“B”

Appendices

Appendix A

Technical Memo #1 - Greenhouse Gas Emissions Inventory and Forecasts

Memo

455 Capitol Mall, Suite 300
Sacramento, CA 95814
916.444-7301

Date: August 25, 2016

To: David Morrison and Jason Hade (County of Napa)

From: Honey Walters, Erik de Kok, and Brenda Hom (Ascent Environmental, Inc.)

Subject: Napa County Climate Action Plan
Revised Final Technical Memorandum #1: 2014 Greenhouse Gas Emissions Inventory and Forecasts

INTRODUCTION

The initial phase in the preparation of Napa County's Climate Action Plan (CAP) includes: (1) updating the unincorporated County's community-wide greenhouse gas (GHG) emissions inventory to 2014, and (2) preparing new GHG emissions forecasts for 2020, 2030, and 2050. This revised final technical memorandum provides the results of the 2014 GHG emissions inventory update and future year emissions forecasts, including associated methods, assumptions, emission factors, and data sources. This final revision supersedes the version dated April 13, 2016, and incorporates changes throughout based on feedback from County staff and public input, as well as technical corrections.

The updated GHG emissions inventory and forecasts will provide a foundation for the forthcoming phases of work on the CAP including the development of GHG emissions reduction targets, GHG emissions reduction measures, and an action plan to help the County achieve identified targets.

ORGANIZATION OF THIS MEMORANDUM

This memorandum consists of two main parts:

- Section 1 summarizes the updated 2014 GHG emissions inventory for each sector, including any new sectors not previously included in the 2005 baseline inventory. Key components include:
  - A summary of annual emissions by sector; and
  - Data sources and methods used.
- Section 2 summarizes the forecasted GHG emissions under "business-as-usual" (BAU) and legislative-adjusted BAU scenarios. A BAU scenario is one in which no action is taken by local, State or federal agencies to reduce GHG emissions. A legislative-adjusted scenario is one in which BAU conditions are adjusted to reflect policy or regulatory actions enacted by State or federal agencies, without taking into account any local actions to reduce GHG emissions.

1 2014 GREENHOUSE GAS EMISSIONS INVENTORY UPDATE

SUMMARY OF RESULTS

Based on the modeling conducted, the unincorporated area of Napa County generated approximately 484,283 metric tons of carbon dioxide equivalents ($MTCO_2e$) in 2014. Major emissions sectors included building energy use, on-road vehicles, off-road vehicles and equipment, wastewater management, solid waste, agriculture, and land use changes. In addition, the 2014 inventory update included several new emissions sources that were not included in the 2005 baseline inventory. These new sectors include emissions from methane generated at landfills (e.g., waste-in-place), electricity use from importing water, fuel use in recreational watercrafts, and the release of high global warming potential (GWP) gases.

Table 1 and Figure 1 present the County's 2014 GHG emissions inventory by sector. A description of each emissions sector, including key sources of emissions, is provided in further detail below.

Table 1 2014 Unincorporated Napa County Greenhouse Gas Inventory

Sectors	2014[1] ($MTCO_2e$/yr)	Percent of Total (%)
Building Energy Use	148,338	31
On-Road Vehicles	125,711	26
Solid Waste	83,086	17
Agriculture	52,198	11
Off-Road Vehicles	42,508	9
High GWP Gases	13,481	3
Wastewater	11,189	2
Land Use Change	7,684	2
Imported Water Conveyance	88	<1
Total with new sectors	**484,283**	**100**
Total without new sectors	**374,793**	**77**

Notes: For a comparison of the 2005 and 2014 inventories, see Table 2. Note that columns may not add to totals due to rounding.

$MTCO_2e$ = metric tons of carbon dioxide equivalent
GWP = global warming potential
IPCC = Intergovernmental Panel on Climate Change
NA = Not applicable

[1] Uses GWP Factors from IPCC's Fourth Assessment Report
[2] Includes new off-road subsectors

Source: Data compiled by Ascent Environmental in 2016.

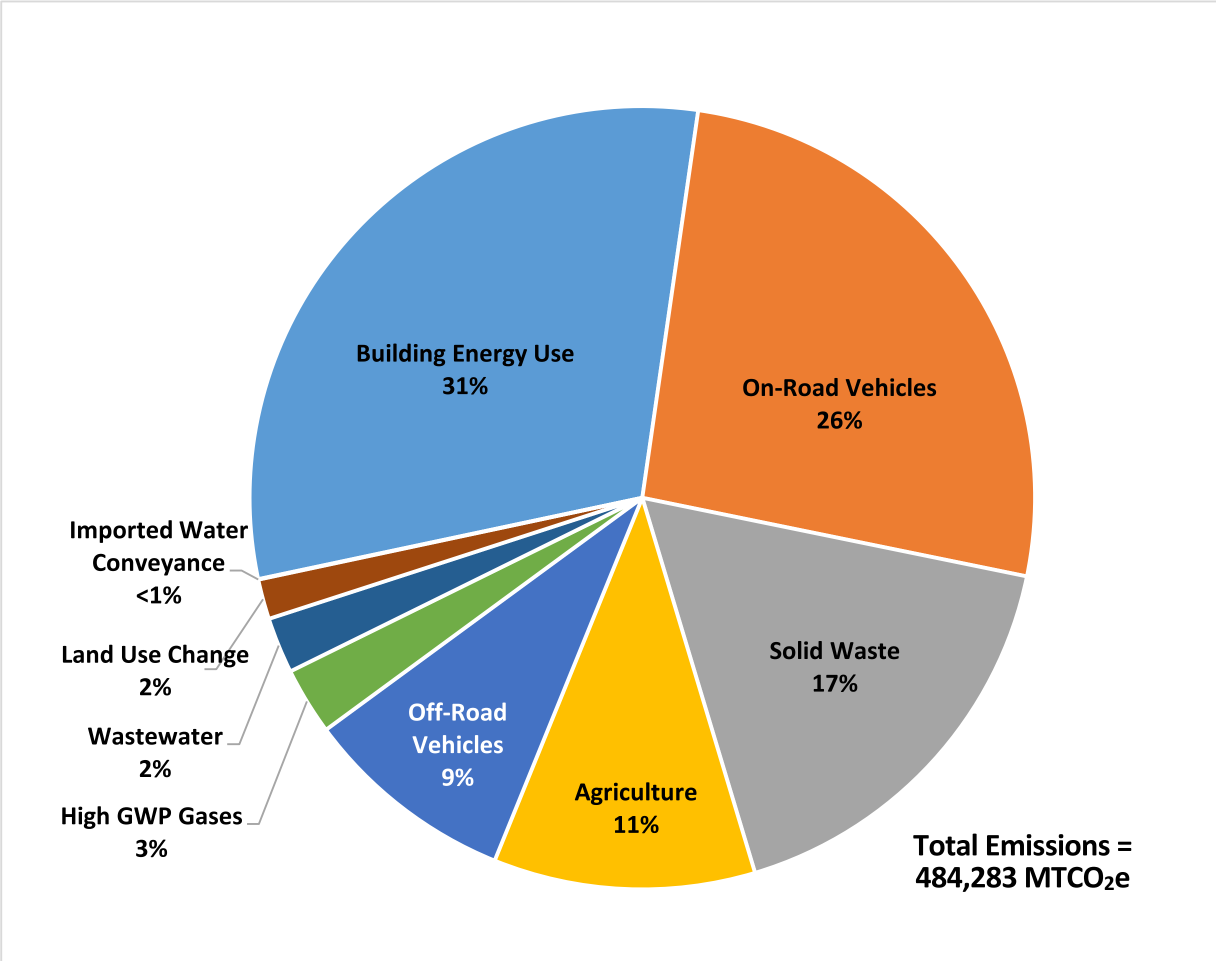


Figure 1: 2014 Unincorporated Napa County Greenhouse Gas Inventory

For comparison purposes only, Table 2 shows the 2005 baseline inventory alongside the 2014 inventory, which has been adjusted to use GWP factors from the IPCC's Second Assessment Report, consistent with the methodology used in the 2005 inventory. This approach was necessary because the 2005 inventory did not make methane (CH_4) and nitrous oxide (N_2O) emissions available for adjustment with newer GWP factors from the IPCC Fourth Assessment Report. In addition, the Table 2 only includes sectors that were present in the 2005 inventory and does not include sectors introduced in the 2014 inventory shown in Table 1. After comparing the two inventories using the same GWP factors and considering only emissions sectors included in the 2005 inventory, County emissions decreased by about 14 percent between 2005 and 2014. This decrease in emissions between 2005 and 2014 is due to a variety of factors including, but not limited to:

- adjustments in calculation methodologies (e.g., equations and emission factors),
- differences in data sources between the two inventories, and
- changes in actual activity levels within the County (e.g., building energy use and vehicle travel).

Table 2 Comparison of Unincorporated Napa County Greenhouse Gas Inventories (2005 and 2014) using GWP factors from IPCC's Second Assessment Report (for comparison only)

Sectors	2005 (MTCO2e/yr)	2014[1] (MTCO2e/yr)	Difference (MTCO2e/yr)	Percent change from 2005 (%)
Residential and Commercial Building Energy Use	143,540	145,994	2,453	2
Wastewater	9,900	9,457	-443	-4
Solid Waste (Waste Generation)	9,240	16,767	7,527	81
On-Road Vehicles	191,270	125,830	-65,440	-34
Off-Road Vehicles (old categories)	16,620	10,740	-5,880	-35
Agriculture	46,800	49,982	3,182	7
Land Use Change	26,300	7,746	-18,554	-71
Total	**443,670**	**365,448**	**-78,222**	**-18**

Notes: This table contains adjusted 2014 inventory numbers and is only to be used for comparing the 2014 inventory with the 2005 inventory. See Table 1 for the official 2014 inventory results.

$MTCO_2e$ = metric tons of carbon dioxide equivalent
GWP = global warming potential
IPCC = Intergovernmental Panel on Climate Change
NA = Not applicable

[1] Emissions have been adjusted to use the global warming potentials in IPCC's Second Assessment Report to be consistent with the 2005 baseline GHG inventory assumptions. The 2005 baseline inventory did not make methane and nitrous oxide emissions available for adjustment with newer GWP factors from the IPCC Fourth Assessment Report. This inventory only shows emissions for sectors that were present in the 2005 inventory.
[2] Uses unincorporated-only solid waste generation data from CalRecycle. The 2005 inventory used data directly from waste providers.

Source: ICF Jones & Stokes, 2012 (2005 inventory data); 2014 inventory prepared by Ascent Environmental in 2016.

DATA SOURCES AND METHODS

In addition to including new GHG emissions sectors and sources, the 2014 inventory update includes several changes to the data sources and emission factors used, along with changes in methods. These differences were necessary in cases where the original data sources used in the 2005 inventory were no longer available or have been updated. New methods that provide more accurate emissions estimates are available for sectors such as the on-road vehicles and solid waste sectors. The general approach used to estimate the County's 2014 GHG inventory is consistent with the latest guidance from the *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions* (Community Protocol) (Versions 1.0) produced by the International Council for Local Environmental Initiatives (ICLEI) (ICLEI 2012).

The following summarizes data sources and methods used in estimating the unincorporated County's 2014 GHG emissions inventory (see Table 3 for further detail):

- **Building Energy:** Annual electricity and natural gas usage data for the unincorporated areas were obtained from Pacific Gas and Electric's (PG&E's) Green Communities report for Napa County. Data were only available for 2013 and; thus, was scaled to 2014 based on the change in the unincorporated population and jobs between 2013 and 2014.

- **Solid Waste:** The solid waste inventory was updated using disposal and landfill data from the California Department of Resources Recycling and Recovery (CalRecycle) and landfill gas data from the U.S. Environmental Protection Agency (EPA), respectively. Domestic wastewater emissions were calculated using population-based equations from the Community Protocol (ICLEI 2012).

- **Water and Wastewater:** Winery wastewater emissions were also estimated using guidance from EPA and county-specific data. Water import numbers were available from each of the specific water suppliers that service the unincorporated areas of Napa County.

- **On-Road and Off-Road Vehicles:** For the on-road vehicle sector, annual vehicle miles traveled (VMT) by speed bin (e.g., zero to five miles per hour, or twenty to twenty-five miles per hour) were obtained from the Metropolitan Transportation Commission (MTC) for the unincorporated area, using the Regional Technical Advisory Committee's (RTAC's) origin-destination method. Vehicle emission factors were available from California Air Resources Board's (ARB's) 2014 EMissions FACtor (EMFAC) model. Off-road vehicle emissions were estimated from ARB's OFFROAD 2007 model and scaled by population, jobs, or location of activity in the unincorporated area. For example, the majority of countywide watercraft emissions occur within the unincorporated County because most navigable waterways, such as Lake Berryessa and Napa River, in the County are located in the unincorporated area. On the other hand, use of lawn and garden equipment would be proportional to the population distribution between the unincorporated and incorporated areas of the County.

- **Agriculture:** Agricultural emissions were based on livestock and crop data from the County's 2014 Crop Report; pesticide use data from the California Department of Pesticide Regulation (DPR); fertilizer use from the California Department of Food and Agriculture (CDFA), ARB's GHG inventory, and University of California Davis Agricultural studies; diesel irrigation pump information from ARB; and open burning permit data from the Bay Area Air Quality Management District (BAAQMD).

- **Land Use Change:** Lost carbon storage and sequestration potential due to land use changes were based on estimated changes in natural lands from the County's assessor parcel data and associated differences in carbon storage and sequestration rates by land cover type.

- Demographic data related to population, jobs, and housing in the unincorporated County were obtained from the California Department of Finance (DOF) and the California Employment Development Department (EDD) (DOF 2015, EDD 2015).

- Emissions associated with aircraft operations were not included because they are outside of the County's jurisdictional control.

Table 3 below compares the differences in data sources, calculation methods, and emission factors by sector and between the two GHG inventory years.

Table 3 Unincorporated Napa County GHG Inventory: Data Sources and Methods by Year and Sector

Sector	2005 Inventory	2014 Inventory
Residential and Commercial Building Energy Use	**Data sources:** Energy consumption provided by sector from PG&E **Method:** ICLEI CACP software.	**Data sources:** PG&E Green Communities Report for 2013 for the unincorporated Napa County. Scaled to 2014 by population growth between 2013 and 2014.

