multiple uses and in infill locations would improve the diversity of nearby land uses and facilitate easy access to retail and commercial destinations. Improving the County's jobs/housing balance would also increase access to work destinations. Locating these diverse uses in proximity to each other would encourage walking or bicycling, reducing VMT. New development near high-quality transit would facilitate the use of transit by people traveling to or from the project site, resulting in reduced VMT.

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.

The CAPCOA report states the following about mixed-use development (CAPCOA 2010): "Having different types of land uses near one another 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."

The CAPCOA report indicates that mixed-use development can result in a 9-30% reduction in VMT, based on two reports: *Travel and the Built Environment - A Meta-Analysis* (Ewing and Cervero 2010) and *Measuring the effects of mixed land uses on housing values* (Song and Knaap 2004). Additional literature cited by CAPCOA that supports VMT reductions from mixed-use developments include *Crediting Low-Traffic Developments* (Nelson\Nygaard 2005) and *A Quick-Response Method of Estimating Travel Impacts from Land-Use Changes* (Criteron Planner/Engineers and Fehr & Peers Associates 2001).

Mixed-use development is widely considered an effective means of reducing traffic impacts. Ranking in the EPA top-ten Smart Growth planning principles, and achieving higher levels of support from planners, policy makers and elected officials and developers, mixing a variety of land uses is generally considered a strategy that optimizes use of transportation infrastructure, improves community quality-of-life, and reduces vehicle travel and related concerns over global warming. Mixed-use developments come in a wide range of sizes, mixes and configurations. One common characteristic is that such development can reduce off-site traffic impacts by satisfying travel needs within the development site and reducing external travel (Fehr & Peers 2014a).

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TRANS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
44	0.04%	0.1%	1.4%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

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

[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- 38% of projected new units are applicable to this measure assuming 125 new single family units and 75 multi-family units are developed by 2020. Estimates are based on historical permit data/current trends, existing approved but unbuilt projects like the Oakview Master Plan and existing policies and regulations governing mixed-use development. Applicable project characteristics include: density of 8 housing units per acre; 50% multifamily and 50% institutional ; 4 mile distance to downtown or major job center; 0.25 mile distance to transit node/route; and 20% of units are deed-restricted below market rate housing (Fehr & Peers 2014b)
- Pedestrian network enhancement will occur within the applicable projects and connect off-site (Fehr & Peers 2014b).
- The applicable project, the Oakview Senior Facility, will include access to a car-sharing program
- This strategy would reduce VMT growth in new residential developments by 5.76% to 5.86% (Fehr & Peers 2014b, 2014c). This value was calculated as follows:
    - The equation *1- (1-5%)*(1-0.9%)* was used, where:
        - 5% = VMT credit from land use strategies (including increased density, land use diversity, destination accessibility, transit accessibility, and below market rate housing). Land use strategies in a suburban setting have a maximum/cap on the amount of effectiveness that can be achieved. This is explained in more detail in the CAPCOA report (2010) (Chapter 6, page 61) and essentially utilizes a Holtzclaw report on location efficiency to conduct reasonableness checks to prevent over-estimation of effectiveness of land use strategies.
        - 0.9% = VMT credit from neighborhood site enhancement strategies, including pedestrian access network and a carshare program. The pedestrian network strategy provided 0.8% VMT credit. The calculations are detailed in the CAPCOA report (2010) (Chapter 7, page 186), and are based on two literature resources (Center for Clean Air Policy n.d.; 1000 Friends of Oregon 1997). These literature sources provide a 2% VMT credit for pedestrian accommodations within a project site and connecting off-site. This 2% is reduced by a 38% applicability input (see below) and thus results in a 0.8% VMT credit. The car share strategy provided a 0.1% VMT credit. The calculations are detailed in the CAPCOA report (2010) (Chapter 7, page 245) and are based on two literature resources (Millard-Ball et. al. 2005; Cambridge Systematics 2009). These literature provide a 0.37% VMT credit, and it is reduced by a 38% applicability input (see below) and thus results in a 0.1% VMT credit.

- The equation *1- (1-5%)*(1-0.9%)* is very similar to simply adding the credit of 5% to 0.8% but instead of adding, "multiplicative dampening" was used to take into account that if one strategy is already reducing VMT, then the additional strategies would be reducing VMT from a smaller base (because the first strategy has already reduced some of the VMT). It is negligible here since 5.0%+0.9% = 5.8% which is very close to 5.86%.

- 38% of new units are applicable to this measure (Fehr & Peers 2014b, 2014c)
- Resulting VMT reductions are 168,084.

Analysis Method: Based on modeling conducted by Fehr & Peers, Trans-1.1 was assumed to result in a light-duty VMT reduction of 168,084 annual miles. Implementation of the strategy is not anticipated to significantly affect the distribution vehicle speeds within the County. 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.

A moderate level of cost associated with additional staff time to develop policies guidelines, and incentives is anticipated. Developing these guidelines might require as much as ¼ of an FTE for one year.

Implementation Information: The County would promote and apply existing policies and incentives to encourage mixed-use, infill, and transit-oriented development for the unincorporated County. Potential incentives could include parking variances, reductions in building and permit fees, and other related items.

Supporting Marin Countywide Plan policies: HS-3.o - Conduct a Survey of Potential Mixed-Use Sites, HS-3.q - Establish Mixed-Use Development Standards and Incentives, CD-2.c Enact Zoning Changes, CD-2.g - Identify and Plan Mixed-Use Sites, CD-5.b - Develop Highway 101 Corridor–Specific Plans, DES-2.a - Designate Target Nodes, DES-2.b - Encourage Flexible-Use Building Types, DES-2.c - Allow Mixed Use in Commercial Districts, DES-3.a - Encourage Mixed-Use Projects, HS-3.o - Conduct a Survey of Potential Mixed-Use Sites, HS-3.p - Prepare a White Paper on Mixed-Use Housing Development Feasibility, TR-3.f - Promote Transit-Oriented Development, TR-3.f Promote Transit-Oriented Development, DES-2.a - Designate Target Nodes, CD-5.b - Develop Highway 101 Corridor–Specific Plans, HS-3m - Establish Transit-Oriented Development (TOD) Zoning Standards, EC-1.h - Encourage Transit-Oriented Development.

Trans-1.2. Support Regional Carpool and Vanpool Programs

Objective: Enhance the existing Vanpool Incentive Program to attract and retain participants. Vanpools usually service employees' commute to work and the program provides financial incentive for purchasing or leasing of vans. These vans would then be used to provide rides to multiple commuters with similar commute times, origins, destinations, or destinations along the route.

This measure is a supporting measure for Trans-1.3, V*MT Reduction Monitoring and Implementation and Transportation Demand Management Program*, and the GHG reductions are therefore included in Trans-1.3

Summary Metrics:

Assumptions: N/A

Analysis Method: This measure is a supporting measure for Trans-1.3, V*MT Reduction Monitoring and Implementation and Transportation Demand Management Program*, and the GHG reductions are therefore included in Trans-1.3.

Since this strategy would require staff time to develop guidelines and policies for the program, the level of effort is likely to be about ¼ of an FTE for one year. The cost of the program itself would likely be low but would depend on the level of participation.

Implementation Information: County Staff would develop enhancements to the existing Vanpool Incentive Program to attract and retain participants. The current Vanpool Incentive Program offers $3,600 over a two year period for vanpools that carry at least 7 passengers, and have an origin, destination, or have at least three pick-up points, in Marin County. It has had moderate success, with 34 registered vanpools as of 2013.

Possible strategies to increase participation in the program include making the requirements less restrictive to reduce the barrier to entry. Connecting vanpool organizers with commuters would also be beneficial. The County should consider using 511 ridesharing forums, dynamic rideshare apps (the County recently launched a pilot project app called "Carma"), or facilitate communication among employers in the same geographic area. To retain vanpool participants, the County should consider extending the benefits beyond the first two years.

Supporting Marin Countywide Plan policies: N/A

Trans-1.3. VMT Reduction Monitoring and Implementation and Transportation Demand Management Program

Objective: Identify and require in new developments VMT performance thresholds for reducing the VMT 10 percent below levels that would otherwise occur without implementation of strategies outlined below. Provide developments with a suite of strategies, including, but not limited to, those listed below, as a menu of options to apply to eligible sites or projects. Require that strategy outcomes be monitored on a regular basis.

Potential strategies may include:

- Reduced parking requirements for affordable or senior housing projects
- Reduced cost transit passes
- Unbundled parking costs
- Bicycle amenities
- Car-share pods
- Support alternative work schedules
- Parking cash-out
- Ride-matching services
- Participation in vanpool program
- Emergency ride home

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TRANS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
76	0.07%	0.2%	2.4%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for land use, transportation, and offroad strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- 100% of employees in the County are eligible for this program (Fehr & Peers 2014b)
- This strategy would reduce VMT growth in new residential and commercial developments by 5.2% (Fehr & Peers 2014b, 2014c)
- 50% of growth is applicable to this measure (Fehr & Peers 2014b, 2014c)
- Resulting VMT reductions are 287,078.

Analysis Method: Based on modeling conducted by Fehr & Peers, Trans-1.3 was assumed to result in a light-duty VMT reduction of 287,078 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.

This cost estimate is only for the mandatory VMT reduction and monitoring program. The efforts for the bundled strategies are described in their respective sections.

This commute trip reduction program would require a moderate amount of ongoing effort to develop the general program, create required strategies on a project basis, and administer the regular monitoring. The number of new projects per year as well as the total number of active projects would figure into the effort. As such, ¼ of an FTE may be required for up to one year to develop the program, one FTE to intake ten projects per year, and one FTE to administer 30 projects per year.

Implementation Information: The County may mandate that certain TDM strategies be implemented for all new residential projects consisting of 25 or more units and new or expanded projects with 50 or more employees. The TDM strategies may be agreed upon with the project sponsor dependent on the appropriateness of the strategy to the site and its location within the County. Incentives may also be used to implement measures, such as parking variances, reductions in building and permit fees, and other related items. Fees and penalties may be issued for non-compliance.

Supporting Marin Countywide Plan policies: TR-1.s - VMT Reduction Monitoring and Implementation and Transportation Demand Management Program.

Trans-1.4. Support Alternate Work Schedules and Telecommute Programs

Objective: Encouraging alternate work schedules and telecommuting reduces the number of commute trips and therefore VMT traveled by employees. Alternative work schedules could take the form of staggered starting times, flexible schedules, or compressed work weeks.