Table 3 Unincorporated Napa County GHG Inventory: Data Sources and Methods by Year and Sector

		Method: PG&E 2014 Emission Factors for CO_2 electricity generation emissions. EPA's eGrid2010 emission factors for CH_4 and N_2O from electricity generation. Natural gas emission factors from 2014 TCR emissions factor report.
Wastewater	**Data sources:** Residential wastewater volumes and populations served (provided by County). On-site septic based on number of homes with septic (provided by the County). Commercial wastewater based on volume of wine produced annually in Napa County and default values for wastewater produced per gallon of wine. **Method:** LGOP methods for residential wastewater; EPA methods for commercial wastewater.	**Data sources:** Population of unincorporated Napa County from DOF. Percentage of unincorporated Napa population served by septic and sewer systems, provided by the County. Total winery wastewater produced based on gallons of wastewater generated per ton of grape from a Napa San report. Profile of winery wastewater treatment from Napa Green, Napa San, and EBMUD. **Method:** Equations WW.11 (Alt) and WW.6 from the ICLEI Community Protocol to calculate domestic wastewater CH_4 emissions. Winery wastewater emissions based on industrial wastewater method from Chapter 7 of U.S. GHG Inventory 1990-2013.
Imported Water Conveyance	Sector not included	**Data sources:** Total volume of potable and recycled water delivered by incorporated cities to the unincorporated areas in 2014. Volume broken down by water source (e.g., State water project). **Method:** Electricity factors for each water source from CEC water-energy study, when electricity use was not provided by a utility. PG&E 2013 Emission Factors for CO_2 electricity generation emissions. EPA's eGrid2010 emission factors for CH_4 and N_2O from electricity generation.
Solid Waste (Waste Generation and Waste-in-Place Emissions)	**Data sources:** Waste generation data provided by waste provider. Waste-in-place emissions not included. **Method:** ICLEI CACP software.	**Data sources:** Unincorporated County solid waste generation by amount, type, and disposal landfill available from CalRecycle. Landfill gas emissions within the unincorporated County from EPA's LMOP Landfill/Project database. **Method:** Equation SW.4.1 from ICLEI Community Protocol combined with known CH_4 capture rates at landfills to calculate CH_4 from waste generation. Waste type emissions based on EPA WARM emission factors. EPA landfill gas reports provided CH_4emissions from American Canyon and Clover Flat landfills located within the unincorporated area. These landfills did not accept unincorporated waste, so there was no double-counting.
On-Road Vehicles	**Data sources:** VMT estimates using the Napa-Solano travel demand model; origin-destination analysis; **Method:** EMFAC emissions factors applied to total VMT	**Data source:** VMT from MTC using the RTAC origin-destination method **Method:** EMFAC 2014 Emission Factors per vehicle mile CARB approved methods for N_2O, PG&E 2014 Emission factors for electric vehicles.
Off-Road Vehicles	**Data source/Method:** ARB Off-Road model used for lawn/garden and construction/industrial sectors only. No indication of whether emissions were scaled to the unincorporated area.	**Data source/Method:** ARB's OFFROAD 2007 model, scaled to unincorporated areas by unincorporated jobs or population depending on the vehicle category (e.g., recreational equipment scaled by population).
Agriculture	**Data sources:** Vehicle and equipment data from ARB Off-Road model. Enteric fermentation and manure management data from livestock populations from Napa County agriculture report. Fertilizer data from crop acres from Napa County agriculture report and UC Davis Cost Return Studies. **Method:** ARB methods	**Data sources:** Vehicles and equipment from ARB's OFFROAD 2007 model for agricultural equipment only. Agricultural diesel pump estimates from ARB. Enteric fermentation and manure management from livestock populations from Napa County agriculture report. Nitrogen fertilizer used in County from ARB 2013 GHG Inventory. Lime and urea sold in County from 2012 CDFA Fertilizer Tonnage Report. 2014 Napa County Crop Report.

Table 3 Unincorporated Napa County GHG Inventory: Data Sources and Methods by Year and Sector

		Fertilizer use by crop from UC Davis Cost Return Studies. Open burning permit data for burns in 2014 from BAAQMD. **Method:** ARB agricultural emissions inventory methods. BAAQMD emissions inventory methodology for open burning.
Land Use Change	**Data sources:** Acres and land cover types converted for period 1993-2007 provided by Napa County Conservation, Development and Planning Department. Existing acres and land cover types in Napa Baseline Data Report **Method:** IPCC methods	**Data source:** Change in land cover acreages from 2005 through 2015 provided by Napa County. Tree densities, carbon storage rates for above and belowground biomass, and net carbon sequestration rates were available or derived from published research (USDA 2005, CUFR 2009, IPCC 2006a, and Liang et. al. 2005). These data sources were selected based on their regional or state-specific contexts. The definition of riparian species was provided by Napa County. **Method:** Carbon sequestration and storage factors by land use type from various studies applied to estimated change in land use. For oak woodlands, coniferous forests, and riparian lands, average annual change in carbon sequestration accounts for the cumulative loss of trees over time.
High-GWP Gases	Sector not included	**Data source/Method:** SF_6 emissions based on total electricity usage. SO_2F_2 emissions based on CDPR pesticide sales reports. HFC, PFC, and PFE emissions based on unincorporated population and statewide per-capita emission factors calculated from the most recent California 2013 inventory. These emission factors were scaled to 2014 assuming that per capita emissions would increase by two percent between 2013 and 2014, consistent with recent historical trends.

Notes: ARB = California Air Resources Board, BAAQMD = Bay Area Air Quality Management District, CACP = Clean Air and Climate Protection, CDFA = California Department of Food and Agriculture, CDPR= California Department of Pesticide Regulation., CEC = California Energy Commission, CH_4 = CH_4, CO_2 = carbon dioxide, DOF=California Department of Finance, EBMUD = East Bay Municipal Utility District, eGRID = Emissions & Generation Resource Integrated Database, EMFAC = ARB's Emission Factor model, EPA = U.S. Environmental Protection Agency, GHG = greenhouse gases, GWP = global warming potential, HFC = hydrofluorocarbons, ICLEI = International Council for Local Environmental Initiatives, IPCC = Intergovernmental Panel on Climate Change, LMOP = Landfill Methane Outreach Program, N_2O = nitrous oxide, Napa San = Napa Sanitation District, RTAC = Regional Technical Advisory Committee, NA = Not Applicable, PFC = perfluorinated compounds , PFE = perfluoroethane, PG&E = Pacific Gas & Electric, SF_6 = sulfur hexafluoride, SO_2F_2 = sulfuryl fluoride, TCR= The Climate Registry, UC = University of California, WARM = Waste Reduction Model

Source: ICF Jones and Stokes, 2012: Table A-1; 2014 Inventory prepared by Ascent Environmental 2016

Global Warming Potentials

GHG emissions other than carbon dioxide (CO_2) generally have a stronger insulating effect (e.g., ability to warm the earth's atmosphere or greenhouse effect) than CO_2. This effect is measured in terms of a pollutant's global warming potential (GWP). CO_2 has a GWP factor of one while all other GHGs have GWP's measured in multiples of one. ARB currently uses GWP factors published in the Fourth Assessment Report (FAR) from the Intergovernmental Panel on Climate Change (IPCC), where CH_4 and N_2O have GWP's of 25 and 298, respectively (IPCC 2007). This means that CH_4 and N_2O would be 25 and 298 times stronger than CO_2, respectively, in their potential to insulate solar radiation within the atmosphere. This inventory uses the same FAR GWP values. (In comparison, the Second Assessment Report, used in the development of the 2005 inventory, reported GWP's of 21 and 310 for CH_4 and N_2O, respectively.)

Additionally, the 2014 GHG inventory includes an additional assessment of high-GWP gas emissions, including sulfur hexafluoride (SF_6), sulfuryl fluoride (SO_2F_2), hydrofluorocarbons (HFCs), perfluorinated compounds (PFCs), and perfluoroethane (PFEs). GWP values for high-GWP gases range from 124 to 22,800. SF_6 is most commonly used as an electrical insulator in electricity transmissions and any associated emissions are primarily due to leakage. SO_2F_2 is predominantly used as a pest fumigant in residential and commercial buildings. The IPCC formally identified SO_2F_2 and its associated GWP in IPCC's Fifth Assessment Report. HFCs, PFC, and PFEs are most commonly used in refrigerants, aerosols, fire protection, foams, and solvents. Other high-GWP gases are used in specific industrial applications like semiconductor manufacturing or make up less than 0.01 percent of the overall State's emissions inventory (ARB 2015b). Because Napa County is not a major center for semiconductor manufacturing and because these other high-GWP gases make minimal contributions to the State's inventory, other high-GWP emissions are not included in the County's GHG inventory.

1.1 BUILDING ENERGY SECTOR

Based on GHG emissions modeling conducted, residential and non-residential building energy use in 2014 resulted in approximately 148,338 $MTCO_2e$ in 2014. This sector comprised approximately 31 percent of the unincorporated County's emissions, resulting in the largest emissions sector in the inventory. These emissions were a result of electricity and natural gas energy use at buildings and facilities. The building energy sector consumed 336 megawatt-hours (MWh) of electricity and 12 million therms of natural gas. This estimate includes a negative credit for electricity consumption from electric vehicle charging to avoid double-counting with the on-road vehicle sector. PG&E supplied all electricity and natural gas in the County in 2014, and provided electricity with a renewable mix of 27 percent (PG&E 2015a).

Marin Clean Energy (MCE), a new community choice aggregation (CCA) program offering additional renewable electricity options to northern Bay Area counties through PG&E, did not begin automatic enrollment of customers in the unincorporated County until February 2015. Through automatic enrollment, MCE customers would immediately have a 50 percent renewable mix in their electricity consumption and customers are allowed to either increase their renewable mix for an additional fee or opt out of the program. Those opting out would have, by default, PG&E's renewable mix (MCE 2015a).

Natural gas and electricity use each accounted for approximately half of total emissions from the building energy sector. Approximately 68 percent of building energy emissions were from commercial and industrial facilities, contributing a total of 100,379 $MTCO_2e$ in 2014. Residential buildings generated 47,984 $MTCO_2e$, or approximately 32 percent of total building energy sector emissions. Table 4 presents building energy use and associated emissions by fuel and source. Table 5 presents emission factors used to quantify emissions from electricity and natural gas use, which are also used to quantify emissions in other sectors that also use electricity and natural gas.

Table 4 2014 Unincorporated Napa County GHG Inventory: Building Energy Use and GHG Emissions by Source

Source		$MTCO_2$/yr	MT CH_4/yr	MT N_2O/yr	$MTCO_2e$/yr
Electricity	**MWh/yr**				
Residential	116,340	21,756	2	0	21,893
Commercial	214,162	40,048	3	1	40,300
Industrial	5,281	987	<1	<1	994
Electric Vehicles[1]	-137	-24	>-1	>-1	-25
Electricity Total	335,643	62,767	4	1	63,149
Natural Gas	**Therms/yr**				
Residential	3,809,649	20,199	190	4	26,096
Commercial	8,626,723	45,739	431	9	59,093
Industrial[2]	0	0	0	0	0
Natural Gas Total	12,436,372	65,938	622	12	85,189
Energy Combined	**MMBTU/yr**				
Residential	777,935	41,954	192	4	47,984
Commercial	1,593,424	85,787	434	9	99,385
Industrial	18,018	987	<1	<1	993
Electric Vehicles	-445	-24	>-1	>-1	-26
Total	2,388,931	128,703	626	13	148,337

Notes: Totals in columns may not add due to rounding. PG&E provided electricity and natural gas use for 2013. 2014 was not available at the time of this writing. 2013 emissions are scaled to 2014 levels by population for residential energy use and employment for commercial and industrial energy use.

MWh = megawatt-hours; MT = metric tons; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent, MMBTU = Million British Thermal Units, PG&E=Pacific Gas and Electric

[1]Electric vehicle charging is subtracted from total building electricity, based on the total kilowatt-hours (kWh) of charging already estimated under the on-road vehicle fleet sector.

[2] PG&E reported zero natural gas usage in the unincorporated area in 2013 from the industrial sector.

Source: Data provided by Ascent Environmental in 2016 based on modeling using data provided by PG&E's Green Communities program.

Table 5 2014 Unincorporated Napa County GHG Inventory Building Energy Emission Factors

Emission Factor	Unit	Source
Electricity		
0.187	$MTCO_2$/MWh	PG&E 2015 for 2014
28.49	lb CH_4/GWh	EPA eGrid 2010 (2014)
6.03	lb N_2O/GWh	EPA eGrid 2010 (2014)
Natural Gas		
53.02	kg CO_2/MMBtu	2014 Climate Registry Emission Factors. Table 12.1. (TCR 2014)
5	g CH_4/MMBtu	2014 Climate Registry Emission Factors. Table 12.9. (TCR 2014)
0.1	g N_2O/MMBtu	2014 Climate Registry Emission Factors. Table 12.9. (TCR 2014)

Notes: CH_4 = CH_4; CO_2 = carbon dioxide; eGrid = Emissions & Generation Resource Integrated Database; EPA = U.S. Environmental Protection Agency; GHG = greenhouse gas; GWh = gigawatt-hours; kg = kilograms; lb = pounds; MMBTU = million British thermal units; MT = metric tons; MWh = megawatt-hours; N_2O = nitrous oxide; PG&E = Pacific Gas and Electric; TCR = The Climate Registry

Source: PG&E 2015, EPA 2014, TCR 2014; data compiled by Ascent Environmental 2016.

1.2 WASTEWATER GENERATION

Based on modeling conducted, wastewater generation in 2014 resulted in emissions of approximately 11,189 $MTCO_2e$, or 2 percent of total emissions, primarily from fugitive CH_4. The County does not own or operate any wastewater treatment plants. All wastewater generated by the unincorporated areas of the County is treated in a number of methods: (1) conveyed to other wastewater treatment facilities in the region through sewer systems, (2) stored in septic or winery waste tanks then occasionally hauled to an off-site wastewater treatment facility, or (3) treated on-site, particularly in the case of winery wastewater.

This sector accounts for both the CH_4 emissions from wastewater treatment processes and emissions resulting from electricity use for treatment. Because wastewater treatment facilities are located outside of the unincorporated area, electricity use at those facilities is not captured in the building energy sector and is included in the wastewater sector instead. Wastewater process and electricity use emissions were evaluated in two parts: 1) domestic wastewater and 2) commercial winery wastewater. These emissions are summarized in Table 6.

Table 6 2014 Unincorporated Napa County Wastewater Methane Emissions by Source

Wastewater Treatment Process Emissions					
Wastewater Source	MG /yr	$MTCO_2$/yr	MT CH_4/yr	MT N_2O/yr	$MTCO_2e$/yr
Domestic - Septic	214	0	22	0	546
Domestic - Sewer	759	0	209	0	5,230
Domestic - Total	*973*	*0*	*231*	*0*	*5,776*
Winery Wastewater[1]	80	0	202	0	5,053
Conveyance and Treatment Electricity Use					
Wastewater Source	Electricity Use (kWh)	$MTCO_2$/yr	MT CH_4/yr	MT N_2O/yr	$MTCO_2e$/yr
Domestic – Septic[2]	0	0	0	0	0
Domestic – Sewer[3]	1,730,868	324	0	0	326
Domestic – Total	*1,730,868*	324	0	0	*326*
Winery Wastewater[1,3]	182,194	34	0	0	34
Total[4]	**1,913,062**	**358**	**433**	**0**	**11,189**

Notes: MG = million gallons; MT = metric tons; CH_4 = methane; CO_2e = carbon dioxide equivalent, LGOP = Local Government Operations Protocol, MGD = million gallons per day, PG&E= Pacific Gas and Electric

[1] Estimates only account for winery wastewater sent to off-site treatment facilities and assumes those facilities use aerobic systems. On-site treatment of wastewater is not accounted for here because it is generally aerobically treated on-site and would not generate significant CH_4 emissions. Building energy use at on-site treatment facilities are captured under the building energy sector.
[2] According to the LGOP Community protocol, wastewater discharge and treatment energy intensities associated with septic tanks and other on-site systems are assumed negligible. Also, electricity use for facilities that require discharge pumping is difficult to separate from treatment plant energy use as a whole (ICLEI 2012:81). Hauling emissions are captured in the on-road vehicle sector.
[3] Wastewater conveyance and treatment electricity factors were obtained from Tables WW.15.2 (median values) and WW.15.3 for a 5-20 MGD treatment facility, based on Napa Sanitation District's treatment capacity. Emission factors were based on PG&E factors for 2014.
[4] Totals may not add due to rounding.

Source: ICLEI 2012; data provided by Ascent Environmental in 2016.

WASTEWATER TREATMENT PROCESS EMISSIONS

Domestic Wastewater

Domestic wastewater CH_4 emissions were based on average population-generated wastewater rates from:

- equations WW.11 (alt) for septic systems and WW.6 (alt) for sewer systems from the ICLEI Community Protocol;

- the County's estimate of the percent of the population that are serviced by sewer connections and septic connections; and
- the 2014 population estimate for the unincorporated county, available from the California Department of Finance.

The County estimated that approximately 78 percent of the unincorporated population is served by sewer connections while the other 22 percent use septic tanks for wastewater treatment. Table WW.15.1 from the LGOP shows that California's average wastewater generation factor is 100 gallons per day per capita. Using this factor, the County is estimated to have generated 973 million gallons (MG) in 2014. Although only population was required to calculate CH_4 emissions from wastewater treatment process, total wastewater volumes were used to estimate electricity use associated with wastewater conveyance and treatment.

Winery Wastewater

Winery wastewater emissions are unique to the region due to the wine industry's presence in the County, warranting a separate calculation from domestic wastewater emissions. Napa Sanitation District (Napa San) estimates that 1,100 gallons of wastewater are generated for every ton of grapes produced (Napa San 2009). Based on Napa San's wastewater generation factor and the 2014 Napa County Crop Report, Napa County produced 175,607 tons of grapes and 193 million gallons of winery wastewater. According to the Napa County Winery Database listing available from the County website, wineries in the unincorporated area produced 95 percent of the county's total wine production (Napa County 2015a). Thus, the unincorporated County would have produced approximately 183 million gallons of winery-related wastewater. However, wineries differ in their disposal and treatment methods of wastewater, affecting potential downstream GHG emissions. The discussion below addresses these differences.

According to a survey done by Napa Sanitation District (Napa San) for the district's service area, wineries within the County are known to use a wide variety of methods to treat wastewater generated from the winemaking process (Napa San 2009). These methods include on-site aerobic and anaerobic treatment, pre-treatment prior to off-site treatment, and hauling of untreated wastewater to an off-site treatment facility. However, the Napa San survey did not quantify the overall level of anaerobic treatment used for winery wastewater within the County. Thus, the assessment of the County's wastewater treatment profile for wineries depended on total estimated winery wastewater production, known winery wastewater volumes accepted by wastewater treatment plants, the treatment processes at those plants, and estimated volumes of wastewater generated by Napa Green certified wineries.

Communications with Napa San and East Bay Municipal Water District (EBMUD) revealed that winery wastewater treated at these facilities either underwent aerobic treatments generating no CH_4 or anaerobic treatments where generated CH_4 was captured and flared or converted to energy. Napa San and EBMUD together accepted 25 million gallons of winery wastewater in 2014, primarily through hauled delivery (Damron, pers. comm., 2015; Pham, pers. comm., 2015).

Napa Green, the County's local sustainability certifier, reports that approximately 4.5 million cases of wine were produced by Napa Green Certified Wineries in 2014 (Novi, pers. comm., 2015). Assuming 9 liters per case and 64 cases per ton of grapes, this would translate to 154 million gallons of wine and 79 million gallons of wastewater (Napa San 2009). Although Napa Green does not explicitly require aerobic treatment for certification, many certified sustainable wineries use on-site aerobic wastewater treatment systems or pretreat wastewater such that most solids are filtered out and used as compost. Thus, it is assumed that that all wastewater produced at Napa Green certified wineries are treated aerobically, generating no CH_4.

After subtracting the winery wastewater sent to Napa San and EBMUD and those generated by Napa Green certified wineries from total estimated wine production in the unincorporated county (183 minus 104 million gallons), the remaining 79 million gallons of winery wastewater were assumed to undergo anaerobic treatment. According to the EPA, on average, 4.2 percent of wastewater from fruit and vegetable processing was treated anaerobically during secondary treatment. Using the industrial wastewater equation provided in Chapter 7 of the U.S. GHG Inventory 1990-2013 and biochemical oxygen demand (BOD) levels identified in the Napa San report, the CH_4 emissions from winery wastewater were estimated to be 202 MT CH_4/year or 5,053 $MTCO_2e$/year (EPA 2015: 7-21).

WASTEWATER CONVEYANCE AND TREATMENT EMISSIONS

Electricity used to convey and treat wastewater generated by the unincorporated County was based on total wastewater volumes in 2014, as shown in Table 6, and energy intensity factors per gallon of wastewater (ICLEI 2012: Tables WW.15.2 and WW.15.3). In 2014, no municipal wastewater treatment facilities were located within the unincorporated County, confirming that emissions from conveyance and treatment of wastewater are not double-counted in the building energy sector. For wastewater conveyed to and treated at these off-site wastewater treatment facilities, it is assumed that 280 kWh/MG is required for conveyance and 2,000 kWh/MG is required for treatment. This assumes a median level of conveyance energy intensity and a treatment facility with a capacity size between 5 and 20 MGD, similar to that of Napa San.

According to the ICLEI Community Protocol, wastewater discharge and treatment energy intensities associated with septic tanks and other on-site systems are assumed negligible. In addition, electricity use for facilities that require discharge pumping is difficult to separate from treatment energy use as a whole. (ICLEI 2012:81). Hauling emissions associated with maintenance of septic tanks are captured in the on-road vehicle sector and not included in this sector.

1.3 IMPORTED WATER CONVEYANCE

Based on modeling conducted, water imports into the unincorporated area accounted for 88 $MTCO_2e$ in 2014, less than one percent of the County's 2014 GHG inventory. These resulted from GHG emissions from electricity generation required to deliver and treat water outside unincorporated areas. Water conveyance within the unincorporated County is accounted for under the electricity usage reports from PG&E. However, the unincorporated area imported over 194 million gallons of potable and recycled water in 2014 from water suppliers located within the five incorporated city areas. Much of this water was used for vineyard irrigation.

Water suppliers from each of the five incorporated cities provided total water volume deliveries to the unincorporated area in 2014 broken out by water source and type of water (e.g., recycled or potable). Water conveyance and treatment energy rates per gallon vary by water source and type. These factors were available from a 2006 California Energy Commission report (CEC 2006). Water conveyed from the State Water Project (SWP) requires thirty times more energy than water sourced from local surface water. Approximately 44 percent of water imported to the unincorporated county was sourced from the SWP, as shown in Table 8.

Water energy intensity rates are shown in Table 9. Emission factors in Table 5 were applied to the calculated electricity use to estimate associated GHG emissions. Results are shown below in Table 7 and 8 below.

Table 7 2014 Unincorporated Napa County Imported Water Conveyance GHG Emissions by Supplier

Water Suppliers	$MTCO_2e$/yr
City of Napa	8
City of American Canyon	8
Town of Yountville	47
City of Calistoga	7
City of St. Helena	18
Total	**88**

Notes: MWh = megawatt-hours; MT = metric tons; CO_2e = carbon dioxide equivalent.

Source: Data compiled by Ascent Environmental in 2016.

Table 8 2014 Unincorporated Napa County Imported Water Conveyance Energy Use by Supplier

Water Suppliers	Volume Transported (MG/yr)	Water Source Breakdown by Percent (%)			Percent Recycled Water[1] (%)	MWh/yr
		Local Surface Water	State Water Project (Bay Area)	Groundwater		
City of Napa	18	44	56	0	22	42
City of American Canyon	13	0	100	0	0	44
Town of Yountville	116	100	0	0	93	252
City of Calistoga	16	35	65	0	0	35
City of St. Helena	31	79	0	21	0	94
Total	**194**	**52**	**44**	**4**	-	467

Notes: MG = million gallons; MWh = megawatt-hours; MT = metric tons; CO_2e = carbon dioxide equivalent

[1] Potable Water Volume = Total water volume – Recycled Water Volume

Source: City of Napa 2015, City of American Canyon 2010, Baer, pers. comm., 2015, Moore, pers. comm., 2015, Harrington, pers. comm., 2015, Tuell, pers. comm., 2015; data compiled by Ascent Environmental in 2016.

Table 9 2014 Unincorporated Napa County GHG Inventory: Water Energy Intensity Factors

Water Source	Conveyance Energy Intensity (kWh/MG)	Treatment Intensity (kWh/MG)
Local Surface Water	120	100
State Water Project (Bay Area)	3,150	100
Groundwater	4.45 kWh/MG/foot	100
Recycled (Average)	2,100	0

Notes: kWh = kilowatt-hours; MG = million gallons

Source CEC 2006: Table 9

Sufficient stormwater pumping energy use was not available from the incorporated water suppliers and was not included in the 2005 inventory. Incorporated utilities either could not apportion stormwater pumping energy use to the unincorporated area or did not provide stormwater pumping services to the unincorporated area (Moore, pers. comm., 2015, Tuell, pers. comm., 2015, Baer, pers. comm., 2015). Thus, energy and emissions associated with stormwater management by incorporated utilities were not included in this analysis or in the County's GHG inventory.

1.4 SOLID WASTE (WASTE GENERATION AND WASTE-IN-PLACE EMISSIONS)

Based on modeling conducted, the solid waste sector was responsible for approximately 83,086 $MTCO_2e$, or 17 percent of the County's 2014 GHG inventory. The ICLEI Community Protocol recommends that community GHG inventories include emissions from both solid waste facilities located in the community (i.e., "waste-in-place") and waste generated by the community. Waste-in-place CH_4 emissions from landfill gas (LFG) generated at solid waste facilities located within the unincorporated area accounted for 63,125 $MTCO_2e$, or 76 percent of emissions from the solid waste sector. CH_4 emissions from decay of waste generated annually by residences and businesses in the unincorporated community accounted for 22,357 $MTCO_2e$, or 24 percent of emissions from the solid waste sector. Table 10 summarizes emissions from the solid waste sector.

Table 10 2014 Unincorporated Napa County GHG Inventory: Solid Waste Emissions by Source

Source	Disposal Tonnage	MT CH_4	$MTCO_2e$
Waste-in-Place LFG emissions within Unincorporated Napa County	N/A	2,525	63,125
Solid Waste generated by Unincorporated Napa County	20,155	798	19,961
Total	20,155	3,324	83,086

Notes: LFG = Landfill Gas

Source: Data provided by Ascent Environmental 2015 based on data from EPA 2015b.

LFG is a mix of gases, primarily composed of CH_4, generated from decomposing organic waste and waste chemical reactions and evaporation in landfills. If a landfill has an impermeable membrane that covers a portion or all of the landfill (i.e., cover-and-capture), it can harvest the LFG and prevent CH_4 emissions from being released into the atmosphere. Once captured, a landfill can either convert the CH_4 to CO_2 through flaring or use it as a fuel for other energy-related applications. For the two landfills in the unincorporated County, LFG generation and flaring rates for 2014 were available from EPA's GHG emissions database and EPA's Landfill Methane Outreach Program (LMOP). Any CO_2 emissions from flaring were not counted toward the County's inventory because the IPCC considers any CO_2 emissions from flaring or fugitive emissions to be of biogenic origin and not significant to overall solid waste emissions (IPCC 2006b).

The only landfills located within the unincorporated area are the American Canyon Sanitary Landfill (ACSL) and the Clover Flat Landfill near Calistoga. While Clover Flat is open and currently accepting waste, ASCL closed in 1995 and currently has an active LFG collection system. According to EPA's Facility-Level Information on Greenhouse Gases (FLIGHT) database, in 2014, the American Canyon landfill generated 2,044 MT CH_4 in fugitive CH_4 emissions from accumulated waste at the landfill in 2014 (EPA 2015b). Clover Flat also has an active LFG collection system, but does not anticipate closure of the landfill until 2053. In 2014, Clover Flat generated 481 MT CH_4 in fugitive CH_4 emissions (EPA 2015b). CH_4 emissions from closed landfills generally decrease overtime due to the gradual reduction in organic decomposition. According to

CalRecycle, the landfills within the unincorporated area do not contain any waste generated by the unincorporated County itself (CalRecycle 2015).

For emissions related to annual solid-waste generation from the community in the unincorporated County, CH_4 emissions are also generated from organic decomposition. The release of CH_4 emissions from community-generated waste depends on the LFG management systems of the landfills at which the waste are disposed. According to CalRecycle reports, 98 percent (19,751 tons) of the waste generated by the unincorporated County in 2014 were sent to the Potrero Hills Landfill in Solano County, approximately 30 miles east of the County (CalRecycle 2015). In 2014, Potrero Hills Landfill did not have an active LFG collection system in place; although, according to EPA's LMOP database, the landfill plans to install such a system by January 2016 (EPA 2015c). Calculations of emissions from County-generated waste used factors unique to the unincorporated area. EPA's WARM model provides decay emissions factors for various types of waste, such as food or paper waste. The latest profile of the unincorporated County's waste stream was available from CalRecycle for the 1990 calendar year. The data from EPA and CalRecycle were used to calculate a weighted CH_4 emissions factor per ton of waste generated by the unincorporated County. The result was applied to the unincorporated County's total waste tonnage to calculate CH_4 emissions. However, because the waste stream profile for the County was only available for 1990, the County could have shown improved recycling rates of paper and reduction in food waste due to recent composting efforts, meaning that actual waste generation emissions could be lower than estimated.

1.5 ON-ROAD VEHICLES

Based on modeling conducted, on-road vehicle usage in the unincorporated County resulted in 125,711 $MTCO_2e$ in 2014, or 26 percent of the County's inventory. On-road vehicle emissions are primarily the result of exhaust from the combustion of gasoline and diesel fuels. To a smaller degree, emissions from on-road vehicles also result from upstream electricity generation for electric vehicles. Due to lack of available data, emissions from the combustion of natural gas and other non-electric alternative fuels in on-road vehicles were not included in this analysis, and are assumed to have minimal contribution to total emissions.

On-road passenger vehicle emissions were calculated by estimating the annual vehicle miles traveled (VMT) associated with trips that begin or end in the unincorporated County. These vehicle trips included 100 percent of vehicle trips that both originate from and end in the unincorporated area (i.e., fully internal trips), 50 percent of trips that either end in or depart from the unincorporated area (i.e., internal-external or external-internal trips), and zero percent of vehicle trips that are simply passing through the area (i.e., external-external, or "pass-through", trips). This passenger vehicle trip accounting method is consistent with the method recommended to ARB in 2010 by the RTAC (established through the Sustainable Communities and Climate Protection Act of 2008 [Senate Bill 375]). Table 11 shows total annual VMT by vehicle fuel type and associated emissions estimates for the unincorporated County.

Table 11 2014 Unincorporated Napa County GHG Inventory: On-Road Vehicle Fleet Activity and Emissions by fuel type

Vehicle Type	VMT/yr	Fuel Use (1000 gallons or MWh)/yr	$MTCO_2$/yr	MT CH_4/yr	MT N_2O/yr	$MTCO_2e$/yr
Gasoline	238,043,173	111,497	94,146	4.64	2.44	94,990
Diesel	23,527,464	27,721	27,943	0.56	9.19	30,696
Electric	450,077	131	24	0.00	0.00	25
Total	262,020,714		122,113	5	12	125,711

Notes: VMT = vehicle miles traveled; kWh = kilowatt-hour; MT = metric tons; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent

Source: Metropolitan Transportation Commission (Brazil, pers. comm., 2016a); data compiled by Ascent Environmental 2016

MTC provided vehicle travel information for the unincorporated County based on their regional travel demand model. MTC provided average daily VMT estimates in 2014 for both passenger and commercial vehicles for the unincorporated area, which were multiplied by 347 days per year to estimate annual VMT to account for lower VMT during weekends, holidays, and summer periods. Passenger VMT was calculated using the RTAC method with VMT available by origin and destination categories from MTC. However, due to modeling limitations, MTC was only able to provide commercial VMT using the boundary method. The boundary method accounts for all vehicle travel occurring within the physical boundaries of a given jurisdiction regardless of origin or destination. This means the commercial VMT estimates only include travel within the physical boundary of the unincorporated area. Without commercial VMT available by origin and destination, the RTAC method could not be applied to commercial VMT. As a proxy, the available commercial VMT was scaled based on the ratio between passenger VMT calculated by the RTAC method (available from MTC) and passenger VMT calculated by the boundary method (calculated from Caltrans VMT data) (Caltrans 2014:72, Caltrans 2016). This alternative method for estimating commercial VMT is consistent with MTC recommendations (Brazil, pers. comm., 2016).

MTC also provided the speed distribution profile by fuel and vehicle class, which allowed for the use of detailed emission factors calculated for the same categories from EMFAC 2014. Although, EMFAC provides CO_2 and CH_4 emissions data, direct N_2O emission factors were not available. Instead, N_2O emissions were calculated using ARB inventory methods that assume N_2O emissions are equal to 4.16 percent of NO_X emissions for gasoline vehicles and 0.3316 g N_2O per gallon fuel for diesel vehicles (ARB 2014a). Emissions from electricity use in electric vehicles were quantified using the same methods used for the building energy inventory.