This measure is a supporting measure for Trans-1.3, V*MT Reduction Monitoring and Implementation and Transportation Demand Management Program*, and the GHG reductions are therefore included in Trans-1.3

Summary Metrics: N/A

Assumptions: N/A

Analysis Method: The cost of implementation would consist of developing and administering the program. The amount of effort to develop may be ¼ of an FTE for one year.

Implementation Information: This strategy involves providing incentives for employers to allow and promote alternate work schedules for employees and telecommuting. This strategy would be provided as a suite of options for employers to use under Trans 1.3.

Supporting Marin Countywide Plan policies: TR-1.a - Support Alternate Work Schedules.

Trans-1.5. Transportation Marketing

Objective: Conduct Countywide efforts to implement marketing strategies to reduce commute trips. Marketing available strategies to employees, employers, residents, and developers is an important component to successful VMT reduction. Marketing efforts may encourage or mandate dissemination of information to the above groups on specific strategies or alternate travel means in general.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TRANS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
2,715	2.6%	8.1%	87.6%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for land use, transportation, and offroad strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- 100% of employees in the County are eligible for this program (Fehr & Peers 2014b)
- This strategy would reduce total residential and commercial VMT by 4% (Fehr & Peers 2014b, 2014c)
- 74.2% of total VMT is applicable to this measure (Fehr & Peers 2014b, 2014c)
- Resulting VMT reductions are 10,280,530.

Analysis Method: Based on modeling conducted by Fehr & Peers, Trans-1.6 was assumed to result in a light-duty VMT reduction of 10,280,530 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.

The cost of implementation would consist of developing and administering the program. The amount of effort to develop may be ¼ of an FTE for one year. Regular updates to the marketing material and online presence would require a minimal annual effort, approximately 1/8 of an FTE per year.

Implementation Information: This strategy involves providing targeted marketing in both print and online formats to employees, employers, residents, and developers. Materials should provide accurate and timely information regarding commute reduction strategies. Information sharing could be rolled into HR policies for new employee orientation. Real time transit data should be made available online with trip planning tools, with mobile phone apps as a future development. The marketing could be made mandatory for new residential projects consisting of 25 units or more, and new or expanded projects with 50 employees or more, as is consistent with Trans-1.3.

Supporting Marin Countywide Plan policies: N/A

Trans-2. Public Transportation

The following sub-measures are part of the County's Public Transportation action strategy.

Trans-2.1. Expand Transit Service

Objective: Expand local and regional bus service in range and/or frequency where service expansion would result in higher bus occupancy and would result in lower GHG emissions per passenger mile than for average passenger vehicles. Expanding the geographical reach of the transit system would provide transit access to a higher number of residents and workers. Increasing transit frequency would make transit a more attractive and convenient option for travel. Both of these strategies would shift the mode choice of travelers toward transit, reducing VMT but also potentially reducing bicycle and walk trips. However, expansion of transit service should be prioritized to locations where bus occupancy can be maximized. While rural transit routes may be important for providing transit service to less served populations and communities, low occupancy routes using diesel buses may not be effective in reducing GHGs compared to passenger vehicles. Thus, the focus on expanding transit service should be on locations where the bus occupancy can be high enough to result in lower GHG emissions per passenger mile than individual vehicles.

This measure will also reduce transit-passenger travel time through more reduced headways and increased speed and reliability. This makes transit service more attractive and may result in a mode shift from auto to transit which reduces VMT.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TRANS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
183	0.2%	0.5%	5.9%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for land use, transportation, and offroad strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- 2.5% increase of transit network coverage (Fehr & Peers 2014b)
- 2.5% reduction in headways (increase in frequency) (Fehr & Peers 2014b)
- The existing transit mode share is 9.4% (as a % of total daily trips) (Fehr & Peers 2014b)
- Strategy would reduce Countywide passenger VMT by 0.2% (Fehr & Peers 2014b, 2014c)
- Resulting VMT reductions are 692,330/year.

Analysis Method: Methods from CAPCOA (2010) were used to calculate VMT reductions for this measure. CAPCOA presents the following equation for estimating VMT reductions:

$$\%\, VMT\ Reduction = Coverage * B * Mode * D$$

Where:

- Coverage = % increase in transit network coverage (2.5%)
- B = elasticity of transit ridership with respect to service coverage (1.01) (Transportation Research Board 2004).
- Mode = existing transit mode share (9.4%)
- D = adjustments from transit ridership increase to VMT (0.67) (CAPCOA 2010)

Based on the equation listed above, Trans-2.1 was assumed to result in a light-duty VMT reduction of 0.2% or 692,330 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.

This strategy would require some staff time to develop policies, guidelines, and pursue funding opportunities. We estimate that the level of effort required would be about 1 FTE for one year. Cost of implementing actual transit expansion would be medium to high, depending on capital and operating expenses of the proposed expansions.

Additional Discussion of GHG Emission Changes from Transit Service Expansion

As noted above, switching from automobile travel to transit travel can reduce GHG emissions but may not always reduce GHG emissions. GHG emissions are dependent on a number of factors,

including the fuel efficiency of the automobile, the fuel type and fuel efficiency of the transit vehicle, and occupancy rates for both.

For Marin County Transit vehicles, the average revenue-mile weighted daily passenger load during peak and midday (AM peak, midday, and PM peak periods) is **9.21 passengers per bus** and the average revenue-mile weighted daily passenger load including nighttime is **8.57 passengers per bus** (Reebs pers. comm.). Marin Transit has a variety of bus makes, models and years. In 2012, 50% of the bus fleet was model year 2007 or newer (including some 2012 and 2013 model year diesel hybrid buses) and 50% of the bus fleet is model year 2000-2006 (Reebs pers. comm.). Marin Transit anticipates replacing the majority of buses in the current fleet, and the 2020 bus fleet is anticipated to be 30% diesel, 51% diesel hybrid, and 20% gasoline. Of these new buses, the majority will be model year 2015 or newer (Reebs pers. comm.). Diesel hybrid buses are anticipated to improve fuel economy over non-hybrid diesel buses by up to 50% (New Flyer n.d.).

The likely timing of any transit service increases per this measure would be commuter routes during peak periods and possible mid-day periods as opposed to the more lightly used other routes. According to EMFAC2011 for the year 2012, taking Pavley and the Low Carbon Fuel Standard regulations into account, the average emission rate for a Marin County Transit bus traveling at 35 mph (the average weighted speed of urban buses provided by MTC) at an occupancy of 9.2 passengers per bus is **0.47** pounds of CO_2 per passenger mile traveled and the average emission rate for a Marin County passenger vehicle traveling at 35 mph (the average weighted speed of passenger vehicles provided by MTC) using the FHWA 2009 NHTS commute occupancy of 1.14 passengers per vehicle (USDOT/FHWA 2011) is **0.64** pounds of CO_2 per passenger mile traveled. For the year 2020, incorporating Marin Transit's anticipated fleet turnover, and assuming no change in vehicle occupancy or average speed, the average emission rate for a Marin County Transit bus for peak and mid-day routes is **0.28** pounds of CO_2 per passenger mile traveled and the average emission rate for a Marin County passenger vehicle for commute trip purposes is **0.48** pounds of CO_2 per passenger mile traveled. Consequently, switching from auto travel to transit travel for commuter transit service (and for other high-occupancy transit service) is anticipated to reduce GHG emissions in Marin County.

When considering transit service for all purposes (not just commuter purposes), the conclusions will be similar to the peak/mid-day analysis above but GHG benefits would be lower. According to EMFAC2011 for the year 2012 using the same assumptions noted above, the average emission rate for a Marin County Transit bus at an occupancy of 8.57 passengers per bus is **0.50** pounds of CO_2 per passenger mile traveled. For the year 2020, incorporating Marin Transit's anticipated fleet turnover, and assuming no change in vehicle occupancy or average speed, the average emission rate for a Marin County Transit bus is **0.30** pounds of CO_2 per passenger mile traveled. While national averages for vehicle occupancy for all purposes in 2009 was **1.67** person/vehicle (USDOT/FHWA 2011), this does not reflect Bay Area trip characteristics. To use a more accurate factor for vehicle occupancy appropriate to the Bay area, the national occupancy factors for different types of trips (commute, shopping/other family, and social/entertainment) were weighted by the percent of Bay Area VMT for these different trips using data from the MTC/BAAQMD (MTC/BAAQMD no date). The resultant all-purpose vehicle occupancy factor would be **1.42** persons/vehicle. Using this factor, passenger vehicle emissions for 2012 would be **0.51** pounds of CO_2 per passenger mile and for 2020 would be **0.38** pounds of CO_2 per passenger mile. The 2012 amount is nearly the same as transit all-purpose value, but the 2020 passenger vehicle emissions per passenger mile are still more than the transit value for 2020. Use of the all-purpose trip factor would likely substantially understate

the targeted benefits of focused transit expansion on commuter and high-occupancy transit routes/service which would yield greater ridership and GHG reductions.

Implementation Information: The County would support Marin Transit as it continues to make service plan improvements outlined in the Marin Transit Short Range Transit Plan (Marin Transit 2012). Search for funding opportunities from grants or other sources to finance unfunded service needs. Continue to assess other service plan needs.

Supporting Marin Countywide Plan policies: TR-3.a Increase Bus and Ferry Services, AIR-4.b - Reduce Greenhouse Gas Emissions Resulting from Transportation.

Trans-3. Off-Road Equipment

The following sub-measures are part of the County's Off-Road Equipment action strategy.

Trans-3.1. Electric-Powered Electric 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 10% of landscaping equipment operating in the County to be electric- or battery-powered by 2020.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TRANS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
84	0.08%	0.3%	2.7%	-[d]	-[e]	-[f]

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

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

[d] Not estimated.

[e] Upfront cost assumed to be negligible; equipment costs vary significantly based on other features besides energy source.

[f] Annual cost savings associated with an electric leaf blower or chainsaw estimated at between $500 and $600 per unit, assuming 960 hours of operation.

Assumptions: All assumptions utilized for the analysis of this strategy are identified in Table C-7.

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.

Total costs not quantified. Upfront cost is assumed to be negligible; equipment costs vary significantly based on other features besides energy source. As an example, the annual cost savings associated with an electric leafblower or chainsaw is estimated at between $500-$600 per unit, assuming 960 annual hours of operation.

Implementation Information: The County would work in close cooperation with the air district in drafting an ordinance or developing outreach programs to be consistent with current air district rules and CEQA guidelines. The ordinance could also include the following provisions for community landscaping equipment:

- Sponsor a lawnmower exchange program that allows residents to trade in their gasoline powered mower for an electric mower at a low or discounted price.
- Require exterior electrical outlets on all new building developments.