1.6 OFF-ROAD VEHICLES

Based on modeling conducted, off-road vehicles operating in the unincorporated County emitted approximately 42,508 $MTCO_2e$ in 2014, or nine percent of the County's 2014 inventory. These emissions were the result of fuel combustion in off-road vehicles and equipment used in construction, industry, and recreation and were available from ARB's OFFROAD 2007 model. Unfortunately, the OFFROAD 2007 model only provides emissions detail at the State, air basin, or county level. Napa County emissions data from OFFROAD 2007 were apportioned to the unincorporated area using custom scaling factors depending on the off-road fleet type, as shown in Table 12. For example, due to the likely correlation between commercial activity and employment, the unincorporated portion of emissions from light commercial equipment in the County is assumed to be proportional to the number of jobs in the unincorporated County as compared to the County as a whole. On the other hand, emissions from pleasure craft are assumed to occur entirely within the County because the majority of navigable waterways in the County are located in the unincorporated area. Further details on how OFFROAD emissions from each fleet type were scaled to the unincorporated area are discussed below. Note that, although reported by the OFFROAD model, emissions from agricultural equipment included separately in the agriculture sector and are excluded from the off-road vehicles sector.

Emissions from locomotives are not included in the OFFROAD model and were added in separately to account for the Napa Valley Wine Train, which is the only operating locomotive in the County at this time. The estimated annual emissions and scaling factors are presented in Table 12 below by fleet type.

Table 12 2014 Unincorporated Napa County GHG Inventory: Off-Road Emissions by Fleet Type

Off-Road Fleet Type	$MTCO_2$/yr	MT CH_4/yr	MT N_2O/yr	$MTCO_2e$/yr	Unincorporated : Countywide Scaling Method
Pleasure Craft[1]	29,004	20	6	31,440	not scaled
Construction and Mining Equipment	6,546	1	0	6,575	jobs
Transport Refrigeration Units	1,413	0	0	1,420	jobs
Industrial Equipment	1,182	0	0	1,212	jobs
Light Commercial Equipment	851	0	0	899	jobs
Lawn and Garden Equipment	460	1	0	568	population
Recreational Equipment[1]	196	1	0	325	population
Oil Drilling	34	0	0	34	jobs
Locomotives (Napa Valley Wine Train) [1]	20	0	0	20	not scaled
Entertainment Equipment[1]	14	0	0	14	jobs
Railyard Operations	0	0	0	0	jobs
Total	**39,721**	**24**	**7**	**42,508**	

Notes: MT = metric tons; CO_2 = carbon dioxide; CH_4 = CH_4; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas

[1] Not in 2005 emissions inventory

Source: Data provided by Ascent Environmental in 2016, based on modeling from OFFROAD 2007

All commercial and industrial off-road emissions were scaled from countywide estimates by the unincorporated percentage of jobs in 2014. Emissions related to lawn and garden and recreational equipment were scaled by population. Countywide emissions from pleasure craft were assumed to entirely occur in the unincorporated areas such as Lake Berryessa and Lake Hennessey. Locomotive emissions were based on locomotive information from the Napa Valley Wine Train website, which provided engine model types, fuel types, car weights, average trip distance, and number of daily trips (Napa Valley Wine Train 2015). Locomotive fuel efficiency and emissions factors were available from the Alternative Fuels Data Center and the Climate Registry, respectively (AFDC 2014, TCR 2014).

Although ARB has released newer category-specific models designed to replace OFFROAD 2007, these newer models estimate statewide emissions without county-level detail and focus primarily on criteria pollutant emissions. ARB recommends using OFFROAD 2007 where desired information is unavailable from the newer off-road models (ARB 2015a). Notwithstanding ARB recommendations, OFFROAD 2007 model may tend to overestimate emissions in 2014. The model was developed prior to the 2009-2010 recession and, thus, presumes a higher growth rate in equipment population than what may have actually transpired in 2014 (ARB 2010). Additionally, the model does not include recent regulatory changes such as idling limits and newer engine tier requirements (ARB 2014b).

1.7 AGRICULTURE

Based on modeling conducted, emissions from the agriculture sector accounted for approximately 52,198 from agricultural activity such as farm equipment operations, direct emissions from livestock, and fertilizer use. Fuel combustion in farm equipment and CH_4 emissions from livestock made up 60 percent and 32 percent of total emissions from the sector, respectively. Other emissions estimated for this sector were from fertilizer use, lime application, burning of agricultural residue, and diesel-powered agricultural pumps. These emissions are summarized in Table 13 below.

Table 13 2014 Unincorporated Napa County GHG Inventory: Agriculture Emissions by Source

Source	$MTCO_2$/yr	MT CH_4/yr	MT N_2O/yr	$MTCO_2e$/yr
Farm Equipment	31,359	4	0	31,571
Enteric Fermentation from Livestock	0	414	0	10,345
Manure Management from Livestock	0	165	2	4,829
Fertilizer Use	0	0	9	2,683
Agricultural Irrigation Pumps	1,657	0	0	1,657
Residue Burning	533	10	1	1,094
Urea Fertilization	16	0	0	16
Lime Application	4	0	0	4
Pesticide Application[1]	0	0	0	0
Total	**33,568**	**593**	**13**	**52,198**

Notes: : MT = metric tons; CO_2 = carbon dioxide; CH_4 = CH_4; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas

[1] Pesticide application emissions were less than 0.5 MT.

Source: Data compiled by Ascent Environmental, 2016.

GHG emissions associated with farming equipment were obtained from ARB's OFFROAD2007 model. ARB has a more recent off-road equipment model, the 2011 off-road inventory model, but it is limited to construction, industrial, and oil drilling equipment types and does not include agricultural equipment. In cases where the new model does not cover a desired category, the ARB recommends using OFFROAD2007 as the current tool for estimating emissions. Farming equipment emissions reported for Napa County are assumed to occur entirely within the unincorporated County.

With respect to livestock emissions, CH_4 and nitrous oxide emissions are released through enteric fermentation (a type of digestion process) and exposure of manure produced by these animals. The 2014 Napa County Crop Report provided estimates of total weight of cattle, lamb, and slaughter sheep in the County. Average weight per head of livestock were calculated by comparing historical County livestock population estimates from the California Agricultural Statistical Review and total livestock weights reported in the County crop reports in the same year. This was used to calculate livestock population needed for emissions estimates. All livestock-generated GHG emissions were estimated using population-based emission factors and quantification methods identical to those by ARB in the statewide inventory.

Emissions from fertilizer use vary by crop type and acreage. The acreage of crops cultivated in the County was based on the *2014 Napa County Crop Report* (Napa County 2015b). The amount of fertilizer application for each crop type grown in the County was based on sample cost reports for each crop that are published by the University of California Cooperative Extension (UCCE). UCCE have special fertilizer reports available for wine grapes grown in the Napa region. Information about the mass amounts of urea and lime was provided in the Fertilizing Materials Tonnage Report for January to June of 2012. Emission factors and quantification methods for GHG emissions associated with urea and lime fertilizer application were obtained from IPCC (IPCC 2000). These emission factors and quantification methods were also used by ARB in its development of the statewide GHG inventory and subsequent updates (ARB 2015b).

The GHG emission factor and quantification method for agricultural irrigation pumps and number of pumps were obtained from ARB reports on diesel irrigation pumps (ARB 2003, 2006). Latest reports provided total diesel pumps in the Bay Area Air Quality Management District in 2006, but did not break down the inventory by County. However, an older report reported pumps at both the county-level and air district-level. Assuming the ratio of pumps in the air district remained the same as in 2003, approximately 26 pumps were estimated to operate in the County in 2006. The County's pump inventory in 2014 was assumed unchanged from 2006. (ARB 2006: Table D-2).

Residue burning refers to the burning of croplands after they are harvested to clear the land of residual vegetation. The GHG emissions from residue burning in Napa County were based on BAAQMD emissions inventory methods for open burning (emissions per ton of material burned), 2014 open burning permit data submitted to the air district (ton or cubic yard of material burned), and organic waste densities from CalRecycle (tons per cubic yard) (BAAQMD 2014, Reed, pers. comm., 2016, CalRecycle 2010). BAAQMD provided the permit information in response to a public records request. However, the air district had not yet quantified emissions from open burning for the 2014 calendar year. The permit data provided either cubic yards or tons of material (e.g. orchard pruning, crop replacement) burned by material category and location. Thus, it was necessary to calculate emissions separately. In Napa County, over 102,000 cubic yards, or 82 percent, of material openly burned in Napa County consisted of discarded grapevines (Reed pers. comm., 2016). BAAQMD opening burning permits also included open burning of flood control debris, forest and fire management, and other non-agricultural prescribed burns. Although these are not necessarily agricultural, emissions from those burns are included in the residue burning sub-sector to facilitate a more complete inventory.

A common pesticide that is also categorized as a GHG is methyl bromide. Based on the published factors from IPCC's Fifth Assessment Report, methyl bromide is assumed to have a GWP factor of 2. However, according to the California Pesticide Information Portal, no methyl bromide was used in 2013. 2014 information was not available, but no changes in methyl bromide use are expected. Sulfuryl fluoride is also considered a pesticide, but is most often used in structural pest control as a fumigant, and is not included as an agricultural emissions source. Sulfuryl fluoride is discussed in the High-GWP sector.

1.8 LAND USE CHANGE

As urban development and vineyards continue to expand with the growth of the wine industry and the County's population, certain natural land cover types are replaced with vineyards, residential/commercial development, and other anthropogenic development. Natural flora present on these lands such as forests, shrublands, and grasslands remove CO_2 from the atmosphere and sequester carbon in plant material through photosynthesis. Due to the relatively low rate of carbon sequestration associated with vineyards and urban development, the conversion of undeveloped lands to vineyards or urban development generally reduces or eliminates further carbon sequestration and removes stored carbon from plant life on the original undeveloped lands, depending on the type of vegetation removed or replaced. This displacement of natural vegetation on undeveloped lands leads to an overall net increase in emissions from a carbon cycle perspective.

Land use change and associated sequestration and stored carbon losses due to vineyard and urban development in Napa County resulted in the indirect emissions of approximately 7,746 $MTCO_2e$ in 2014, or two percent of total emissions, due to lost carbon sequestration potential and removal of stored carbon. According to County records, from 2005 to 2014, vineyard expansions displaced an estimated 1,492 acres of natural land cover, including over 700 acres of grasslands, 300 acres of shrubland, and 250 acres of oak woodland. This means that, on average, 166 acres of natural lands have been converted to vineyards every year between 2005 and 2014. Historical land use conversions to vineyards are shown in Table 14, and historical land use inventories between 2005 and 2015 are shown in Table 15.

Table 14 Historical Conversion of Land Uses to Vineyards by Land Cover Type between 2002 and 2014 in Unincorporated Portion of Napa County

Land Cover Type	2005-2007	2007-2010	2010-2014	2005-2014
Grasslands	170.1	300.0	243.0	713.2
Shrublands	129.5	86.4	121.0	336.9
Oak woodlands	81.5	83.7	87.4	252.6
Developed	64.9	79.9	89.2	234.1
Coniferous forest	45.5	58.8	21.5	125.8
Riparian woodlands	6.9	4.9	3.3	15.1
Other	2.5	2.2	37.9	42.6
Wetlands	1.4	0.0	2.4	3.8
Streams and reservoirs	0.4	0.1	0.1	0.6
Rock Outcrop	0.0	0.4	0.8	1.2
Total Natural Land Cover	**437.9**	**536.4**	**517.5**	**1,491.8**
Total	**502.8**	**616.4**	**606.7**	**1,725.8**

Note: Conversions represent land use change in the unincorporated areas of Napa County.

Source: Lambom, pers. comm., 2015; data compiled by Ascent Environmental, 2016.

Table 15 Historical Land Use Estimates by Land Cover Type between 2005 and 2015 in Unincorporated Portion of Napa County

Land Cover Type	2005[1]	2007[2]	2010[2]	2013[2]	2014[2]	2015[1]
Oak Woodlands	160,146	160,077	159,975	159,872	159,838	159,803
Chaparral/Shrublands	106,190	106,149	106,086	106,024	106,003	105,983
Vineyards	50,317	50,820	51,436	51,891	52,043	52,803
Coniferous Forest	42,469	42,461	42,450	42,439	42,435	42,431
Grasslands	48,844	48,786	48,699	48,612	48,583	48,554
Rock Outcrop/Other	38,096	38,637	39,448	40,259	40,529	40,800
Developed	28,619	28,588	28,540	28,493	28,478	28,462
Non-vineyard Cropland	19,591	19,229	18,686	18,143	17,962	17,781
Riparian Woodlands	7,838	7,833	7,826	7,820	7,817	7,815
Wetlands	5,328	4,864	4,167	3,471	3,239	3,007
Total[3]	**507,438**	**507,444**	**507,314**	**507,023**	**506,926**	**507,438**

Note:

[1] Land use estimates provided directly from the County.

[2] Except for vineyards, all land use estimates for these years were interpolated between 2005 and 2015. Vineyard acreages were based on historical vineyard conversion data shown in Table 14. Vineyard acreages in 2013 were interpolated between 2010 and 2014.

[3] Totals between 2007 and 2014 do not add up to the total acreage provided by the County for 2005 and 2015. This is because of the two different methods used to estimate acreages by land use between 2007 and 2014, as described in Note 2. Interpolated estimates assume a linear trend between 2005 and 2015. Actual acreages may vary from the interpolated results. Conversely, vineyard acreages were based on historical data, which does not show a linear trend between the two years. Therefore, the total acres shown for years from 2007 to 2014 do not reflect actual acreage totals in the County, but are within 99.9 percent of the totals shown for 2005 and 2015.

Source: Hade, pers. comm., 2015; data compiled by Ascent Environmental, 2016.

As mentioned, land use change affects emissions in two ways: 1) change in carbon sequestration potential and 2) change in carbon storage. To estimate net emissions in 2014 associated with land use change, per-acre carbon sequestration and carbon storage factors were applied to the change in acreage by land cover type between 2013 and 2014. Table 16, on the next page, presents the per-acre carbon sequestration and storage factors that were derived for region-specific tree densities and species and collected from various sources.[1] These factors are converted to carbon dioxide equivalents by multiplying by 44/12, the molecular weight ratio of CO_2 to carbon. Attachment A provides presents the calculations used to derive the per-acre carbon storage and sequestration factors in this analysis.

[1] In the April 2016 version of the inventory, the carbon sequestration and storage factors were based on per-acre carbon storage and sequestration rates that were specific to California at the state level only and not at the regional level. This current version of the inventory update revises the rates used for oak woodlands, coniferous forests, and riparian woodlands based on tree densities representing a 12-county northern California region that includes Napa County, as directed by the County (Hade, pers. comm., 2015). These densities are published in the USDA report “Oak Woodlands and Other Hardwood Forests of California, 1990s” (USDA 2005).

Table 16 2014 Unincorporated Napa County GHG Inventory: Lost Carbon Stock and Sequestration Factors by Land Use Type[1]

Land Use Type	Stored Carbon		Annual Sequestration	
	Carbon stored per acre (MT C/acre)	Method or Sources	Annual Net Carbon Sequestration per acre (MT C/acre/yr)	Method or Sources
Oak Woodlands	34.9	Calculated from carbon fractions and biomass ratios from IPCC 2006a and per-acre aboveground biomass factors and tree densities from USDA 2005. Tree densities represent 12 northern California counties, including Napa County. Calculated factor represents above and below ground live biomass only. Represents average of eight oak species.	2.017	Calculated from annual growth rates derived from Table 13 in USDA 2005 calculated carbon storage values per tree from IPCC 2006a and USDA 2005, and tree densities from USDA 2005. Represents average of eight oak species.
Coniferous Forest	47.0	Calculated from carbon fractions and biomass ratios from IPCC 2006a, per-tree aboveground biomass factors from CUFR 2009, and tree densities from USDA 2005. Tree densities represent 12 northern California counties, including Napa County. Calculated factor represents above and below ground live biomass only.	3.129	Softwood factors calculated from ratio of growth and mortality rates between California softwoods and hardwoods from Table 3 in Liang et. al. 2005 and adjusted against hardwood growth rates in USDA 2005.
Riparian Woodlands	57.0	Calculated based on average of eight oak species, tanoaks, and redwoods using same sources as above IPCC 2006a, USDA 2005, and CUFR 2009, as directed by the County. Calculated factor represents above and below ground live biomass only.	4.744	Average of 8 oak species, tanoaks, and redwoods, a softwood, using same methods as above depending on wood type.
Grasslands	2.6	Factor calculated from total area and total carbon stocks for grassland from Table 5 in Battles, et. al. 2014.	0	Factor available directly from page 19 of Brown, et. al. 2004.
Shrublands	12.8	Factor calculated based on page 18 in Battles, et. al. 2014 that states that on average, the carbon density of grassland is only 20% of shrublands.	0	Factor available directly from page 19 of Brown, et. al. 2004.
Croplands (Not Vineyards)	2.2	Includes the County mix of olives, vegetables, and hay as reported in the County's 2014 Crop Report. Carbon storage factors from Battles, et. al. 2014 and Brown, et. al. 2004 scaled by acreage for each crop type.	0.081	Weighted average of olives, vegetables, and hay sequestration rates based on acreages in Proietti et. al. 2014 and the 2014 Crop Report. Assumes vegetables and hay have zero annual sequestration.
Vineyards	1.2	Factor converted directly from Table 2.6 in Brown, et. al. 2004.	0.016	Factor converted directly from page 1980 of Kroodsma, et. al. 2006. Includes sequestration in woody mass, pruning, removal of vineyards after a 25-year lifetime, burial in soil, and an average level of conversion to biomass energy.