Supporting Marin Countywide Plan policies: N/A

Waste Reduction, Reuse, and Recycling

Waste-1. Zero Waste by 2025

Objective: The Marin Hazardous and Solid Waste JPA seeks to send zero tons of waste to landfills by the year 2025. This program is supported by the County's existing recycling programs, the food waste collection program, the C&D waste ordinance, the plastic bag ban, and the polystyrene ban. To support the 2025 zero waste goal, divert from landfills at least 83% of waste generated in the County overall by 2020.

Existing waste management programs collectively diverted 75% of waste generated in the County to recycling centers and other end uses in 2012. Implementation of this strategy will further the amount of diverted waste to at least 83% by 2020. The County will work with the Marin Hazardous and Solid Waste JPA 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)
2.995	2.9%	9%	100%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for waste reduction, reuse, and recycling strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Marin County would have a BAU waste diversion rate of 75% (Marin County Civil Grand Jury, 2014).
- The County would generate 191,016 tons of solid waste in 2020, of which, 47,754 tons would be landfilled under BAU conditions.
- One ton of landfilled waste generates 0.196 $MTCO_2e$ (ICLEI – Local Governments for Sustainability USA. 2012).

Analysis Method: Waste-1 would increase the waste diversion rate from 75% under BAU conditions to 83%. Landfilled waste in 2020 was recalculated assuming an 83% 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.

Although a cost analysis was not performed for this measure, potential costs would include incremental costs for new and expanded policies, programs, and infrastructure to increase

diversion. As an example, the City of Santa Monica recently conducted a cost analysis for its Zero Waste Strategic Operations Plan (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.

Water Conservation and Wastewater

Water/Wastewater-1. Water Conservation

The following sub-measures are part of the County's Water Conservation action strategy.

Water/Wastewater-1.1. Senate Bill X7-7

Objective: Meet (or exceed) the State-established per capita water use reduction goal[3] as identified by Senate Bill (SB) X7-7 for 2020. SB X7-7 was enacted in November 2009 and requires urban water agencies throughout California to increase conservation to achieve a statewide goal of a 20% reduction in urban per capita use (compared to nominal 2005 levels) by December 31, 2020 (referred to as the "20X2020 goal"). Each urban water retailer in the county subject to the law has established a 2020 per-capita urban water use target to meet this goal. These water retailers are the Marin Municipal Water District (MMWD) and the North Marin Water District (NMWD). As a rural water retailer, the Stinson Beach Water District (SBWD) which supplies water to some County residents is not required to comply with SB X7-7.

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 County. Specific per capita water use reduction goals vary by water agency.

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

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of WW Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
946	0.9%	2.8%	29.4%	-[d]	-[d]	-[d]

[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 84% (799 $MTCO_2e$) of the GHG emissions reductions achieved by Water-1.1 are associated with reduced hot water heating. The remaining reductions (148 $MTCO_2e$) are related to reduction in energy use required to transport, distribute, and treat water, and reductions in wastewater treatment fugitive emissions.

[b] State and local reductions for all sectors.

[c] Local reductions for water conservation and wastewater strategies.

[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Water energy intensities were based on the 2012 Community Inventory and are 2,163 and 647 kWh per million gallons for MMWD and NMWD, respectively.
- BAU water consumption rates were assumed to be 127 gallons per capita per day (gpcd) for MMWD and 160 for NMWD
- SB X7-7 targets were assumed to be 124 gpcd for MMWD and 123 gpcd for NMWD (Marin Municipal Water District 2010; North Marin Water District 2010).

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 County 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.

Although costs were not quantified for this measure, costs would include up-front costs of installing low-flow fixtures and other water saving appliances in homes and businesses, and savings would include reduced water bills.

Implementation Information: N/A

Supporting Marin Countywide Plan policies: N/A

Water/Wastewater-1.2. Additional Water Conservation for New Construction

Objective: Implement a County-wide water reduction target for new development that exceeds the SB X7-7 20% reduction target, such as a 30% reduction in water use. To satisfy this goal, require Adoption of the Voluntary CALGreen Tier 1 water efficiency measures for new residential and

nonresidential construction. CALGreen voluntary measures recommend use of certain water-efficient appliances, and plumbing and irrigation systems, as well as more aggressive water savings targets.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of WW Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
134	0.1%	0.4%	4.2%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for water conservation and wastewater strategies.

[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- All new residential and nonresidential buildings would comply with CalGreen Voluntary Tier 1 measures.
- Water energy intensities were based on the 2012 Community Inventory and are 2,163, 647, and 3,855 kWh per million gallons for MMWD, NMWD, and SBWD, respectively.

Analysis Method: Water savings were calculated on a per-fixture basis for residential and nonresidential water use using the difference between the mandatory CalGreen flow requirements for fixtures and the voluntary Tier 1 requirements for fixtures. Fixtures included lavatory and kitchen faucets, dishwashers, clothes washers and toilets/urinals. 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. Water savings from overlapping State and local strategies were removed from the energy forecast to avoid double counting. 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.

Although costs were not quantified for this measure, costs would include up-front costs of installing low-flow fixtures and other water saving appliances in homes and businesses, and savings would include reduced water bills.

Implementation Information: The County would update building standards and codes for new buildings to require adoption of these voluntary measures, including:

- Use of low-water irrigation systems
- Installation of rainwater and graywater systems
- Installation of water-efficient appliances and plumbing fixtures, as well as composting toilets
- A 30-40% reduction over baseline in indoor water use, and a 55-60% reduction in outdoor potable water use (CALGreen Tier 1 or 2).

Supporting Marin Countywide Plan policies: N/A

Water/Wastewater-1.3. Additional Water Conservation for Existing Buildings

Objective: Implement a County-wide water reduction target for existing buildings that exceeds the SB X7-7 20% reduction target, such as a 30% reduction in water use. To satisfy this goal, implement a program to renovate existing buildings to achieve higher levels of water efficiency. Encourage existing buildings (constructed before 2015) to adopt voluntary CALGreen Tier 1 water efficiency measures.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of WW Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
132	0.1%	0.4%	4.1%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for water conservation and wastewater strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- 2% of existing residential and nonresidential buildings would comply with CalGreen Voluntary Tier 1 measures by 2020.
- Water energy intensities were based on the 2012 Community Inventory and are 2,163, 647, and 3,855 kWh per million gallons for MMWD, NMWD, and SBWD, respectively.

Analysis Method: The approach for calculating water and emissions reductions is similar to what is described for Water/Wastewater-1.2, *Additional Water Conservation for New Construction*. However, the strategy was assumed to apply to existing developments constructed before 2015, as specified in the strategy objective.

Implementation Information: Education and outreach programs can help educate individuals on the importance of water efficiency and how to reduce water use. Rebate programs can help promote installation of water-efficient plumbing fixtures. The program could include:

- A Water Audit Program in collaboration with efforts by local water purveyors that offer free water audits.
- Development plans to ensure water conservation techniques are used (e.g. rain catchment systems, drought tolerant landscape, etc.).
- Water efficiency upgrades as a condition of issuing permits for renovations or additions of existing buildings.
- Water conservation pricing, such as tiered rate structures, to encourage efficient water use.
- Incentives for projects that demonstrate significant water conservation through use of innovative water consumption technologies.

Supporting Marin Countywide Plan policies: N/A

Water/Wastewater-2. Increase Pump Efficiency

Objective: Work with water agencies to maximize water pump efficiency to achieve a 10% reduction in energy use by 2020.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of WW Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
109	0.1%	0.3%	3.4%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for water conservation and wastewater strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Energy use for water pumping was reduced by 10%

Analysis Method: Energy savings were calculated by multiplying the 2020 BAU electricity use for water pumping by 10%. Energy savings from overlapping State and local strategies were removed from the energy forecast to avoid double counting. Total energy reductions from water movement were multiplied by RPS-adjusted utility emission factors to estimate emissions reductions.

Although costs were not quantified for this measure, costs would include up-front costs of installing more efficient pumps, and savings would include reduced utility bills for the water districts.

Implementation Information: The County, in partnership with PG&E and MCE, will work with MMWD, NMWD, and SBWD to improve the water pumping efficiency by at least 10% by 2020. Primary responsibility for the implementation of this measure rests with the water districts.

Supporting Marin Countywide Plan policies: N/A

Water/Wastewater-3. Reduce Wastewater Generation

Objective: Reduce residential wastewater generation by at least 15% and nonresidential wastewater generation by at least 10% by 2020. This would be supported by water conservation measures that seek to reduce indoor water use in buildings along with the County's existing graywater ordinance.

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of WW Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
1,898	1.8%	5.7%	59%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for water conservation and wastewater strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Residential wastewater generation was reduced by 15%; nonresidential wastewater generation was reduced by 10%

- Water energy intensities were based on the 2012 Community Inventory and are 2,163, 647, and 3,855 kWh per million gallons for MMWD, NMWD, and SBWD, respectively.

Analysis Method: 2020 indoor water use, after taking into consideration other previous measures that reduce water use, was multiplied by a 15% reduction factor for residential water use and a 10% reduction factor for nonresidential water use. 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.

Implementation Information: Implementation actions will be similar to those listed for Water/Wastewater-1.2 and Water/Wastewater-1.3 and will include promotion of the County's graywater ordinance.

Supporting Marin Countywide Plan policies: PFS-3.a Reduce wastewater volume, PFS-3.e Explore wastewater disposal alternatives, PFS-3.f Develop appropriate wastewater treatment technologies.

Summary Metrics:

Agriculture

Agriculture-1. Methane Capture and Combustion at Dairies and Livestock Operations

Objective: This is a voluntary measure to be undertaken by dairies and livestock operations. The measure encourages the installation of methane digesters to capture methane emissions from the decomposition manure. The methane could be used as on-site as an alternative to natural gas in combustion, power production, or as a transportation fuel. Using captured biogas could potentially offset natural gas use or offroad fuel use in the County (reductions may be achieved in the building energy sector and/or the off-road sector).Further, individual project proponents can sell GHG credits associated with these installations on the voluntary carbon market.[4]

Under this measure, it is assumed that 20% of dairies and other livestock facilities will install methane digesters.

[4] Individual project proponents could also sell GHG credits associated with these installations on the voluntary carbon market. GHG credits are used to offset GHG emissions due to other activities. Thus, even though there might be reductions in local emissions, there would be no net reduction in emissions globally. Thus, to the extent that project proponents sell GHG credits into carbon markets, this may not be taken as "credit" in reducing local GHG emissions.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of AG Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
4,638	4.4%	13.9%	100%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for agriculture strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Participating dairies will capture at least 50% of methane emissions from manure management.
- 20% of dairy cows and non-dairy cows in the County will feed the methane digesters
- 75% of captured methane would be combusted to produce electricity.

Analysis Method: 2020 BAU Manure management emissions from dairy cows, beef cows, and other cattle were multiplied by 10% (20% participation rate * 50% capture rate) to determine GHG emission reductions from this measure. Total captured methane was multiplied by 75% to calculate the amount of methane combusted for electricity generation. Using the conversion factors in Table C-1, the electricity generation potential from this methane was estimated. This electricity was assumed to offset PG&E electricity. GHG emissions reductions achieved through this electricity generation were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

Implementation Information: As a voluntary measure, the County would support dairies (and other animal operations) to consider existing and new technologies to control emissions from enteric fermentation and manure management and assess the feasibility and cost effectiveness of these technologies. Dairies would be encouraged to explore new technologies and implement feasible and cost-effective manure digestion projects based on their own local conditions and operations. The County would assist in seeking local, regional, state, and/or federal grants to help offset capital costs, linking dairies to new research opportunities, and working with local partners to help assess the feasibility of reduction projects and implement cost-effective options where available.

Supporting Marin Countywide Plan policies: N/A

GHG Performance Standard

PS-1. GHG Performance Standard for New Development

Objective: The County's GHG Performance Standard for New Development (PS) would provide a streamlined and flexible program for new projects to reduce their emissions. The PS would include performance standards for new private developments as part of the discretionary approval process under CEQA. Under the PS new projects would be required to quantify project-generated GHG emissions and adopt feasible reduction measures to reduce project emissions to 30% below BAU project emissions.

The PS does not require project applicants implement a pre-determined set of measures. Rather, project applicants are encouraged to choose the most appropriate measures for achieving the

percent reduction goal, while taking into consideration cost, environmental or economic benefits, schedule, and other project requirements.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of PS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
1,949	1.9%	5.8%	100%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for GHG Performance Standard strategies.

[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- 90% of new projects would be subject to this measure; 10% of projects would be exempt. This is based on a 3,000 $MTCO_2e$ threshold for BAU annual operational emissions for new projects. Approximately 10% of new projects would emit less than 3.000 $MTCO_2e$ of GHGs from annual operations, and 90% of new projects would emit more than 3.000 $MTCO_2e$ annually. Projects emitting more than 3.000 $MTCO_2e$ annually would be subject to this measure.
- New development emissions would be reduced by 30% compared to BAU

Analysis Method: GHG emissions from new development were calculated as the difference in emissions from 2020 and 2012. This value was then multiplied by 90% to determine emissions subject to the PS (as 10% of projects are assumed to be exempt) and by 30% to determine the GHG reductions expected under this measure.

Some state and local measures contribute directly to the PS goal for new development; these measures include State-2, Energy 1.1, Energy-3.1, Energy-3.2, Trans-1.1, Trans-1.3, and Water/Wastewater-1.2 (other state and local measures may reduce GHG emissions from new development, but the GHG reductions could not be broken down into reductions associated with new development only as these measures apply to all development, existing and new). The value of these state and local measures for new development were subtracted from the PS reduction to derive the net additional reductions that would result from the PS implementation. This does not mean that the other state and local measures would apply on an equal basis for every single project; individual new development projects may have higher or lower project-level burdens than the average. However, state and local measures are still expected to result in the largest share of the burden in meeting the PS reduction target for the County (with a smaller portion from project-level reductions).

Implementation Information: Implementation of the performance standard would reduce GHG emissions attributable to new discretionary development projects at least 30% by 2020. Measurable reductions of GHG emissions would be achieved through the County's review and discretionary approval of residential, commercial, and industrial development projects. It is expected that project proponents would often include energy-efficiency and alternative energy strategies to help reduce their project's GHG emissions because these are often the most cost-effective approach to reducing GHG emissions, but are free to propose any valid measures that would achieve the overall reduction goal.

One means of implementing the Performance Standard would be through development of a point-based "screening table" which identifies a wide-range of project-level measures that could be used to provide GHG reductions. The screening table provides the points for different types of measures and level of commitment and allows an easy way for project applicants to tally up their different proposed measures and see whether they meet the County's specific PS. Other cities and Counties have developed screening tables and guidance of how to apply them that are presently being used by new project applicants as a means to help streamline project review. The County could develop its own screening tables.

Supporting Marin Countywide Plan policies: N/A

Local Emissions Reduction Strategies - Municipal

Energy Efficiency and Renewable Energy

Energy-1. Energy Efficiency

The following sub-measures are part of the County's Energy Efficiency action strategy.

Energy-1.1. Energy Efficiency Measures for the new Emergency Operations Facility

Objective: Energy efficient designs and a solar photovoltaic system at the Emergency Operations Facility (EOF) are anticipated to save 1.17 million kWh and 812 therms (solar hot water system) a year (over base Title 24 requirements).

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)
222	4.8%	15.5%	49.3%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- 1.17 million kWh and 812 therms will be saved through implementation of this measure

Analysis Method: This measure would result in 1.17 million kWh of electricity savings and 812 therms of natural gas savings. GHG emissions reductions achieved by the strategy were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

Implementation Information: The County completed construction of the EOF in 2014 and implemented the energy efficiency measures.

Energy-1.2. Existing Building Retrofit Program

Objective: Conduct energy efficiency retrofits of existing County buildings. 2012 electricity use will be reduced by 5% by 2020 through retrofits of existing County buildings. Require these retrofits to improve building-wide energy efficiency by 20%. Retrofits should target lighting, heating and air conditioning units, and overall building energy use. In addition, the County will require that newly leased buildings improve energy consumption by 20% over 2012 levels.

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)
55	1.2%	3.8%	12.2%	$517-$741	$67,000-$212,000	$45,000

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- 2012 electricity use will be reduced by 5% by 2020 through retrofits of existing County buildings
- Retrofits will reduce energy consumption by 20% compared to baseline
- The cost per square foot for building energy audits ranges from $0.18 to $0.50 for a comprehensive energy audit (AECOM 2010).
- The lower cost per square foot for building energy retrofits (16-30% energy efficiency improvement) is $9.55 (AECOM 2010).
- The higher cost per square foot for building energy retrofits is $13.57, which includes lighting and HVAC measures (Benson et al. 2011).

Analysis Method: Total energy use (electricity and natural gas) in 2012 was multiplied by 5% to determine the amount of energy subject to retrofits. The resulting number was multiplied by 20% to determine energy reductions. 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 utility rates.

Implementation Information: These retrofits could be accomplished by a variety of actions, including:

- Energy inspections and audits
- Active Lighting Management System (including LED lighting retrofits, lighting controls, etc.)

- Major Equipment Procurement Standards: Require all major equipment purchases be more energy-efficient than the equipment it replaces.
- Building energy management system (such as requiring all occupied rooms maintain an ambient temperature of 71 degrees during the summer months)

Energy-1.3. Energy Efficiency Measures for County-Owned Computers and Printers

Objective: This measure includes two separate actions to improve energy efficiency at County facilities: 1) replace 100 traditional desktop or laptop computers with tablets; and 2) replace 50 printers with Energy Star printers.

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)
6	0.1%	0.4%	1.4%	$336-$2,368	$15,000-$70,000	$7,500

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

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Each tablet computer will save 234 kWh annually compared with a standard desktop computer (Electric Power Research Institute 2012)
- Each Energy Star printer computer will save 229 kWh annually compared with a standard printer (ICLEI – Local Governments for Sustainability USA 2010)
- The incremental costs of Energy Star printers are zero.
- Incremental costs of tablets are assumed to range from $150-$700, depending on quality (Dell 2014).
- Assumed lifetime for printers and tablets is 5 years (ICF International 2014).

Analysis Method: Electricity savings for computers were estimated by multiplying the number of tablet computers (100) by the annual energy savings for each (234 kWh). Electricity savings for printers were estimated by multiplying the number of Energy Star printers (50) by the annual energy savings for each (229 kWh). GHG emissions reductions achieved by the strategy were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

The county would incur upfront costs from the purchase of tablets. Incremental costs of tablets are assumed to range from $150-$700, based on a review of tablet and desktop prices on dell.com (Dell 2014). Little price difference is found between higher and lower efficiency printers. Assuming printers are replaced at the end of their useful life, incremental costs of Energy Star printers are zero. Annual cost savings are based on electricity reductions, multiplied by the appropriate utility rates.

Implementation Information: N/A

Energy-1.4. Computer Energy Management

Objective: The County will use Verdiem software (or other similar software) to reduce energy consumption in computers. The County will also require that computers be turned off every night before County employees go home and before weekends. Explore and/or pilot programs that turn off PCs after hours when not in use. Require all PCs to be set at the highest energy-saving mode for regular use.

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)
46	1%	3.2%	10.2%	$1,083	$52,000	$55,000

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- This measure will reduce baseline computer energy use by 15%
- 8.2% of total municipal electricity use is for office equipment (California Energy Commission 2006).
- Assumed capital costs of Verdiem software are $52,081 (Verdiem 2014).

Analysis Method: Total 2020 BAU municipal electricity use, after taking into account energy savings from other overlapping state and local strategies, was multiplied by 8.2% to determine the amount of electricity subject to this measure. This was then multiplied by 15% to determine electricity savings. GHG emissions reductions achieved by the strategy were quantified by multiplying the energy reductions by the appropriate RPS-adjusted utility emission factors.

Verdiem advertises a "less than one year payback" for their software (Verdiem 2014). Consequently, capital costs are conservatively assumed to be equal to one year of energy savings. Annual cost savings are based on electricity reductions, multiplied by the appropriate utility rates.

Implementation Information: N/A

Energy-1.5. Shade Tree Planting

Objective: Promote the planting of shade trees around County facilities. Plant 10 new trees each year as part of this goal. Promote California natives or low water trees and include irrigation upgrades to support tree health until established.

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	0.02%	0.1%	0.2%	$846-$2,077	$8,000	($800)-($2,000)

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Strategy requirements would take effect in 2015.
- 10 trees per year would be planted by the County adjacent to buildings.
- Average tree planting age is 1 year and 96% of planted trees would survive.
- For modeling purposes, new trees would be a mix of maple, ash, pine, oak, and redwood. The County Parks department may plant different tree species because soils and water conditions will dictate the species planted and there are many tree options. Average upfront cost to plant a tree is $170, with a range of $142 to $197 per tree based on whether root barriers are present (ICF International 2014).
- Annual maintenance costs were assumed to range from $34-$69 per tree (City of Goleta 2009; McPherson et al. 2005).

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. All 10 trees planted per year were assumed to be planted adjacent to buildings 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 county 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) and McPherson et al. (2005). 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).