Note: MT = metric tons; C = carbon; GHG = greenhouse gas. See Attachment A for detailed calculations of the carbon storage and sequestration factors.

[1] Changes in land use patterns do not immediately change soil carbon levels. Instead, changes to soil carbon may be gradual, while change in land use patterns would have immediate impacts on aboveground and some belowground biomass. As such, soil carbon is not included in this analysis.

Source: IPCC 2006a, USDA 2005, CUFR 2009, Battles, et. al. 2014, Brown, et. al. 2004, Liang et. al. 2005, Proietti et. al. 2014, Napa County 2015, Kroodsma, et. al. 2006, Hade, pers. comm., 2015; data compiled by Ascent Environmental, 2016.

With respect to sequestration from vineyard growth and production, the information on carbon sequestration in vineyards is very limited. One study found that vineyards, over their lifetime, sequester approximately 4 g C per square meter per year (or 0.016 MT C/acre/year) in its woody biomass (Kroodsma and Field 2006:1980). Soil carbon was also quantified in this study, but is outside the scope of this inventory. This study accounted for pruning levels and usage of vineyard biomass at the end of a 25-year lifetime. It assumed that mature vines convert 35 to 50 percent of sequestered carbon as fruit, which was assumed to release the sequestered carbon after consumption. The study also noted that actual sequestration rates depend on what is done with the discarded vineyard biomass. Burying biomass can help increase soil carbon rates, but carbon levels in soil can saturate and decomposition would also return some sequestered carbon back into the atmosphere. Burning biomass, either out in the open or in a biomass plant, would return sequestered carbon into the atmosphere. However, using biomass as energy also offsets fossil fuel emissions. The Kroodsma study assumed some statewide level of biomass-to-energy conversion. Given this research and the uncertainty of how vineyard biomass in Napa County is treated, Napa County vineyards are assumed have an average statewide net annual sequestration level of 0.016 MT C/acre/year.

Based on the methods and data sources discussed above, Table 17 below presents a summary of the land use changes that occurred between 2013 and 2014 along with the estimated net GHG emissions due to lost carbon storage and sequestration potential. Total net emissions with respect to each land use type in baseline year of 2014 equal total lost carbon storage and the lost sequestration potential associated with removed vegetation between 2013 and 2014.

Methods used to forecast emissions differ from the method used for the inventory year for the land use change sector. Emissions forecasting methods are discussed under the Forecast section.

Table 17 2014 Unincorporated Napa County GHG Inventory: Lost Carbon Stock and Sequestration Potential from Land Use Change between 2013 and 2014

	Change in acreage between 2013 and 2014	Lost Carbon Storage due to Land Use Change (MT CO_2)	Loss in carbon sequestration potential (MT CO_2)	Total Net Emissions (MT CO_2)
Coniferous Forest	-4	657	12	669
Croplands (Not Vineyards)[1]	-181	1,455	54	1,508
Grasslands	-29	272	0	272
Oak Woodlands	-34	4,383	69	4,452
Riparian Woodlands	-2	483	11	494
Shrublands	-21	973	0	973
Vineyards	152	-675	-9	-684
Other[2]	119	0	0	0
Total	**0**	**7,547**	**137**	**7,684**

Notes: Land use change based on acreages provided by Napa County. Values may not sum due to rounding. MT = metric tons; CO_2 = carbon dioxide; GHG = greenhouse gas

[1] "Cropland (Not Vineyards)" includes the County mix of olives, vegetables, and hay as reported in the 2014 Napa County Crop Report.

[2] "Other" refers to wetlands and non-vegetative land uses such as developed areas and rock outcrops. Non-vegetative land uses are assumed to have no carbon storage or sequestration potential and are not included here. Carbon sequestrations and storage potential of wetlands vary greatly depending on location, ecosystem, and other factors. Factors for wetlands unique to Napa County are not available and were assumed to be zero.

Source: Napa County (Hade, pers. comm., 2015); data compiled by Ascent Environmental, 2016.

1.9 HIGH-GWP GASES

High-GWP gases accounted for 13,481 $MTCO_2e$, or approximately three percent of total emissions in 2014. This sector includes emissions from SO_2F_2, a fumigant; SF_6, an electric insulator used in electricity transmission; and a list of other high-GWP gases including various HFCs, PFE, and PFCs as listed in Table 18. HFCs and CFCs are generally emitted into the atmosphere through off-gassing, leakage, or direct emission of refrigerants, solvents, aerosols, foams, and fire protection. County-specific information was available for inventorying of SO_2F_2 and SF_6; however, estimates of other high-GWP gases were only available at the State level and were scaled from the statewide GHG inventory to the unincorporated area by population. Emissions from the various high-GWP gases included in the unincorporated County's 2014 inventory are shown in Table 18, by GHG.

Table 18 2014 Unincorporated Napa County GHG Inventory: High-GWP Gases by Greenhouse Gas

Greenhouse Gas[1]	GWP	Application	2013 State Mass Emissions (MT/yr)	2014 State per capita Emissions (MT/yr-cap)[2]	Unincorporated Napa County Emissions (MT/yr)	Unincorporated Napa County Emissions ($MTCO_2e$/yr)
HFC-125	3,500	Fire Protection, Refrigerants	1359	3.65×10^5	0.9720	3,402
HFC-134a	1,430	Aerosols, Foams, Refrigerants	5676	1.52×10^4	4.0593	5,805
HFC-143a	4,470	Refrigerants	758	2.03×10^5	0.5419	2,422
HFC-152a	124	Aerosols, Refrigerants	4080	1.09×10^4	2.9176	362
HFC-227ea	3,220	Fire Protection, Aerosols	58	1.56×10^6	0.0416	134
HFC-236fa	9,810	Fire Protection, Refrigerants	10	2.59×10^7	0.0069	68
HFC-245fa	1,030	Foams, Solvents	466	1.25×10^5	0.3330	343
HFC-32	675	Refrigerants	673	1.80×10^5	0.4810	325
HFC-365mfc	794	Solvents	0	1.10×10^8	0.0003	0
HFC-43-10mee	1,640	Solvents, Aerosols	18	4.77×10^7	0.0127	21
PFC-14 (CF_4)	7,390	Fire Protection, Solvents	0	8.19×10^9	0.0002	2
Other PFC and PFE's	9,300	Solvents	0	6.40×10^9	0.0002	2
Sulfuryl Flouride[3]	4,090	Fumigant	5	NA	0.0950	389
Sulfur Hexaflouride[4]	22,800	Electrical Insulator	NA	NA	0.0091	207
				TOTAL	**9.4709**	**13,481**

Note: ARB= California Air Resources Board, DPR = California Department of Pesticide Regulation, GHG = greenhouse gas, MT = metric tons, CO_2e = carbon dioxide equivalents, HFC = hydrofluorocarbons, IPCC = Intergovernmental Panel on Climate Change, NA = not applicable, PFC = perfluorinated compounds, PFE = perfluoroethane

[1] Names of gases consistent with ARB's list of "Use of substitutes for ozone depleting substances". Sulfur hexafluoride is also accounted for in the State's GHG inventory. IPCC recently included sulfuryl fluoride in its list of GHGs, but it has not yet been included in the State's inventory. (IPCC 2013)
[2] Assumes a 2% growth in per capita emissions from 2013 to 2014. This is based on historical year-to-year changes in per-capita emissions from compounds used in ARB category, "Use of substitutes for ozone depleting substances".
[3] Calculations based on statewide emissions scaled to the unincorporated area by total electricity usage in the unincorporated area in 2014, not population.
[4] Calculations based on actual consumption reports for Napa County from DPR and scaled to the unincorporated area by population.

Source: ARB 2015b, DPR 2013, IPCC 2007: Table 2.14, IPCC 2013; data compiled by Ascent Environmental in 2016.

As mentioned, HFC, PFC, and PFE emissions were calculated based on ARB's 2013 State GHG inventory. 2013 statewide per-capita emission factors were calculated from the most recent California 2013 inventory. These emission factors were then scaled to 2014 assuming that per capita emissions would increase by 2 percent between 2013 and 2014, consistent with recent historical trends. The final 2014 emission factors were applied to the known population of unincorporated County to obtain county-level emissions. As shown in Table 18 and following statewide trends, emissions of HFC-134a, HFC-143a, and HFC-125 account for 86 percent of the high-GWP gas sector in 2014. According the breakdown of these emissions in Table 19, most of these gases are used as refrigerants in the commercial and in refrigerated vehicles, such as trucks transporting perishables. Given the prominence of the wine industry in the County where wine, grape juice, and grapes may be transported in refrigerated trucks, the percent of refrigerants used in transportation could be higher than what is reported in Table 18 and 19.

Table 19 2014 Unincorporated Napa County GHG Inventory: HFC-125, HFC-134a, and HFC-143a emissions by Source and Application

Emissions Source and Application	Unincorporated Napa County Emissions ($MTCO_2e$/yr)
Commercial	**5,456**
Aerosols	102
Fire Protection	2
Foams	57
Refrigeration and Air Conditioning	5,294
Industrial	**1,908**
Aerosols	14
Fire Protection	1
Foams	332
Refrigeration and Air Conditioning	1,561
Residential	**1,776**
Aerosols	653
Foams	139
Refrigeration and Air Conditioning	983
Transportation	**2,490**
Aerosols	140
Refrigeration and Air Conditioning	2,350
Grand Total	**11,629**

Note: GHG = greenhouse gas, MT = metric tons, CO_2e = carbon dioxide equivalents, HFC = hydrofluorocarbon

Source: ARB 2015b, DPR 2013, IPCC 2007: Table 2.14, IPCC 2013; data compiled by Ascent Environmental in 2016.

With respect to SO_2F_2, the latest report from the California Department of Pesticide Regulation indicates that Napa County used 1,627 pounds of SO_2F_2 in 2013 (DPR 2013). A 2009 article in the Journal of Geophysical Research estimated that approximately one third of SO_2F_2 used in fumigation would be destroyed in the fumigation process (Mühle et.al. 2009). Assuming that all sulfuryl fluoride used in the County was for fumigation and scaling the resulting emissions by the unincorporated population in 2013 and population growth to 2014, total sulfuryl fluoride emissions from the unincorporated County in 2014 are estimated to be 389 $MTCO_2e$.

To estimate emissions from SF_6, an average statewide emissions factor (MT SF_6 per kWh) was calculated using ARB's 2013 GHG inventory that reported both total emissions and total associated electricity use. Using the total 2014 electricity use for the unincorporated area based on data provided by PG&E, total SF_6 emissions from the unincorporated County in 2014 are estimated to be 207 $MTCO_2e$.

2 GHG EMISSIONS FORECASTS TO 2020, 2030, AND 2050

Legislative-adjusted BAU emissions forecasts provide the County with an assessment of how the County's emissions would change over time without further action from the County. In addition to accounting for the County's growth, a legislative-adjusted BAU forecast accounts for legislative actions at the local, State, and federal levels that would affect emissions, such as through participation in MCE or regulatory requirements to increase vehicle fuel efficiency. These forecasts provide the County with the information needed to focus efforts on certain emissions sectors and sources that have the most GHG reduction opportunities. The selected future milestone years of 2020, 2030, and 2050 are generally based on the State's GHG reduction target years established in key State legislation and policies, including Assembly Bill (AB 32), Executive Order B-30-15, and Executive Order S-305.

BAU emissions forecasts, for most sectors, were based on predicted growth in existing demographic forecasts, including population, jobs, and household growth between 2014 and 2040 for Napa County, as shown in Table 20 below. The calculated growth rates were used as scaling factors and extrapolated for years other than 2040. These scaling factors were then applied to background calculations for a given emissions sector depending on what was most appropriate for the sector (e.g. household growth was used to scale residential energy use). For the land use change sector, forecasted emissions relied on the anticipated changes various land uses in the unincorporated County through 2050 based on the build-out of the County's 2008 General Plan. Any legislative adjustments were applied on top of the BAU forecasts.

Table 20 Napa County Demographic Forecasts

Input	2014	2040	Change from 2014
Napa County (Countywide)			
Households	49,859	56,312	6,453 (13%)
Population	136,550	158,792	22,242 (16%)
Employment	74,697	89,550	14,853 (20%)
Unincorporated Napa County Only			
Households	11,635	13,893	2,258 (19%)
Population	30,958	38,225	7,267 (23%)
Employment	17,320	19,503	2,183 (13%)

Source: Metropolitan Transportation Commission (Brazil, pers. comm., 2016); data compiled by Ascent Environmental in 2016.

Legislative-adjusted forecasted emissions account for anticipated changes in future vehicle emissions factors and electricity emissions factors due to State and federal policies that would occur with or without County action, which can be referred to as "legislative adjustments" to the forecasts. These actions are reflected in forecasted emissions factors either provided by PG&E or assumed in EMFAC 2014.

The unincorporated County's BAU emissions, accounting for applicable legislative reductions, would decrease by 24 percent between 2014 and 2050, as shown in Table 21 and Figure 2. Figure 2 also shows the emissions trend that would occur without anticipated legislative reductions and accounting only for population, housing, and employment changes and the anticipated build-out of land uses. Without the legislative reductions, discussed above, emissions would be 51 percent higher in 2050 compared to BAU forecasts.