Implementation Information: N/A

Energy-1.6. Install energy-efficient street lights

Objective: Require that all streetlights use LED bulbs. There are currently 213 high pressure sodium and 3 Incandescent streetlights owned and operated by the County; the rest are all LED. Install lighting meters on streetlights at key distribution points.

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)
11	0.2%	0.7%	2.4%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- High pressure sodium lights operate at 0.192 kW (U.S. Department of Energy 2012b).
- Incandescent lights operate at 0.15 kW (U.S. Department of Energy 2012b).
- LED lights operate at 0.12 kW (U.S. Department of Energy 2012b).
- Streetlights operate 11 hours per day, 365 days per year (ICLEI 2010).

Analysis Method: 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 213 high pressure sodium cutoff fixtures and 3 incandescent 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.

Implementation Information: N/A

Energy-2. Solar Energy

The following sub-measures are part of the County's Solar Energy action strategy.

Energy-2.1. Install solar panels on municipal facilities

Objective: Install solar on municipal facilities by aiming to provide 1.1% of all 2012 electricity consumed by County buildings and properties by 2020 to be from solar photovoltaic (PV) panels. Require that, where feasible, new or major rehabilitation of County-owned buildings are constructed to allow for easy, cost effective installation of solar energy systems in the future.

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)
42	0.9%	2.9%	9.4%	$10-$214 (DP); $117-$234 (PPA)	$540,000-$640,000 (DP); $0 (PPA)	$45,000 (DP); $4,800-$9,600 (PPA)

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

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.:

- Does not include existing County installed PV arrays located on Emergency Operations Facility, Fairgrounds, Throckmorton Fire Station, 120 N. Redwood, Health and Wellness Campus and General Services Buildings. These systems are already incorporated into the 2012 Municipal GHG Inventory and 2020 BAU forecast, and will therefore not contribute to reductions from 2020 BAU emissions.
- Does not include electricity offsets from Energy-2.2 *Solar Panel Carports*
- Initial costs for a nonresidential system range from $4.3 to $5.3 per watt (Burbose et. al 2013).
- The average system size is 40 kW.
- Solar systems would have a 25-year lifetime (U.S. Department of Energy 2013b).

Analysis Method: Total 2020 BAU municipal electricity use, after taking into account energy savings from other overlapping state and local strategies, was multiplied by 1.1% to determine the amount of electricity supplied by solar PV under this measure. GHG emissions reductions achieved by the strategy were quantified by multiplying the 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-system basis, based on an initial cost of $4.3 to $5.3 per watt for a 40 kW system. The direct purchase capital costs include a federal investment tax credit (ITC) of 30% of initial cost of the system. The lower cost scenario includes the CSI performance based incentive (PBI) of $0.12 per kWh for municipal governments 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. 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 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.

Implementation Information: N/A

Energy-2.2. Solar Panel Carports and Parking Areas

Objective: Install solar panels over carports and parking areas by 2020. The County will install solar PV over the equivalent of 200 parking spaces. If carports include plug-in-electric stations, the County should install enough PV panels to offset 80% of the electric station's expected energy use. Renewable energy generated by carport PV panels can be sold as an offset or used to power adjacent buildings or stand-alone plug-in charging stations.

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)
68	1.5%	4.8%	15.1%	$10-$214 (DP); $117-$234 (PPA)	$842,000-$1,000,000 (DP); $0 (PPA)	$72,000 (DP); $7,800-$15,500 (PPA)

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for Building Energy (BE) including energy efficiency and renewable energy strategies.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Each parking space is 171 square feet (9' x 9'); for each parking space, 171 square feet of solar PV will be installed.
- Solar PV generation is approximately 8 watts per square foot of panel, producing 11.2 kWh per square foot of panel annually based on 5,606 kWh per year for a typical 4 kW solar system (National Renewable Energy Laboratory 2005; U.S. Department of Energy 2013b).
- Initial costs for a nonresidential system range from $4.3 to $5.3 per watt (Burbose et. al 2013).
- Installed system size assumed to be 1.4 kW per parking space (ICF International 2014).
- Solar systems would have a 25-year lifetime (U.S. Department of Energy 2013b).

Analysis Method: For each parking space, 171 square feet of solar PV panels would be installed. The County will install solar PV over 200 parking spaces, or 34,200 square feet of solar PV panels. This value was multiplied by 11.2 kWh solar electricity generation per square foot of PV to determine total annual electricity production. 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-system basis, based on an initial cost of $4.3 to $5.3 per watt for a 280 kW system. The direct purchase capital costs include a federal investment tax credit (ITC) of 30% of initial cost of the system. The lower cost scenario includes the CSI performance based incentive (PBI) of $0.12 per kWh for municipal governments 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. 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 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.

Implementation Information: N/A

Vehicle Fleet and Employee Commute

Trans-1. New Vehicles

The following sub-measures are part of the County's New Vehicles action strategy.

Trans-1.1. Purchase fuel efficient (e.g., hybrid) and/or smaller fleet vehicles to replace existing fleet vehicles

Objective: Expand on the fuel-efficient fleet vehicles program by replacing 25 of County-owned traditional-fueled vehicles (passenger/light-duty, medium-duty, and heavy-duty) with the most efficient vehicles (hybrid, compressed natural gas, or diesel) available by the year 2020.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TRANS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
17	0.4%	1.2%	2.0%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy Vehicle Fleet and Employee Commute strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Standard vehicle fuel economy is 34 miles per gallon (average from the 2012 Municipal Inventory)
- Hybrid vehicle fuel economy is 46 miles per gallon (provided by County). The actual hybrid fuel economy will likely be higher.
- Average annual VMT is 10,000

Analysis Method: Hybrids will achieve 12 mpg beyond standard vehicles, resulting in 78 gallons of gasoline saved per year per vehicle (10,000 miles ÷ 34 mpg - 10,000 miles ÷ 46 mpg). This value was multiplied by 25 vehicles to determine total annual fuel savings. Total fuel savings were multiplied by the emission factors presented in Table C-1 to determine GHG emission reductions.

Implementation Information: N/A

Trans-1.2. Electric Vehicles

Objective: Require the replacement of 20 non-emergency gasoline powered sedans with electric vehicles by 2020.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TRANS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
42	0.9%	2.9%	5.0%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy Vehicle Fleet and Employee Commute strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Standard vehicle fuel economy is 34 miles per gallon (average from the 2012 Municipal Inventory)
- EVs require 32 kWh per 100 miles, using the 2014 Ford Focus Electric vehicle as a proxy (U.S. Department of Energy 2014)
- Average annual VMT is 10,000

Analysis Method: Gasoline savings were calculated by dividing average annual VMT for each vehicle (10,000) by the fuel efficiency of standard vehicles (34 mpg). Increased electricity use to power the new EVs was estimated by multiplying average annual VMT by 32 kWh per 100 miles. These values were multiplied by 20 vehicles to determine total annual fuel savings and electricity use. Total fuel savings were multiplied by the emission factors presented in Table C-1 to determine GHG emission reductions from reduced fuel use. Total increased electricity emissions were calculated by multiplying new electricity use for EVs by the appropriate RPS-adjusted utility emission factors.

Implementation Information: N/A

Trans-1.3. Electric Landscaping Equipment

Objective: Require the replacement of 10 pieces of County landscaping equipment with electric equipment by 2020. Install outdoor electrical outlets on County buildings as appropriate.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TRANS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
3	0.1%	0.2%	0.4%	-[d]	-[e]	-[f]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy Vehicle Fleet and Employee Commute strategies.
[d] Not estimated.
[e] Upfront cost assumed to be negligible; equipment costs vary significantly based on other features besides energy source.
[f] Annual cost savings associated with an electric leaf blower or chainsaw estimated at between $500 and $600 per unit, assuming 960 hours of operation.

Assumptions: All assumptions utilized for the analysis of this strategy are identified in Table C-7.

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.

Total costs not quantified. Upfront cost is assumed to be negligible; equipment costs vary significantly based on other features besides energy source. As an example, the annual cost savings associated with an electric leafblower or chainsaw is estimated at between $500-$600 per unit, assuming 960 annual hours of operation.

Implementation Information: N/A

Trans-2. Alternative Transportation

The following sub-measures are part of the County's Alternative Transportation action strategy.

Trans-2.1. Guaranteed Ride Home

Objective: Provide a free shuttle or taxi ride home to employees in case of an emergency (illness, family crisis, unscheduled overtime). Would apply to any employee who uses any alternative to driving alone to work (public transit, carpooling, vanpooling, biking, or walking) on the day of the emergency.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TRANS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
1	0.02%	0.1%	0.1%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy Vehicle Fleet and Employee Commute strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- 13% of eligible employees will use this program once each year
- In 2020, 674 employees would be eligible for this program (average number of daily employees using an alternative mode of transportation to commute to work)

Analysis Method: 88 guaranteed ride home trips would occur as a result of this measure (13% * 674), offsetting 88 commute trips. The change in VMT by mode was estimated by distributing these trips based on the new commute mode share after the implementation of this strategy and any other overlapping local employee commute measures. GHG emission reductions were then estimated by multiplying VMT reductions for each mode by the associated emission factors used in the 2012 Municipal Inventory.

Implementation Information: N/A

Trans-2.2. Green Commute Program

Objective: Reestablish the County's Green Commute Program which could include measures that allow County employees to purchase public transit fares with pre-tax dollars up to IRS limits, provide employees with low-cost monthly transit passes, and/or provide direct incentives to

employees that take commute alternatives. The County will also encourage car-pooling or van-pooling by municipal employees by providing ride-matching assistance, preferential carpool parking, flexible work schedules for carpools, and vanpool assistance.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TRANS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
342	7.3%	23.9%	40.5%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.

[b] State and local reductions for all sectors.

[c] Local reductions for energy Vehicle Fleet and Employee Commute strategies.

[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- The previous Marin County Green Commute Program (implemented in 2008 but subsequently canceled) was used as a proxy for estimating reduced trips and VMT for this measure. The change in mode share from this program was: -10% for drive alone, +6% for carpool, +2% for transit, and +2% for bike trips (Marin County Department of Public Works 2009).
- The County would also provide a daily alternative transportation incentive to employees.

Analysis Method: The daily number of reduced drive alone trips was calculated by multiplying the baseline number of trips (after the implementation of other overlapping local employee commute measures) by -10% as indicated above. The increase in carpool, transit, and bike trips was then calculated by multiplying the baseline number of trips (after the implementation of other overlapping local employee commute measures) by +6% for carpool, +2% for transit, and +2% for bike trips as indicated above. GHG emission reductions were estimated by multiplying VMT reductions and VMT increases for each mode by the associated emission factors used in the 2012 Municipal Inventory.