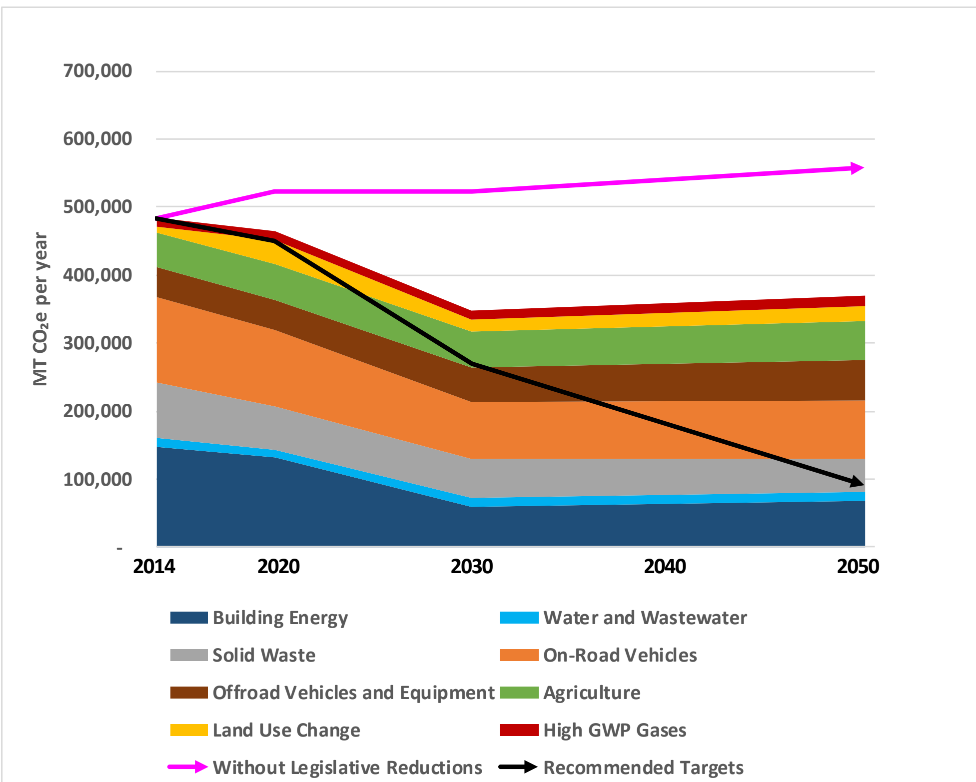
Table 21 Unincorporated Napa County Emissions Inventory and Legislative-adjusted BAU Forecasts ($MTCO_2e$/yr)

Sector	2014	2020	2030	2050
Building Energy	148,338	131,635	59,127	66,184
Water and Wastewater	11,277	11,858	12,959	14,335
On-Road Vehicles	125,711	112,854	84,846	85,735
Waste	83,086	62,345	56,711	48,854
Off-Road Vehicles and Equipment	42,508	45,164	49,592	58,474
Agriculture	52,198	52,521	53,588	57,445
Land Use Change	7,684	35,608	18,239	21,669
High-GWP Gases	13,481	11,828	13,169	15,867
Total	**484,283**	**463,899**	**348,331**	**369,637**
Percent Change from 2014 (%)	0	-4	-28	-24

Notes: BAU = Business as usual, CO_2e = carbon dioxide equivalents, NA = Not Available, GWP = global warming potential, MT = metric tons

Source: Ascent Environmental, 2016

Figure 2: Unincorporated Napa County Legislative-Adjusted BAU Emissions Forecast by Sector



Note that the temporary increase in 2020 for the "Without Legislative Reductions" trend line is due to forecasted changes in land usage that are not associated with any legislative reductions. Otherwise this trend is solely due to demographic forecast data shown in Table 20.

Emissions forecasts are detailed for each sector and discussed below.

2.1 BUILDING ENERGY

Between 2014 and 2050, electricity and natural gas emissions in the unincorporated County, together representing the building energy sector, would decrease by 55 percent from 148,338 to 67,184 $MTCO_2e$ per year, with legislative adjustments and despite growth in the County's housing and employment levels. Table 22 shows the forecasted emissions from the building energy sector by customer class for 2014, 2020, 2030, and 2050.

Table 22 Unincorporated Napa County Electricity and Natural Gas Emissions Forecasts (2014-2050) ($MTCO_2e$/yr)

Customer Class	2014	2020	2030	2050
Electricity Emissions				
Residential	116,340,405	120,241,375	68,572,790	81,817,108
Commercial	214,162,060	218,753,327	119,324,410	134,380,854
Industrial	5,280,679	5,391,267	2,935,240	3,297,896
Electricity Total	**335,783,143**	**344,385,969**	**190,832,440**	**219,495,859**
Natural Gas Emissions				
Residential	3,809,649	3,937,389	2,245,464	2,679,159
Commercial	8,626,723	8,811,666	4,806,541	5,413,034
Industrial1	0	0	0	0
Natural Gas Total	**12,436,372**	**12,749,054**	**7,052,005**	**8,092,193**
Total Building Energy Emissions				
Residential	47,984	42,497	19,436	22,914
Commercial	99,385	88,606	39,981	44,573
Industrial[1]	993	696	174	184
Electric Vehicles[2]	-25	-156	-441	-487
Building Energy Total	**148,338**	**131,643**	**59,150**	**67,184**
Percent Change from 2014 (%)	0	-11	-60	-55

Notes: $MTCO_2e$ = metric tons of CO_2 equivalent, PG&E=Pacific Gas and Electric

[1] PG&E reported zero natural gas usage in the unincorporated area in 2013 from the industrial sector.

[2] Electric vehicle emissions from electricity generation are already accounted for in the on-road transportation sector.

Source: EPIC 2016, Ascent Environmental 2016

Emissions from future electricity and natural gas use were estimated by multiplying anticipated energy use with forecasted emission factors. Future energy use was forecasted in two parts. First, energy use was scaled by the growth in housing units for residential energy use and by employment numbers for commercial and industrial energy use. Second, the level of energy use was adjusted to reflect California's energy efficiency targets. Electricity emission factors are also anticipated to decline based on current regulations, while natural gas emission factors stay constant using the same emission factors presented in Table 5. Table 23 summarizes the scaling factors and legislative reductions used to scale electricity use by customer type.

Table 23 Building Energy Emissions Forecast Methods and Legislative Reductions by Source

Customer Type	Forecast Methods	
	Scaling Factors	Applied Legislative Reductions
Residential Electricity	Scaled by housing units	MCE 50% renewables baseline applied to 89% of energy use, based on current participation rates starting in early 2015. RPS scheduled targets applied to PG&E emission factors for 11% of customers assumed to opt out of MCE. Accounts for 2016 Title 24 energy efficiency gains for all new construction. Accounts for 50% renewable mix by 2050 for P&GE emission factors and 50% improvement in energy efficiency in all existing buildings starting in 2030, per SB 350.
Residential Natural Gas	Scaled by housing units	Accounts for 2016 Title 24 energy efficiency gains for new construction. Accounts for 50% improvement in energy efficiency in all existing buildings starting in 2030, per SB 350.
Commercial and Industrial Electricity	Scaled by employment	MCE 50% renewables baseline applied to 89% of energy use, based on current participation rates starting in early 2015. RPS scheduled targets applied to PG&E emission factors for 11% of customers assumed to opt out of MCE. Accounts for 2016 Title 24 energy efficiency gains for all new construction. Accounts for 50% renewable mix by 2050 for P&GE emission factors and 50% improvement in energy efficiency in all existing buildings starting in 2030, per SB 350.
Commercial and Industrial Natural Gas[1]	Scaled by employment	Accounts for 2016 Title 24 energy efficiency gains for new construction. Accounts for 50% improvement in energy efficiency in all existing buildings starting in 2030, per SB 350.

Notes: BAU = business as usual, RPS = Renewable Portfolio Standard, MCE= Marin Clean Energy, PG&E = Pacific Gas and Electric, SB = Senate Bill

[1] Industrial natural gas was not provided by PG&E and was assumed to be included in commercial natural gas.

Source: Ascent Environmental, 2016

The assumptions behind the adjustments to energy efficiency and future electricity emission factors are described below.

2.1.1 Electricity Emission Factors

Emissions from the building energy sector would see gradual declines into the future without additional County action, even with population increase, due to local and State measures already in place. As mentioned previously, MCE is a CCA that began servicing unincorporated County in February 2015. As part of MCE's service, MCE automatically provides customers within its service area with 50 percent renewable electricity, although customers are allowed to opt out of MCE's service or pay into MCE's "Dark Green" program that would allow for a higher percentage renewable mix. Those that opt out would remain under PG&E's electricity service, which is currently 27 percent renewable (MCE 2015). According to MCE's Integrated Resource Plan, MCE plans to increase the minimum renewable energy supply of the program from 50 to 80 percent by 2025 (MCE 2015b).

With respect to BAU forecasts, it is assumed that the unincorporated County would continue to participate in the MCE program. This assumes that the unincorporated County's current opt-out rate would remain at approximately 11 percent into future years (MCE 2015b). Thus, the BAU forecast estimates that 50-percent-renewable electricity emission factors would be applied to 89 percent of future electricity use in unincorporated County buildings. The remaining 11 percent of electricity use would use PG&E emission factors that are scheduled to reach a 33 percent renewable mix by 2020 and 50 percent by 2050, pursuant to statewide legislation of the Renewable Portfolio Standard and SB 350.

PG&E anticipates that by 2020, the utility's CO_2 emission factor will be 0.131 $MTCO_2$ per MWh (PG&E 2015b). This takes into account the utility's achievement of the State's RPS goal to source 33 percent of electricity generation from renewables by 2020. Assuming emission factors from non-renewable sources remain the same, a 50 percent and 80 percent renewable mix would have emissions of 0.127 and 0.051 $MTCO_2$ per MWh, respectively. CH_4 and N_2O electricity emission factors in future years are assumed to be reduced from 2014 levels proportional to the anticipated change in CO_2 emission factors.

2.1.2 Energy Efficiency

California has two major policies that would affect the energy efficiency of buildings in future years. The State's Title 24 Building Energy Efficiency Standards and SB 350 would affect energy efficiency rates in new construction and existing buildings, respectively. The 2016 Title 24 standards were adopted in December 2015 and will go into effect January 2017. The California Energy Commission (CEC) estimates that new residential buildings built to these standards would be 28 percent more efficient than buildings built to the current 2013 Title 24 standard. Relative savings for non-residential buildings was not readily available from the CEC; thus, it was assumed that non-residential buildings built to 2016 standards would have similar improvements as the residential standards. (CEC 2015).

SB 350, in addition to targeting a 50 percent renewable mix in California electricity by 2030, targets a cumulative doubling of statewide energy efficiency savings in electricity and natural gas final end uses of retail customers by January 1, 2030 with annual targets established by the CEC. SB 350's energy efficiency goals are applicable to both existing building stock and new construction, but would have the most impact on existing building stock.

Forecasts of future building energy use account for both Title 24 and SB 350 policies. It is assumed that all new construction taking place between 2014 and 2050 would have energy efficiencies 28 percent better than current energy usage rates (i.e., energy use per household and employment). Although this method does not exactly reflect improvements from 2013 Title 24 standards, this method is a conservative approach as a 28 percent reduction from current energy usage rates would result in more energy use than a 28 percent reduction from building built to the 2013 Title 24 standard. In addition, it is assumed that all existing building stock (i.e., buildings built before 2015) would continue to operate through 2050 and would use 50 percent less energy starting in 2030. The forecasted energy efficiency improvements in existing building stock are meant to reflect implementation of SB 350 energy efficiency goals met by 2030. As a conservative assumption, estimated energy efficiency levels in existing buildings are assumed to stay constant from 2030 through 2050.

2.2 WATER AND WASTEWATER

Between 2014 and 2050, water- and wastewater-related emissions in the unincorporated County would increase by 27 percent from 11,277 to 14,335 $MTCO_2e$ per year, with legislative adjustments and despite a 44 percent increase in population over the same period[2]. This change reflects an increase in water consumption proportional to population growth in the unincorporated County in combination with lower electricity emissions factors related to the MCE, RPS, and SB 350 legislative actions described in Section 2.1.1. **Error! Reference source not found.**24 shows the forecasted emissions from each water supply activity source for 2014, 2020, 2030, and 2050. Forecasted population growth in the unincorporated County and electricity emissions factors are available in Table 5 and Section 2.1.1.

[2] In the April 2016 version of this memorandum, the totals incorrectly double counted for electricity from wastewater treatment. This memorandum removes the double counting and corrects the total emissions from water and wastewater activity.

Table 24 Unincorporated Napa County Water and Wastewater Emissions Forecasts (2014-2050) ($MTCO_2e$/yr)

Activity	2014	2020	200	2050
Imported Water Conveyance	88	66	65	59
Wastewater (Domestic)	5,776	6,443	7,151	8,540
Wastewater (Wine Making)	5,053	5,348	5,743	5,737
Total	**11,277**	**11,858**	**12,959**	**14,335**
Percent Change from 2014 (%)	0	5	15	27

Note: There was insufficient information on stormwater energy use for the unincorporated County. Thus, stormwater energy use and related emissions were excluded.

GHG = greenhouse gas, $MTCO_2e$ = metric tons of CO_2 equivalent

Source: EPIC 2016, Ascent Environmental 2016

Most of the electricity use for water imports, wastewater conveyance, and wastewater treatment occurs outside of the unincorporated County in the incorporated Napa cities. Although MCE currently does not serve incorporated areas in Napa County, many cities in the County have expressed interest in joining MCE in the future (Choi, pers. comm., 2016). In fact, the City of Calistoga currently already participates in MCE's program (Kirn pers. comm., 2015). Because City applications for MCE are not yet public, forecasts for the water and wastewater sector assume electricity emissions factors consistent with PG&E's progress towards RPS and SB 350 targets, except for water conveyance from the City of Calistoga and wastewater treatment at wineries within the unincorporated County that would follow MCE's targets.

Table 25 summarizes the scaling factors and legislative reductions used to scale water and wastewater activity.

Table 25 Water and Wastewater Emissions Forecast Method Summary

Source	Forecast Methods	
	Scaling Factors	Applied Legislative Reductions
Imported Water Conveyance	Scaled by population	Assumes only City of Calistoga has joined MCE's program with at least a 50% renewable mix. All other water providers outside the unincorporated area are assumed to follow the RPS and SB 350 target schedule.
Wastewater Treatment (Domestic)	Scaled by population	Assumes electricity use at all treatment plants outside the unincorporated area follow the RPS and SB 350 target schedule.
Wastewater Treatment (Wine Making)	Scaled by vineyard acres	Assumes electricity use at all treatment plants are located in the unincorporated area and follow MCE, RPS, and SB 350 target schedule.

Notes: RPS = Renewable Portfolio Standard, MCE= Marin Clean Energy, PG&E = Pacific Gas and Electric, SB = Senate Bill. "Target schedule" refers to a utility or policy's renewable energy target by milestone year.

Source: Ascent Environmental, 2016

2.3 SOLID WASTE

Between 2014 and 2050, solid waste emissions in the unincorporated County would decrease by 41 percent from 83,086 to 48,854 $MTCO_2e$ per year, with legislative adjustments and despite growth in unincorporated County's population and employment levels. Table 26 shows the forecasted emissions from the solid waste sector by emissions source for 2014, 2020, 2030, and 2050.

Table 26 Unincorporated Napa County Solid Waste Emissions Forecasts (2014-2050) ($MTCO_2e$/yr)

Source	2014	2020	2030	2050
Solid Waste	19,961	3,537	3,938	4,744
Waste-In-Place	63,125	58,809	52,773	44,109
Total	**83,086**	**62,345**	**56,711**	**48,854**
Percent Change from 2014 (%)	0	-25	-32	-41

Note: MT CO_2e = metric tons of CO_2 equivalent

Source: Ascent Environmental, 2016

The forecasts shown in Table 26 account for the decay rate of waste-in-place at landfills located within the unincorporated County, California's 75 percent waste diversion target effect on per-capita waste disposal rates, and the anticipated population growth affecting overall waste disposal in the unincorporated County. The forecasts also assume that current operational LFG capture systems will continue to operate into the future.

With respect to solid waste generation, CalRecycle established a target pursuant to AB 341 (Chapter 476, Statutes of 2011) to achieve a statewide waste diversion rate of 75 percent by 2020, or 2.7 pounds of waste per resident per day (lb/resident/day). Emissions forecasts for this sector assume the County would reduce its disposal rate from 4.1 lb/resident/day to the State's target of 2.7 lb/resident/day by 2020, a 34 percent reduction from 2014 (CalRecycle 2015, CalRecycle 2012: 7). Future years would see additional open landfills adopting LFG capture systems. This includes Potrero Hills Landfill to which the unincorporated County sent 98 percent of its waste in 2014. Potrero Hills Landfill is anticipated to begin LFG capture 2016, according to EPA reports (EPA 2015c).

With respect to waste-in-place emissions, ASCL and Clover Flat Landfill are assumed to continue current LFG capture and flaring operations into the future. Because the landfill is currently closed, fugitive methane emissions from ASCL are expected to decrease over time as the finite amount of organic material decomposes. EPA's first order decay model, Landfill Gas Emissions Model (LandGEM Version 3.02), was used to scale future emissions from both unincorporated County landfills, based on the landfill open and past and future closure dates and average annual tonnage received by the landfill.

Table 27 summarizes the methods and legislative reductions used to forecast emissions from the solid waste sector.