A moderate level of cost associated with additional staff time to manage the program and incentives are anticipated. Developing, marketing and managing the program might require as much as ½ of an FTE per year and a materials budget.

Implementation Information: N/A

Supporting Marin Countywide Plan policies: TR-1.c - Promote Transportation Alternatives, AIR-4.b - Reduce Greenhouse Gas Emissions Resulting from Transportation, AIR-4.e - Reduce County Government Contributions to Greenhouse Gas Emissions.

Trans-3. Trip Reduction

The following sub-measures are part of the County's Trip Reduction action strategy.

Trans-3.1. Encourage telecommuting by municipal employees

Objective: The County would update telework policies and practices for employees. The policy should specify the following (Victoria Transport Policy Institute 2011b):

- Which job categories are suitable for telework.
- What is required of employees to qualify for the program.
- What equipment, support and benefits the County will provide to telecommuting employees.
- What criteria are to be used to evaluate the performance of employees when they telecommute.
- How telecommuting schedules are determined, and what is required to change schedules.
- Periodic review of the arrangement.
- Model contracts and forms for establishing and tracking telecommuting.

Supporting Marin Countywide Plan policies: AIR-4.b - Reduce Greenhouse Gas Emissions Resulting from Transportation, TR-1.a - Support Alternate Work Schedules.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TRANS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
51	1.1%	3.5%	60%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy Vehicle Fleet and Employee Commute strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- 2% of total employees will be working from home on any given day under this measure; in the 2020 BAU scenario, 1% of total employees are be working from home on any given day.
- The average one-way commute trip distance is 19.3 miles (511 Rideshare & Bicycling 2012).

Analysis Method: The daily number of avoided VMT was estimated by calculating the number of additional employees working from home (1% of total employees) by the average one-way trip distance (19.3). The change in VMT by mode was estimated by distributing these trips based on the new commute mode share after the implementation of this strategy and any other overlapping local employee commute measures. GHG emission reductions were then estimated by multiplying VMT reductions for each mode by the associated emission factors used in the 2012 Municipal Inventory.

Implementation Information: N/A

Trans-3.2. Municipal Parking Management

Objective: Study and, where feasible, implement a Municipal Parking Management Program to discourage private vehicle use. This may include the use of parking pricing for employees.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of TRANS Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
388	8.3%	27.1%	46.0%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy Vehicle Fleet and Employee Commute strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- The County would implement a $1.00 parking price for employees at selected County facilities. A $1.00 parking price was used to be conservative, but studies show increased savings from increased fees. This results in a 0.9% trip reduction for drive alone (Victoria Transport Policy Institute 2011c).

Analysis Method: The daily number of reduced drive alone trips was calculated by multiplying the baseline number of trips (after the implementation of other overlapping local employee commute measures) by 0.9%. The change in VMT by mode was estimated by distributing these reduced trips based on the new commute mode share. GHG emission reductions were estimated by multiplying VMT reductions for each mode by the associated emission factors used in the 2012 Municipal Inventory.

Implementation Information: The County would conduct an updated study of the financial, employee and neighborhood impacts of adding a parking fee to selected County facilities including the Civic Center to design a fee program for appropriate sites. A $1.00 parking price was used in this analysis to be conservative, but studies show increased savings from increased fees. The County would study the impact of different parking fees further in the development of the program. The financial impact to employees could be reduced by allocating surplus revenue from the fees to incentives to encourage the use of commute alternatives and/or by allowing employees to pay the parking fee using pre-tax dollars.

The study would require the participation of the Human Resources Department and will ensure that it complies with all bargaining obligations.

Waste Reduction, Reuse, and Recycling

Waste-1. Increase Recycling at County Facilities

Objective: Increase the recycling rate at County facilities. This could be implemented by additional recycling and composting efforts and through education and outreach programs for County employees.

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)
35	0.8%	2.4%	100%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy Waste Reduction, Reuse, and Recycling strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- The 2020 BAU diversion rates for the following facilities and events were used: Civic Center – 43%; County Jail – 15%; 120 North Redwood – 89%; Kerner Campus – 88%; Marin County Fair – 91%; Marin Home Show – 87%
- The County would generate 623 tons of solid waste from these facilities and events in 2020, of which, 310 tons would be landfilled under BAU conditions.
- Under this measure, the new diversion rates for the following facilities and events were used: Civic Center – 83%; County Jail – 83%; 120 North Redwood – 83%; Kerner Campus – 83%; Marin County Fair – 95%; Marin Home Show – 95%
- One ton of landfilled mixed municipal solid waste (MSW) generates 0 0.1512 $MTCO_2e$ (ICLEI – Local Governments for Sustainability USA. 2012).

Analysis Method: Waste-1 would increase the waste diversion rate under BAU conditions as listed above. Landfilled waste in 2020 for each facility and event was recalculated assuming the new diversion rates listed above. These tonnages were 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.

Implementation Information: N/A

Water Conservation and Wastewater

Water/Wastewater-1. Water Conservation

The following sub-measures are part of the County's Water Conservation action strategy.

Water/Wastewater-1.1. Water Conservation for Existing Buildings

Objective: Implement a program to renovate existing buildings to require a higher level of water efficiency. At a minimum, require a 10% savings in indoor and outdoor water use. Develop a master plan of County facilities to address water efficient landscape, irrigation and maintenance practices.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of WW Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
100	2.1%	7.0%	98.7%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy Water Conservation and Wastewater strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- Water energy intensities were based on the 2012 Municipal Inventory and are 2,163, 647, and 3,855 kWh per million gallons for MMWD, NMWD, and SBWD, respectively.

Analysis Method: Estimated indoor and outdoor water use in existing municipal facilities (for the year 2015) were multiplied by 10% to determine water use reductions associated with this measure. 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. Water savings from overlapping State and local strategies were removed from the energy forecast to avoid double counting. 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.

Although costs were not quantified for this measure, costs would include up-front costs of installing low-flow fixtures and other water saving appliances in County facilities, and savings would include reduced water bills.

Implementation Information: This measure could be implemented by complying with part or all of CALGREEN Tier 1 standards for Non-Residential development, which would achieve a 30% reduction in water use. The County would also conduct water audits on County facilities and expedite repairs, create development plans to ensure water conservation techniques are used, and perform water efficiency upgrades where feasible and effective.

Water/Wastewater-1.2. Irrigation Monitoring and Management System

Objective: Consider installing and or using a water monitoring and management system for all of the County's irrigation needs.

Summary Metrics:

2020 GHG Reduction[a]	% of All Reductions[b]	% of Local Reductions	% of WW Reductions[c]	Savings (Cost)/MT	Initial Capital Cost	Annual Savings (Cost)
1	0.03%	0.1%	1.2%	-[d]	-[d]	-[d]

[a] Presented in terms of $MTCO_2e$.
[b] State and local reductions for all sectors.
[c] Local reductions for energy Water Conservation and Wastewater strategies.
[d] Cost analysis not prepared for this measure.

Assumptions: In addition to assumptions listed in Table C-7, the following were also considered.

- The expected percent reduction in outdoor water use after installation of smart landscape irrigation controllers is 6.1% (CAPCOA 2010).

Analysis Method: Estimated 2020 BAU outdoor water use was multiplied by 6.1% to determine water use reductions associated with this measure. Water savings from overlapping State and local strategies were removed from the energy forecast to avoid double counting. Electricity savings from reduced water movement and treatment were quantified by multiplying the estimated water reductions by the appropriate agency-specific energy intensities. Total energy reductions from water movement were multiplied by RPS-adjusted utility emission factors to estimate emissions reductions.

Although costs were not quantified for this measure, costs would include up-front costs of installing monitoring and irrigation management tools, and savings would include reduced water bills.

Implementation Information: This measure could be accomplished by participation in the California Irrigation Management Information System (CIMIS), such as by installation of a climate station in the County or by using CIMIS irrigation scheduling tools. Other monitoring and irrigation management tools should be considered, as appropriate, to best meet the County's specific needs.

Supporting Strategies – Community

The following community strategies were not quantified for GHG emission reductions or costs and savings, but they support and strengthen the quantified measures listed above and are an important part of the CAP Update.

Energy Efficiency and Renewable Energy

SP Energy-1. District Financing Program for Energy Efficiency and Renewables

Objective: Participate in a PACE financing program for energy efficiency and renewables for commercial and residential properties.

SP Energy-2. Update Code to Encourage Small Scale Solar

Objective: Update County codes to encourage responsible development of small scale (< 1 MW) solar generation facilities.

SP Energy-3. Promote MCE's Deep Green program

Objective: Promote residential and commercial participation in MCE's Deep Green program. Goal of 10% to 15% opt-in

Land Use, Transportation, and Offroad

SP Trans-1. Improve the County's jobs/housing balance

Objective: Measure from the 2006 Marin County GHG Reduction Plan.

Supporting Marin Countywide Plan policies and programs: CD-5.f - Redefine Countywide Planning Functions, HS-3.a - Complete a Nonresidential Job/Housing Linkage Study, HS-3.b - Adopt a Job/Housing Linkage Ordinance.

SP Trans-2. Institute growth boundaries, ordinances or programs to limit suburban sprawl

Objective: Measure from the 2006 Marin County GHG Reduction Plan.

Supporting Marin Countywide Plan policies and programs: AIR-4.l - Preserve Agricultural Lands, AIR-4.m - Focus Development in Urban Corridors, OS-2.b - Coordinate Open Space Planning, OS-2.c - Acquire and Protect Lands Pursuant to the Open Space District's Mission Statement, OS-2.g - Apply County Zoning, OS-2.h - Require Clustered Development, CD-1.a - Keep Urban Uses in the City-Centered Corridor, CD-1.b - Preserve Resources in the Baylands Corridor, CD-1.c - Reduce Potential Impacts

SP Trans-3. Implement Housing Overlay Zone focused on city centered corridor

Objective: Measure from the 2006 Marin County GHG Reduction Plan.

Supporting Marin Countywide Plan policies and programs: CD-2.d - Implement the Housing Overlay Designation Program, HS-3.v - Evaluate the Feasibility of an "Affordable Housing Overlay Designation" Zoning Designation. Includes below market rate housing requirements. CD-1.a - Keep Urban Uses in the City-Centered Corridor.

SP Trans-4. Senior Mobility Action Plan

Objective: Support/Implement recommendations in the Senior Mobility Action Plan.

SP Trans-5. Implement Marin County Unincorporated Area Bike/Ped Master Plan

Objective: Expand community bicycle infrastructure (e.g., dedicated bicycle lanes, additional bicycle parking spaces).

Supporting Marin Countywide Plan policies and programs: TR-2.a - Encourage bicycling and walking, TR-2.b - Adopt Standards for Pedestrian and Bicycle Access, TR-2c - Support Bicycle Stations and Consider Attended Parking, TR-2d - Fund Projects (Marin County Unincorporated Bicycle and Pedestrian Master Plan), TR-2e - Prioritize Completion of the North-South and East-West Bikeways, TR-2g - Add Bicycle Lanes, TR-2h - Encourage Innovative Bicycle Lane Design, TR-2i

- Renovate Tunnels Along the Planned North-South Bikeway into Multi-Use Pathways, TR-2l - Complete Streets.

SP Trans-6. Expand the "safe routes to school" program

Objective: Measure from the 2006 Marin County GHG Reduction Plan.

Supporting Marin Countywide Plan policies and programs: TR-2.b - Adopt Standards for Pedestrian and Bicycle Access, TR-2.j - Ensure Safe Routes to Schools, TR-2.k - Consider Pedestrian Needs.

SP Trans-7. Employer-Based Trip Reduction

Objective: Support voluntary employer-based trip reduction.

Supporting Marin Countywide Plan policies: Countywide Plan – Air-3.a).

SP Trans-8. Traffic Signal Synchronization

Objective: Measure from the 2006 Marin County GHG Reduction Plan.

Supporting Marin Countywide Plan policies and programs: TR-2.k - Consider Pedestrian Needs.

SP Trans-9. Support Alternative Fuels Vehicles

Objective: Actively support infrastructure needed for alternative fuel vehicles, including fueling and charging stations. Review and consider revising applicable codes applying to refueling and recharging infrastructure. Support State, federal, and local efforts to increase fuel efficiency and reduce greenhouse gas emissions.

Supporting Marin Countywide Plan policies: Countywide Plan TR-4.e.

SP Trans-10. Support Alternate Work Schedules and Telecommute Programs

Objective: Encourage employers to allow alternate work schedules for employees, telecommuting, and use of satellite work centers.

Supporting Marin Countywide Plan policies and programs: TR-1.a

SP Trans-11. Transit Agency Coordination

Objective: Encourage coordination amongst transit agencies to conduct a county-wide transit study to identify opportunities for efficiencies, improve transfers/connections, and identify service gaps. Work with transit agencies to increase bike storage on buses, at bus stops, and at transit hubs and ferry terminals.

SP Trans-12. Parking Requirements

Objective: Consider lowering minimum parking requirements, encourage shared use parking (work with County to define boundaries where this may be feasible).

Supporting Marin Countywide Plan policies and programs: DES-1.a, DES-2.a, HS-3.11, HS-3.12, HS-3.l, HS-3.m, HS-3.q, TR-1.q

SP Trans-13. Adopt Flexible Parking Standards

Objective: Amend the Development Code and work with cities and towns to allow reduced automobile parking requirements for projects that participate in subsidy programs for transit riders, or provide direct access to (or are located within a ½ mile of) multimodal transit hubs, participate in a TDM program, provide shared parking.

Supporting Marin Countywide Plan policies and programs: TR-1.i

SP Trans-14. Promote Transportation Choices

Objective: Work with local, State, and federal governments, businesses, schools, seniors, and environmental groups to encourage use of transit, vanpools, carpools, car sharing, bicycles, and walking, including providing incentives to employers, commuters, and recreational users to support these transportation alternatives.

Supporting Marin Countywide Plan policies and programs: TR-1.c

SP Trans-15. Coordinate with Local Agencies

Objective: Work with a proposed City-County Planning Committee, Department of Public Works, Transportation Authority of Marin, Metropolitan Transportation Commission, and other Bay Area counties to coordinate transportation system planning, including updating the County Congestion Management Program and the Capital Improvement Program to prioritize the projects that will meet the goals of the County Transportation Vision. Work with the Transportation Authority of Marin to develop transportation system performance goals in line with the goals of the CAP.

Supporting Marin Countywide Plan policies and programs: TR-1.d

SP Trans-16. West Marin Traffic Reduction Program

Objective: Implement a Traffic Reduction Program for Recreational Traffic to West Marin.

Supporting Marin Countywide Plan policies and programs: TR-3.h.

Waste Reduction, Reuse, and Recycling

SP Waste-1. Landfill Gas to Energy Projects

Objective: As appropriate, install methane capture technology and associated monitoring systems on all landfills without methane capture and that are not required to install or upgrade equipment under the state rule with a goal of increasing the facility level methane capture rate to the highest extent feasible (i.e., approaching 100%).

SP Waste-2. Construction and Demolition Reuse and Recycling Ordinance

Objective: All building and demolition permits must demonstrate a 50% minimum of reused or recycled construction and demolition materials. This ordinance was passed in September 2003. Increase the C&D diversion rate of to 65% for all new construction projects.

SP Waste-3. Waste Education Program

Objective: Provide education and publicity about commercial and residential recycling, reuse, waste reduction, composting, grass cycling, and waste prevention to the public. Encourage local recycling and composting initiatives at the neighborhood level.

Water Conservation and Wastewater

SP Water/Wastewater-1. Encourage Water Conservation

Objective: Encourage water conservation in the County.

Supporting Marin Countywide Plan policies and programs: PFS-2.b Minimize the demand for water in new development, PFS-2.i Promote water saving irrigation, PFS-2.l Reduce energy use from water facilities, WR-3.a - Support Water Conservation Efforts, WR-3.b - Support and Integrate Water District Conservation Efforts, AG-1.p - Evaluate Small-Scale Water Development, AG-1.q - Support Irrigation Alternatives.

SP Water/Wastewater-2. Equipment Upgrades

Objective: Assist local WWT providers with their energy efficiency efforts through the Energy Watch Partnership with PG&E. Encourage providers to upgrade and replace wastewater treatment and pumping equipment with more energy efficient equipment, as is financially feasible, at existing facilities by 2020. Encourage the use of best management practices for the treatment of wastewater.

SP Water/Wastewater-3. Offer Low Interest Loan Program

Objective: Encourage local sanitary districts to offer low interest loan programs to homeowners to repair sewer laterals.

Agriculture

SP Agriculture-1. Marin Carbon Project

Objective: The Marin Carbon Project seeks to enhance carbon sequestration in rangeland, agricultural, and forest soils through applied research, demonstration and implementation. Promote enhanced carbon sequestration in Marin's agricultural and rangeland soils and facilitate development of a carbon market that supports soil carbon sequestration efforts on agricultural, forest and rangelands in Marin County and globally.

SP Agriculture-2. Best Management Practices for Agriculture

Objective: Support voluntary best management practices for agriculture. This could include things like adding compost from local community waste to the soil, no-till and reduced-till practices, the use of organic fertilizers, reduce fossil fuel use in agricultural equipment, use of cover crops on vineyards, using biochar in soils, planting hedgerows and conserving or restoring natural vegetation, etc. Also encourage the conversion of land grazed full-time to land with grazing managed to maximize environmental benefits.

Supporting Marin Countywide Plan policies and programs: Air-1.g Require control measures for construction and agricultural activity, Air-4.d Reduce greenhouse gas emissions from agriculture, Air-4.l Preserve agricultural lands.

SP Agriculture-3. Promote the sale of locally grown foods and/or products

Objective: Continue to support local farmer's markets to provide community residents with a more local source of food, potentially resulting in a reduction in the number of trips and vehicle miles traveled by both the food and the consumers to grocery stores and supermarkets. If the food sold at the local farmer's market is produced organically, it can also displace carbon-intensive food production practices.

Land Conservation

SP Land Conservation-1. Protect Conservation Areas

Objective: Encourage the preservation of existing land conservation areas, especially forested, oak woodland, hillsides, ridgelines, and wetland areas that provide carbon sink benefits. Preserve existing oak woodland and seek no net loss of oak woodland areas.

SP Land Conservation-2. Create New Vegetated Open Space

Objective: Encourage the restoration and re-vegetation of 40 acres of previously settled land in order to promote carbon sequestration in the unincorporated County. Also encourage the conversion of 40 acres of unused urban and suburban areas into parks and forests.

Supporting Strategies - Municipal

The following municipal strategies were not quantified for GHG emission reductions or costs and savings, but they support and strengthen the quantified measures listed above and are an important part of the CAP Update.

Energy Efficiency and Renewable Energy

SP Energy-1. Employee Outreach and Education

Objective: Institute an employee awareness program to educate personnel on energy efficiency steps such as indoor temperature controls.

SP Energy-2. Encourage Paperless Billing

Objective: Encourage online paperless billing as an option for such revenues as traffic tickets and other fines. Make a goal of reducing the number of payments by mail by 45% by 2020. This reduces printing energy use as well as energy required to handle physical payments. This measure will also reduce paper waste generated by County facilities.

SP Energy-3. Data Center Virtualization

Objective: Install virtualization technology in data centers where feasible.

SP Energy-4. New Aeration Blowers at the Central Marin Sanitary Agency

Objective: Two of the four original single-speed aeration blowers at the Central Marin Sanitary Agency (CMSA) were replaced with high-speed, variable-output turbo blowers this past year. These new blowers are more energy efficient due to their ability to change motor speeds to match microorganism air demand fluctuations, rather than throttling down the air supply of the single-speed blowers. The aeration system optimization phase of the project is underway and, when completed, the Agency should realize a projected 20%-30% energy savings. The following information is available for this measure:

- 2012 annual electricity use at the CSMA was 697,028 kWh, provided by MCE.
- The new aeration blowers would reduce this energy use by 20%
- The system has the potential to reduce GHG emissions by 26 $MTCO_2e$. However, these emission reductions will occur at the facility itself, which is located in the City of San Rafael. Consequently, emission reductions were not counted toward the CAP Update.

SP Energy-5. Food Waste-to Energy at the Central Marin Sanitation Agency

Objective: The CSMA currently plans to use their existing WWTP anaerobic digesters to process local commercial food waste to produce renewable, non-fossil-fuel energy (City of San Rafael and Central Marin Sanitation Agency 2008). The following information is available for this measure:

- The potential renewable energy generation from the Food Waste-to-Energy system is 230 kW
- The system would operate 8 hours per day and 260 days per year, generating 478,400 kWh annually.
- The system would require 242,320 kWh annually for the separation facility and the processing facility.
- Net annual energy generation would be 236,080 kWh.
- This electricity would offset MCE Light Green electricity, the current electricity type used at the CMSA.
- The system has the potential to reduce GHG emissions by 44 $MTCO_2e$. However, these emission reductions will occur at the facility itself, which is located in the City of San Rafael. Consequently, emission reductions were not counted toward the CAP Update.