Table 27 Solid Waste Emissions Forecast Method Summary

Source	Forecast Methods	
	Scaling Factors	Applied Legislative Reductions
Solid Waste	Waste tonnage scaled by population.	Incorporates completion dates of near term LFG projects, including Potrero Hills Landfill. Assumes California's 75% waste diversion goal would be achieved in Napa by 2020.
Waste-in-Place	Emissions scaled by population for open landfills. For both open and closed landfills, FOD model was used to scale methane emissions based on average annual tonnage and a given landfill's open and closure dates.	No additional legislative reduction.

Notes: FOD = first order decay, LFG = Landfill Gas

Source: Ascent Environmental, 2016

2.4 ON-ROAD VEHICLE FLEET

Between 2014 and 2050, GHG emissions from on-road transportation in the unincorporated County would decrease by 32 percent from 125,711 $MTCO_2e$ to 85,735 $MTCO_2e$, accounting for VMT growth forecasted by MTC and future vehicle emission factors modeled in EMFAC2014. **Error! Reference source not found.** 28 show the forecasted emissions from the on-road transportation sector by fuel type for 2014, 2020, 2030, and 2050. Consistent with the inventory, annual VMT forecasts provided by MTC were multiplied by EMFAC2014 future emission factors. Emissions from electricity use in electric vehicles were quantified using the same methods used for the building energy forecasts.

Table 28 Unincorporated Napa County On-Road Vehicle Emissions Forecasts (2014-2050) ($MTCO_2e$/yr)

Fuel Type	2014	2020	2030	2050
Gasoline	94,990	82,988	56,216	54,384
Diesel	30,696	29,710	28,189	30,864
Electric	25	156	441	487
Total	**125,711**	**112,854**	**84,846**	**85,735**
Percent Change from 2014 (%)	0	-10	-33	-32

Notes: Only total VMT was provided by MTC. The distribution of annual VMT by fuel type was based on the distribution of VMT by fuel type in EMFAC2014 for Napa County for each milestone year.

$MTCO_2e$ = metric tons of CO_2 equivalent
MTC = Metropolitan Transportation Commission
VMT = vehicle miles traveled

Source: MTC 2016, EMFAC 2014, Ascent Environmental, 2016

Annual VMT forecasts are provided in Table 29 below by fuel type.

Table 29 Unincorporated Napa County VMT Forecasts (2014-2050) (Annual Vehicle Miles Traveled)

Fuel Type	2014	2020	2030	2050
Gasoline	238,043,173	248,829,425	241,326,238	252,573,510
Diesel	23,527,464	23,154,140	22,733,499	24,702,585
Electric	450,077	4,168,201	25,705,923	30,134,106
Total	**262,020,714**	**276,151,766**	**289,765,660**	**307,410,200**

Notes: Only total VMT was provided by MTC. The distribution of annual VMT by fuel type was based on the distribution of VMT by fuel type in EMFAC2014 for Napa County for each milestone year.

VMT = vehicle miles traveled

Source: MTC 2016, EMFAC 2014, Ascent Environmental, 2016

With respect to the legislative adjustments included in this forecast, State and federal policies and associated regulations incorporated in the on-road vehicle emission forecasts include:

- **Tractor-Trailer Greenhouse Gas (TTGHG) Regulation (State):** Establishes stricter fuel efficiency standards in heavy-duty tractors by requiring EPA certification and low rolling resistance tires, reducing GHG emissions.
- **Pavley Clean Car Standards (State):** Establishes GHG emission reduction standards for model years 2009 through 2016 that are more stringent than federal corporate average fuel economy (CAFE) standards.

- **Advanced Clean Cars (State):** Establishes GHG emission reduction standards for model years 2017 through 2025) are more stringent than CAFE standards (State)
- **Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (federal):** Establishes fuel efficiency standards for medium and heavy-duty engines and vehicles.

These policies are already included in EMFAC's emission factor estimates and forecasts. It should be noted that the Low Carbon Fuel Standard regulation was excluded in EMFAC 2014 forecasts because most of the emissions benefits originate from upstream fuel production.

Table 30 summarizes the scaling factors and legislative reductions used to scale on-road vehicle activity.

Table 30 On-Road Vehicle Emissions Forecast Method Summary

Source	Forecast Methods	
	Scaling Factors	Applied Legislative Reductions
On-Road Vehicle Miles Traveled	Estimated by the Metropolitan Transportation Commission	EMFAC emission factors considerations include ACC, Pavley, TTGHG, and fuel efficiency standards for medium- and heavy-duty vehicles.

Notes: ACC = Advanced Clean Cars, EMFAC = Emissions FACtor Model, TTGHG = Tractor-Trailer Greenhouse Gas

Source: Ascent Environmental, 2016

2.5 OFF-ROAD VEHICLES

Between 2014 and 2050, emissions associated with off-road vehicles in the unincorporated County would increase by 38 percent from 42,508 to 58,474 $MTCO_2e$ per year, consistent with the County's growth. Table 31 shows the forecasted emissions from the off-road vehicles sector by equipment type for 2014, 2020, 2030, and 2050.

Table 31 Unincorporated Napa County Off-Road Vehicles Emissions Forecasts (2014-2050) ($MTCO_2e$/yr)

Equipment Type	2014	2020	2030	2050
Pleasure Craft	31,440	33,736	37,562	45,258
Construction and Mining Equipment	6,575	6,766	7,085	7,712
Transport Refrigeration Units	1,420	1,461	1,530	1,666
Industrial Equipment	1,212	1,247	1,306	1,422
Light Commercial Equipment	899	925	969	1,054
Lawn and Garden Equipment	568	610	679	818
Recreational Equipment	325	349	389	468
Oil Drilling	34	35	37	40
Locomotives	20	20	20	20
Entertainment Equipment	14	15	16	17
Railyard Operations	0	0	0	0
Total	**42,508**	**45,164**	**49,592**	**58,474**
Percent Change from 2014 (%)	0	6%	17%	38%

Note: $MTCO_2e$ = metric tons of CO_2 equivalent

Source: Ascent Environmental, 2016

Forecasted emissions from the off-road vehicle are based on MTC's forecasted changes in employment and population. Although OFFROAD 2007 incorporates regulatory actions such as reformulated fuels and more stringent emissions standards, the model was also developed before the recession and has population forecasts that would not be consistent with current estimates from the MTC. As such, current off-road emission factors are assumed to stay constant into the future and total emissions are scaled by either job or population growth depending on the off-road vehicle type. Table 32 summarizes the methods used to forecast emissions from land use change.

Table 32 Off-Road Vehicles Emissions Forecast Method Summary

Source	Forecast Methods	
	Scaling Factors	Applied Legislative Reductions
Pleasure Craft	Scaled by population	No additional legislative reductions.
Construction and Mining Equipment	Scaled by employment	No additional legislative reductions.
Transport Refrigeration Units	Scaled by employment	No additional legislative reductions.
Industrial Equipment	Scaled by employment	No additional legislative reductions.
Light Commercial Equipment	Scaled by employment	No additional legislative reductions.
Lawn and Garden Equipment	Scaled by population	No additional legislative reductions.
Recreational Equipment	Scaled by population	No additional legislative reductions.
Oil Drilling	Scaled by employment	No additional legislative reductions.
Locomotives[1]	Not scaled	No additional legislative reductions.
Entertainment Equipment	Scaled by employment	No additional legislative reductions.
Railyard Operations	Scaled by employment	No additional legislative reductions.

Note:

[1] Locomotives are not included in OFFROAD2007 and were calculated separately based on data from Napa Valley Wine Train.

Source: Ascent Environmental, 2016

2.6 AGRICULTURE

Between 2014 and 2050, emissions associated with land use change in the unincorporated County would increase by 10 percent from 52,198 to 57,445 $MTCO_2e$ per year. Table 33 shows the forecasted emissions from the agriculture sector by source for 2014, 2020, 2030, and 2050.

Table 33 Unincorporated Napa County Agriculture Emissions Forecasts (2014-2050) ($MTCO_2e$/yr)

Source	2014	2020	2030	2050
Soil Management	3,797	3,889	4,108	4,606
Livestock	15,174	14,600	13,527	12,533
Farm Equipment	33,228	34,032	35,953	40,307
Total	**52,198**	**52,521**	**53,588**	**57,445**
Percent Change from 2014 (%)	0	1	3	10

Note: $MTCO_2e$ = metric tons of CO_2 equivalent

Source: Ascent Environmental, 2016

Forecasted emissions from the agricultural sector are based on the County's forecasted changes in agricultural acreages from the County. Agricultural emissions are directly scaled by the anticipated change in acreages, shown in Table 33. Table 34 summarizes the methods used to forecast emissions from agriculture.

Table 34 Agriculture Emissions Forecast Method Summary

Source	Forecast Methods	
	Scaling Factors	Applied Legislative Reductions
Soil Management	Scaled by change in all cropland including vineyards as provided by the County.	
Livestock	Scaled by change in rangeland forecasts as provided by the County from 2005 through 2030 and 2050 changes in rangeland extrapolated from anticipated growth between 2005 and 2030.	
Farm Equipment	Scaled by change in all cropland including vineyards	Scaled by change in all cropland including vineyards

Source: Ascent Environmental, 2016

2.7 HIGH-GWP GASES

Between 2014 and 2050, high-GWP emissions in the unincorporated County would increase by 18 percent from 13,481 to 15,867 $MTCO_2e$ per year, with legislative adjustments and growth in unincorporated County's population and employment levels. Table 35 shows the forecasted emissions from the high-GWP sector by gas for 2014, 2020, 2030, and 2050.

Table 35 Unincorporated Napa County High-GWP Emissions Forecasts (2014-2050) ($MTCO_2e$/yr)

High-GWP Gas	2014	2020	2030	2050
HFC-125	3,402	2,608	2,903	3,498
HFC-134a	5,805	6,229	6,935	8,356
HFC-143a	2,422	1,454	1,618	1,950
HFC-152a	362	388	432	521
HFC-227ea	134	112	124	150
HFC-236fa	68	19	21	25
HFC-245fa	343	368	410	494
HFC-32	325	348	388	467
HFC-365mfc	0	0	0	0
HFC-43-10mee	21	22	25	30
PFC-14	2	1	1	1
Other PFC and PFE	2	0	1	1
SF_6	389	255	284	342
S_2O_2	207	24	27	33
Total	**13,481**	**11,828**	**13,169**	**15,867**
Percent Change from 2014 (%)	0	-12	-2	18

Notes: $MTCO_2e$ = metric tons of CO_2 equivalent, GWP = global warming potential, HFC = hydrofluorocarbon, PFC = perfluorocarbon, PFE = perfluorocarbon ethers, SF_6= sulfur hexafluoride, S_2O_2 = sulfuryl fluoride

Source: Ascent Environmental, 2016

A few current and potential policies could affect emissions of high-GWP gases included in this sector. At the federal level, effective on August 15, 2015, the EPA enacted a national ban on a variety of HFC emissions with very high-GWP values (many over 2,500) under 40 CFR Part 82. ARB estimates that this ban would reduce California's HFC emissions by ten percent annually below current emission rates by 2025 (ARB 2015c: 58). At the State level, ARB's current program in reducing fluorinated gases (F-gases), including HFCs, is the Refrigerant Management Program. This program requires facilities with refrigeration systems to inspect and repair leaks, maintain service records, and in some cases, report refrigerant use (ARB 2015c: 58). ARB is also considering additional reduction measures to reduce high-GWP gases in the state. ARB developed a draft paper in September 2015 that addresses the State's strategy to reduce emissions of short-lived climate pollutants, including F-gases. The draft strategy estimates that the additional State reduction measures could reduce F-gases by 40 percent below forecasted 2030 emissions that take into account current federal and State regulations (ARB 2015c). ARB is also considering developing regulatory requirements to use refrigerants with GWP values less than 150 in new commercial refrigeration systems no later than 2025.

Despite the State's proposed strategies, reduction targets for F-gases have not yet been adopted. Thus, the BAU forecast for this sector only applies EPA's current ban and assumes the ban would stay in place through 2050. However, it is speculative as to what gases would be used to replace the banned high-GWP gases. For the sake of simplifying calculations, it is assumed that high-GWP gases used in the County in future years would have GWP values of no more than 2,500 and overall gas usage would grow proportionally with population.

Table 36 summarizes the scaling factors and legislative reductions used to forecast high-GWP emissions by activity.

Table 36 High-GWP Emissions Forecast Method Summary

Source	Forecast Methods	
	Scaling Factors	Applied Legislative Reductions
All High-GWP Gases	Scaled by population	Assumes federal ban on refrigerants with GWP higher than 2,500. Assumes that refrigerants would have a GWP no higher than 2,500 starting from 2020.

Notes: GWP = global warming potential

Source: Ascent Environmental, 2016

2.8 LAND USE CHANGE FORECASTS

Between 2014 and 2050, emissions associated with land use change in the unincorporated County would increase by 182 percent from 7,684 to 21,699 $MTCO_2e$ per year, accounting for the build out of the County anticipated under the County's current General Plan. This increase in emissions is considerably higher than other sectors and is primarily due to forecasted land use changes under the General Plan. This method is more accurate than scaling changes by historical trends or population. Table 37 shows the forecasted emissions from the land use change waste sector by land use type for 2014, 2020, 2030, and 2050.

Table 37 Unincorporated Napa County Land Use Change Emissions[1] Forecasts (2014-2050) ($MTCO_2e$/yr)

Land Use Type	2014	2020	2030	2050
Coniferous Forest	669	10,602	965	3,943
Croplands (Not Vineyards)[2]	1,508	1,508	1,508	1,508
Grasslands	272	3,394	1,629	1,440
Oak Woodlands	4,452	12,155	7,510	10,089
Riparian Woodlands	494	559	669	888
Shrublands	973	9,212	7,791	5,348
Vineyards	-684	-1,823	-1,835	-1,547
Total	**7,684**	**35,608**	**18,239**	**21,669**
Percent Change from 2014 (%)	0	363	137	182

Notes: $MTCO_2e$ = metric tons of CO_2 equivalent

[1] "Emissions" refers to the lost carbon sequestration or stored carbon associated with land use change.

Source: Ascent Environmental, 2016

The emissions forecasting method for the land use change sector differs somewhat from the land use change inventory method. As in the inventory, the methods used for land use change emissions forecasts account for annual net changes in carbon storage. However, the land use change forecast method differs from the inventory method in that it accounts for the cumulative effect of lost sequestration potential from the net losses in vegetation since 2014, the baseline inventory year. For example, removing a 40-year old tree that can live for 100 years removes the potential annual carbon sequestration that would occur for another 60 years if the tree is not removed. Over time, as the total number of trees decline, fewer trees sequester carbon; thus, the effect of land use change over time is cumulative. This cumulative lost sequestration potential is not applied to other smaller vegetation types that have much shorter lifetimes, such as grasslands and croplands. These vegetation types are assumed to have lifespans of one year or less and, at the end of their lives, would naturally release sequestered carbon through decomposition or consumption.[3]

Fundamentally, emissions forecasts from land use change are based on anticipated land use changes and associated land cover types under buildout of the County's 2008 General Plan. Guided by the General Plan, the County provided acreage forecasts of anticipated conversions of natural lands to vineyards or urban uses from 2005 to 2020 and 2030, as shown in Table 38.

[3] In the previous April 2016 version of this memorandum, land use change forecasts were based on year-to-year changes in carbon storage and carbon sequestration. It did not account for annual sequestration losses from a cumulative loss of trees. The revised method in the current version would result in increasing "emissions" from this sector further into the future as more forest lands and woodlands are converted to vineyards.

Table 38 Projected Acres of Vineyard Development by Lost Land Cover Type in Unincorporated Napa County, 2005-2020 and 2005-2030

Land Cover Type	2005 - 2020	2005 - 2030
Forest	319	322
Woodland	778	1,217
Shrub	1,188	2,847
Grassland	2,097	3,832
Wetland	21	75
Other	104	281
Total	**4,507**	**8,574**

Note: As a conservative assumption, woodland is assumed to refer to oak woodlands.