Land Use, Transportation, and Offroad

SP Trans-1. Vehicle Idling

Objective: Limit idling of municipal vehicles to 3 minutes.

SP Trans-2. Clean Energy Fuels Program Infrastructure

Objective: Provide/encourage construction of refueling infrastructure for electric and alternative-fueled vehicles. This measure will support Trans-1.

SP Trans-3. Smart Global Positioning Systems

Objective: Participate in a pilot program to install smart GPS on County vehicles. Smart global positioning systems (GPS) support trip planning actions by mapping optimal routes to reduce VMT. Through this measure, the County will continue to seek funding to install additional GPS units. This measure will support the measures above.

SP Trans-4. Fuel Tracking System

Objective: Provide an up-to-date fuel tracking system of County fleet. This measure will support the measures above.

SP Trans-5. Vehicle Maintenance Program

Objective: Evaluate and enhance the County's current vehicle maintenance program to reduce fuel consumption. This measure will support the measures above.

SP Trans-6. Bicycle Safety Program

Objective: Provide a bicycle safety program and information about safe routes to work.

Waste Reduction, Reuse, and Recycling

SP Waste-1. Electronic and Universal Waste Recycling

Objective: Require that all electronic and universal waste from County buildings and facilities be diverted from landfills and be recycled instead. Universal waste includes batteries, pesticides, mercury-containing equipment, and bulbs (lamps).

SP Waste-2. Recycled Paper Purchasing

Objective: Continue to require departments to purchase paper with a minimum of 30% recycled content. All paper should be encouraged to be multipurpose, rather than copy paper quality.

Refrigerants

SP Waste-1. Refrigerant Best Management Practices

Objective: Implement best management practices, including frequent appliance inspections and responsible appliance disposal, for the handling and use of refrigerants.

SP Waste-1. Vending Machine Replacements

Objective: Reduce the total number of vending machines at County-owned facilities by 2020.

SP Waste-1. Purchasing Requirements

Objective: Industry experts are currently conducting research to develop refrigerants that are not as a potent a GHG as their existing counterparts. The County will to monitor the availability of these refrigerants.

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Appendix D
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 Marin County (County), public agencies, community members, or a combination of entities, as noted below. The County will pursue a number of financing strategies to support overall management of the Climate Action Plan Update (CAP Update). The County may also promote several of the community-oriented funding options described below as part of CAP Update 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.
- Clean Vehicle Rebate Project (CVRP)
- California Capital Access Program (CalCAP)

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.

[1] For more information on the ARB incentive programs, please visit: http://www.arb.ca.gov/ba/fininfo.htm.

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.[2]

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). Most of the project funding for PG&E customers has been expended but as of early August 2014, there was approximately 7.7 million in funding remaining for residential and non-residential programs.[3]

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. In addition, the County offers a $1,000 incentive for homeowners who have completed an Advanced Upgrade Package and who host a Home Showcase Event.[4]

Energy Efficient Mortgage

Energy Efficiency Mortgages (EEMs) may be available to some County residents. An EEM credits a home's energy efficiency upgrades and gives borrowers the opportunity to finance cost-effective, energy-saving 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.[5]

Federal Tax Credits for Energy Efficiency

Federal government tax credits are available to County residents through 2016. The tax credits provide a discount of 30% of cost with no upper limit for geothermal heat pumps, small wind

[2] For more information on the CalRecycle Recycling and Recovery grants, please visit: http://www.calrecycle.ca.gov/grants/

[3] For more information on the California Solar Initiative, please visit: http://www.gosolarcalifornia.ca.gov/

[4] For more information on Energy Upgrade California financial programs, please visit: http://www.energyupgradeca.org/en/find-programs-and-assistance

[5] For more information on Energy Efficiency Mortgages, please visit: https://www.energystar.gov/index.cfm?c=mortgages.energy_efficient_mortgages

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.[6]

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.[7]

State Funding for Infrastructure

The State's Infill Infrastructure Grant Program may be used by the County 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.[8]

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

[6] For more information on federal tax credits for energy efficiency, please visit: https://www.energystar.gov/?c=tax_credits.tx_index

[7] For more information on Planning Grants from the Strategic Growth Council, please visit: http://sgc.ca.gov/m_grants.php

[8] For more information on the State's Infill Infrastructure Grant Program, please visit: http://www.hcd.ca.gov/fa/iig/

- 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

Bay Area Air Quality Management District

Bay Area Air Quality Management District (BAAQMD) 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.[9]

- Mobile Source Incentive Fund (MSIF)
- Transportation Fund for Clean Air (TFCA) (County Program Manager Fund and Regional Fund)
- Cash for Retiring Vehicles - California Consumer Assistance Program (administered by the California Bureau of Automotive Repair)
- Environmental Justice Small Grants Program (administered by the California Environmental Protection Agency)
- Hybrid Electric Vehicle Purchase Vouchers (HVIP) (administered by CALSTART)
- Zero-Emission Agricultural Utility Terrain Vehicle (Agricultural UTV) Rebate Program (administered by the San Joaquin Valley Air Pollution Control District)
- Strategic Incentives Division (SID) Program

Marin Transit

While the County does not have control over how Marin Transit chooses to expend its resources, it is possible that Marin Transit could take the following measures to generate revenue that would lead to reductions in GHG emissions.

[9] For more information on the incentive programs, please visit: http://www.baaqmd.gov/Divisions/Strategic-Incentives/Funding-Sources.aspx.

- **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.
- **Parcel Tax**. An election consistent with Proposition 218[10] 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.

Golden Gate Transit

Golden Gate Transit is funded through tolls at the Golden Gate Bridge. Tolls could be altered to provide supplemental funding for expansion of transit.

Marin Energy Watch Partnership

The Marin Energy Watch Partnership, administered by the County in partnership with PG&E, provides resources and incentives to residents, businesses, and public agencies to increase energy efficiency. All public agencies, business, and residences in the County who are PG&E or Marin Clean Energy customers can participate.[11]

Marin Clean Energy Programs

Marin Clean Energy offers energy efficiency programs and financing for multi-family, single-family and commercial properties. MCE's programs include the following:[12]

- A Feed-In Tariff (FIT) program is now available to anyone in Marin County wishing to sell the power output from an eligible small-scale (1 MW or less) distributed renewable generation resource.
- Solar Rebate (currently suspended): This program provided a $500 solar rebate for Marin Clean Energy customers in 2011 and 2012. Funds have been exhausted but may continue in the future.
- Green Home Loans: MCE has partnered with First Community Bank to offer Green Home Loans to MCE customers. Homeowners can finance home retrofits with the loan and pay it back directly on their PG&E bill.
- Multi-Family Energy Assessments: MCE is now offering free walk-through energy assessments for qualifying properties to determine specific energy improvements and their potential energy and cost savings. MCE will also provide tenant units with certain free measures such as exchanging incandescent bulbs with high efficiency lighting, installing

[10] 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."

[11] For more information on the Marin Energy Watch Partnership, including a list of available resources and incentives, please visit: http://www.marinenergywatch.org

[12] For more information on efficiency programs from Marin Clean Energy, please visit: http://www.marincleanenergy.org/ee

high performance faucet aerators and showerheads, and wrapping hot water pipes with insulation at no cost to building owners.

- Green Property Loans: MCE has partnered with River City Bank to offer Green Property Loans to provide multi-family and small commercial properties with competitive financing for energy efficiency upgrades. This new program allows property owners to finance energy improvements and re-pay the loan on their energy bill, removing up-front costs.
- Green Business Certification

SmartLights

This program, sponsored by the County, PG&E and MCE, is designed to help small businesses become more energy-efficient by offering free start-to-finish technical assistance and instant rebates to help defray the cost of upgrading and/or repairing existing equipment.[13]

Bay Area Regional Energy Network (BayREN) Energy Efficiency Programs

BayREN offers additional rebates for the Energy Upgrade California program, commercial PACE financing, codes & standards programs and a multi-family program. The PAYS On-Bill Efficiency Program is a joint effort of Bay Area cities and counties and their water agencies to partner in the implementation of a unique on-bill program that allows municipal water utility customers to pay for efficiency improvements through a monthly charge attached to their meter, with no up-front costs and the assurance that their utility bill savings will exceed the program charge.[14]

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 energy efficiency improvements and renewable energy projects, whereas the water service provider programs apply to water conservation efforts.[15]

PG&E and MCE also offer net energy metering to customers who have solar or other small renewable generation systems. Participants who generate more electricity than they use get credited for that excess electricity.[16]

[13] For more information on SmartLights, please visit: www.smartlights.org

[14] For more information on BayREN programs, please visit: https://www.bayareaenergyupgrade.org/get-fit-fast-upgrades

[15] 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: http://www.marinwater.org/163/Rebates and http://www.nmwd.com/conservation.php.

[16] For more information on net energy metering, please visit: http://www.pge.com/en/b2b/energytransmissionstorage/newgenerator/netenergymetering/index.page and http://marincleanenergy.org/PDF/Net_Metering.pdf

On-Bill Financing

On-bill financing (OBF), offered by both PG&E and MCE, can be used to support commercial energy-efficiency retrofits. Funding from OBF is a no- or low 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.[17]

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, sign a new contract, or sell the system at fair market value.

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.

Private Equity Loans

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 reflect improved facilities and defray the investment costs.

Future Funding Options for County Implementation Costs

The County 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.

[17] For more information on 6n-bill financing, please visit:
http://www.pge.com/en/mybusiness/save/rebates/onbill/index.page? and
http://www.mcecleanenergy.org/finance-tools/

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.

Other Incentives

The following programs do not provide funding, but they do provide incentives to the community to participate in CAP actions.

Marin Solar Program

The Marin Solar Program can help homeowners and business owners evaluate the suitability of installing solar systems. County Staff can perform a free preliminary analysis of a site's solar potential to determine if it has the physical properties to support a solar installation. The Marin Solar Program is an outreach and education effort administered by the County of Marin Community Development Agency. The Program does not participate in the design, purchase or sale of photovoltaic systems.[18]

[18] For more information on the Marin Solar Program, please visit www.marinsolar.org

Green Business Program

Business in the County can be certified with Green Business Program if they pledge to stay green, and select measures to conserve water, conserve energy, reduce waste, and prevent pollution. Businesses that participate receive streamlined environmental assistance, money saving opportunities, and promotional items to distribute to customers.[19]

[19] For more information on the Green Business program, visit:
www.maringreenbusiness.org for local resources
www.greenbusinessca.org for statewide resources, directory and enrollment information