Source: Hade, pers. comm., 2015

Using the data provided in Table 38 above, an estimate of forecasted changes in land use by land cover type was developed for 2020 and 2030 and extrapolated for 2050. For land use types not included in Table 38, land use forecasts were based on historical trends between 2005 and 2015, shown in Table 15. Land use forecasts for 2020, 2030, and 2050 for each land use type is shown in Table 39 below.

Table 39 Forecasted Acres of Land Cover in Unincorporated Napa County by Type and Year

Land Cover Type	2020	2030	2050[1]
Grasslands	46,747	45,012	41,946
Chaparral / Shrublands	105,002	103,343	101,065
Oak Woodlands	159,368	158,929	157,956
Riparian Woodlands [2]	7,803	7,780	7,734
Coniferous Forests	42,150	42,147	41,889
Croplands (not vines) [2]	16,876	15,065	11,445
Vineyards	54,824	58,891	65,749
Wetlands	3,007	3,007	1,149
Rock Outcrops / Other [2]	42,152	44,856	50,263
Developed Areas [2]	28,383	28,226	27,912
Total	**506,311**	**507,255**	**507,109**

Notes: Unless otherwise noted, forecasted land uses were based on data provided in Table 38 which was added to the 2005 values shown in Table 15.

[1] All 2050 values were extrapolated from trends between 2020 and 2030.

[2] Values extrapolated from trends between 2005 and 2015, as shown in Table 15.

Source: Ascent Environmental 2016

Future emissions from land use change for each milestone year was estimated by summing for each land use type 1) the year-to-year carbon storage losses and 2) year-to-year carbon sequestration losses from non-forest land uses or cumulative carbon sequestration losses from forest/woodland land lost between 2014 and the milestone year. The per-acre carbon storage and sequestration rates are the same as the ones used in the inventory (see Table 16). Table 40, below, shows the forecasted annual and cumulative acreage and tree losses alongside the estimated net losses in carbon storage and cumulative sequestration potential.

Table 40 Unincorporated Napa County GHG Inventory: Lost Carbon Stock and Sequestration Potential from Land Use Change in 2020, 2030, and 2050

Land Use Type[1]	Change in acres from previous year	Change in acres (number of trees) since 2014	Lost carbon storage due to land use change from previous year (MT CO_2)	Loss in annual carbon sequestration potential (MT CO_2)	Total net emissions (MT CO_2)
2020					
Coniferous Forest	-56	-289 (-40,134)	9,699	903	10,602
Croplands (Not Vineyards)[2]	-181	-1,267 (0) [3]	1,455	54	1,508
Grasslands	-361	-1,865 (0) [3]	3,394	0	3,394
Oak Woodlands	-87	-504 (-76,527)	11,138	1,017	12,155
Riparian Woodlands	-2	-16 (-3,547)	483	77	559
Shrublands	-196	-1,022 (0) [3]	9,212	0	9,212
Vineyards	404	2,933 (0) [3]	-1,799	-24	-1,823
Total	**-480**	**-2,031 (-120,208)**	**33,581**	**2,026**	**35,608**
2030					
Coniferous Forest	0	-292 (-40,555)	52	913	965
Croplands (Not Vineyards)[2]	-181	-3,077 (0) [3]	1,455	54	1,508
Grasslands	-174	-3,600 (0) [3]	1,629	0	1,629
Oak Woodlands	-44	-942 (-143,119)	5,609	1,901	7,510
Riparian Woodlands	-2	-39 (-8,614)	483	186	669
Shrublands	-166	-2,682 (0) [3]	7,791	0	7,791
Vineyards	407	6,999 (0) [3]	-1,810	-24	-1,835
Total	**-160**	**-3,633 (-192,287)**	**15,209**	**3,030**	**18,239**
2050					
Coniferous Forest	-13	-550 (-76,385)	2,223	1,719	3,943
Croplands (Not Vineyards)[2]	-181	-6,698 (0) [3]	1,455	54	1,508
Grasslands	-153	-6,666 (0) [3]	1,440	0	1,440
Oak Woodlands	-49	-1,916 (-290,916)	6,224	3,865	10,089
Riparian Woodlands	-2	-85 (-18,747)	483	406	888
Shrublands	-114	-4,959 (0) [3]	5,348	0	5,348
Vineyards	343	13,858 (0) [3]	-1,527	-20	-1,547
Total	**-169**	**-7,015 (-386,048)**	**15,646**	**6,023**	**21,669**

Notes: Land use change based on acreages provided by Napa County. Values may not sum due to rounding. MT = metric tons; CO_2 = carbon dioxide; GHG = greenhouse gas

[1] Developed areas, rocky outcrops, and wetlands are assumed to have no carbon storage or sequestration potential and are not included here. Carbon sequestrations and storage potential of wetlands vary greatly depending on location, ecosystem, and other factors. Factors for wetlands unique to Napa County are not available and are assumed to be zero.

[2] "Cropland (Not Vineyards)" includes the County mix of olives, vegetables, and hay as reported in the 2014 Napa County Crop Report.

[3] Cumulative acreage changes for non-forested land uses are presented for informational purposes only and are not used to quantify the change in carbon sequestration potential due to the shorter lifetimes of vegetation on these lands compared to trees.

Source: Hade, pers. comm., 2015; data compiled by Ascent Environmental, 2016.

Table 41 summarizes the methods used to forecast emissions from land use change.

Table 41	Land Use Change Emissions Forecast Method Summary
Source	**Forecast Method**
Land Use Change	Emissions forecasts are based on forecasted changes in all land use types as provided by the County. County provided forecasted land use changes for land cover types lost to vineyard development from 2005 to 2020 and 2030. County also provided 2015 land use cover estimates. Where forecast data were not available, future land cover estimates were extrapolated from available land use data between 2005 and 2015 or between 2015 and 2030. Emissions forecasts account for the cumulative effect of lost carbon sequestration potential from trees lost between 2014 and future forecasted years. Lost carbon sequestration potential from non-forested land use types and carbon storage losses are accounted for based on changes in land use from year-to-year.
Source: Ascent Environmental, 2016	

The land use change forecast method does not separately account for individual project-level losses in trees or native vegetation; however, the cumulative effect of land use changes from individual projects that are within the envelope of anticipated land use changes associated with General Plan buildout means that future project-level impacts are generally captured in the analysis.

The land use change forecast method assumes that all future development assumed under the General Plan would result in a complete loss of all existing vegetation on a typical project site. This is a conservative, worst-case assumption and differs from typical losses sustained in actual individual development projects, in which not all existing vegetation is typically permitted for removal due to open space conservation, mitigation, and buffering requirements.

2.9 DISCUSSION

As discussed above and shown in Figure 2 and Table 21, the unincorporated County's legislative-adjusted BAU emissions would decrease by 24 percent between 2014 and 2050. This reduction is a result of multiple legislative regulations, local actions, and County-level land use planning in combination with overall residential and commercial growth in the County.

Between 2014 and 2020, emissions would decrease by four percent although population would grow by about one percent during the same time. This decrease would be due to several near term legislative actions including:

- The unincorporated County's membership in MCE starting from February 2015 which provides electricity with a 50 percent renewable mix (compared to 33 percent under PG&E) by 2020,
- New 2016 Building Energy Efficiency standards, improving energy efficiency in new buildings,
- The inception of a new LFG collection facility at Potrero Hills Landfill, which take 98 percent of the unincorporated County's waste, starting in early 2016,
- Reductions in vehicle emission factors forecasted in EMFAC 2014 (e.g. fuel efficiency improvements, 2 percent EV usage by 2020), and
- Reduced carbon sequestration from forecasted reductions in forest land, oak woodlands, and shrub lands by 2020, resulting in an increase in "emissions" from land use change.

From 2020 to 2030, emissions would decrease by 28 percent below 2014 levels alongside a two percent population increase from 2014. This decrease would be due to a combination of continued and future planned legislative actions including:

- A 50 percent improvement in energy efficiency in existing buildings by 2030 as targeted under SB 350, considerably decreasing energy use in existing buildings,
- An increase in MCE's renewable mix to 80 percent by 2030, further reducing electricity related emissions,
- Non-MCE participants reaching the SB 350 schedule of meeting a 50 percent renewable mix goal by 2050 (this equates to 39 percent by 2030), and
- Reductions in vehicle emission factors forecasted in EMFAC 2014 (e.g. fuel efficiency improvements, 9 percent EV usage by 2030),

From 2030 to 2050, fewer new legislative actions are assumed to be in place, due to the lack of available information about potential State or federal actions beyond 2030. Thus, the County's population growth would begin to overtake any reductions afforded by existing legislative reductions. The main legislative reductions beyond 2030 would come from SB 350's target of a minimum 50 percent renewable mix for all electricity providers, which would apply to non-MCE participants. Other minor additional reductions would be in forecasted improvements in vehicle fuel economy and increased VMT share of EVs (10 percent by 2050), as estimated in the EMFAC2014 model. Other previous legislative actions would continue to apply into the future, but would not outpace growth in population, employment, and housing.

From the sector perspective, emissions from the on-road vehicle sector would replace building energy as the largest emissions sector in 2050, accounting for 23 percent of the County's emissions. From 2014 to 2050, building energy would transition from accounting for 31 percent of total emissions to 18 percent. Emissions from solid waste and agriculture would contribute equally to the inventory, between 13 and 16 percent per sector. Emissions from high-GWP gases, off-road equipment, and agriculture would remain steady between 2030 and 2050. Emissions from lost carbon sequestration would peak in 2020 due to forecasted land use changes by 2020 as natural land cover types would be converted to vineyards. Land use changes after 2020 would be more gradual, but the cumulative effect of lost trees over time tends to increase emissions from this sector. Thus, future legislative-adjusted BAU emissions would decrease through 2050, even though total population would increase by 23 percent between 2014 and 2050.

REFERENCES

ARB. *See* California Air Resources Board.

Battles. J., P. Gonzales, T. Robards, B. Collins, D. Shah. 2014 (January). *California Forest and Rangeland Greenhouse Gas Inventory Development*. Final Report. Revised January 30, 2014. Available: http://www.arb.ca.gov/cc/inventory/pubs/battles%20final%20report%2030jan14.pdf. Accessed October 20, 2015.

Bay Area Air Quality Management District. 2014 (April). Base Year 2011 Emission Inventory Source Category Methodologies. Prepared by Emissions Inventory and Exposure Assessment Section. San Francisco, CA. Available: http://www.baaqmd.gov/research-and-data/emission-inventory/maps-data-and-documents. Accessed April 5, 2016.

BAAQMD. *See* Bay Area Air Quality Management District.

Brown. S., T. Pearson, A. Dushku, J. Kadyzewski and Y. Qi. 2004. Baseline Greenhouse Gas Emissions for Forest, Range and Agricultural Lands in California. CEC-500-04-069F. Prepared for the California Energy Commission by Winrock International.

California Air Resources Board. 2003. Fuel Consumption Methodologies for Agricultural Irrigation Engines (category 052042-12000000). Available at: http://www.arb.ca.gov/ei/areasrc/FULLPDF/FULL1-1.pdf. Accessed October 27, 2015.

______. 2006. Rulemaking to Consider Proposed Amendments to the Stationary Diesel Engine Control Measure - Appendix D: Emission Inventory Methodology Agricultural Irrigation Pumps - Diesel. Available at: http://www.arb.ca.gov/regact/agen06/append.pdf. Table 2. Accessed January 13, 2016.

______. 2008 Greenhouse Gas Emissions Inventory: Agriculture and Forestry. Ag Residue Burned.

______. 2010. *Appendix D: OSM and Summary of Off-Road Emissions Inventory Update.* Available: http://www.arb.ca.gov/regact/2010/offroadlsi10/offroadappd.pdf. Accessed December 1, 2015.

______. 2014a. *California's 2000-2012. Greenhouse Gas Emissions Inventory. Technical Support Document*. 2014 Edition. Available: http://www.arb.ca.gov/cc/inventory/doc/methods_00-12/ghg_inventory_00-12_technical_support_document.pdf. Accessed January 12, 2016.

______. 2014b. *In-Use Off-Road Diesel Vehicle Regulation Overview.* Revised February 2014. Available: http://www.arb.ca.gov/msprog/ordiesel/faq/overview_fact_sheet_dec_2010-final.pdf. Accessed January 13, 2016.

______. 2015a. Mobile Source Emissions Inventory – Categories. Available: http://www.arb.ca.gov/msei/categories.htm. Accessed January 13, 2016. Last Updated November 17, 2015.

______. 2015b. California Greenhouse Gas Emissions Inventory – 2015 Edition. Available: http://www.arb.ca.gov/cc/inventory/data/data.htm. Accessed January 13, 2016.

______. 2015c (September). *Draft Short-Lived Climate Pollutant Reduction Strategy.* Available: http://www.arb.ca.gov/cc/shortlived/2015draft.pdf. Accessed January 26, 2016.

California Department of Finance. 2015. *E-5 Population and Housing Estimates for Cities, Counties, and the State.* Available: http://www.dof.ca.gov/research/demographic/reports/estimates/e-5/2011-20/view.php. Accessed December 10, 2015.

California Employment Development Department. 2015 (March). *Monthly Labor Force Data for Cities and Census Designated Places (CDP). Annual Average 2014 – Revised.* Available: http://www.labormarketinfo.edd.ca.gov/data/monthly-data-release.html. Accessed December 28, 2015.

California Energy Commission. 2006 (December). *Refining Estimates of Water-Related Energy Use In California*. CEC-500-2006-118 Public Interest Energy Research Program. Prepared by Navigant Consulting. December 2006. Available: http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF. Accessed January 13, 2016.

______. 2015. 2016 Building Energy Efficiency Standards. Frequently Asked Questions. Available: http://www.energy.ca.gov/title24/2016standards/rulemaking/documents/2016_Building_Energy_Efficiency_Standards_FAQ.pdf. Accessed January 26, 2016.

California Department of Pesticide Regulation. 2013. 2013 Annual Pesticide Use Report Indexed by Chemical. Napa County. Available: http://www.cdpr.ca.gov/docs/pur/pur13rep/chemcnty/napa13_ai.pdf. Accessed October 5, 2015.

California Department of Resources Recycling and Recovery. 2010 (May). Diversion Study Guide, Appendix I. Conversion Factors: Organics. Available: http://www.calrecycle.ca.gov/lgcentral/library/dsg/IOrganic.htm. Accessed April 5, 2016. Last Updated May 6, 2010.

______. 2012 (May). *California's New Goal: 75% Recycling.* May 9, 2012.

______. 2015. Disposal Reporting System. Available: http://www.calrecycle.ca.gov/lgcentral/drs/. Accessed. October 19, 2015.

California Department of Transportation. 2014 (November). California Public 2013 Road Data. Statistical Information Derived from the Highway Performance Monitoring System.

______. 2016. Truck Traffic (Annual Average Daily Truck Traffic on California State Highways). Available: http://traffic-counts.dot.ca.gov/#vmt and http://traffic-counts.dot.ca.gov/docs/2014_aadt_truck.pdf. Accessed March 29, 2016.

Caltrans. *See* California Department of Transportation.

CalRecycle. *See* California Department of Resources Recycling and Recovery.

The Climate Registry. 2014 (April). *2014 Climate Registry Default Emission Factors.* Available: http://www.theclimateregistry.org/wp-content/uploads/2014/11/2014-Climate-Registry-Default-Emissions-Factors.pdf. Accessed: February 19, 2015.

Center for Urban Forestry Research. 2009. CUFR Tree Carbon Calculator. Developed by the Center for Urban Forest Research. Pacific Southwest Research Station. U.S. Forest Service. In partnership with the California Department of Forestry and Fire Protection. Available: http://www.fs.usda.gov/ccrc/tools/tree-carbon-calculator-ctcc. Accessed August 15, 2016.

City of Napa. 2015 (September). Bulk Water Sales Outside City Limits. City Council staff report from Jacques R. LaRochelle, Public Works Director, to Mayor and Members of City Council. Prepared by Phil Brun, Deputy Director of Public Works (Operations). September 15, 2015. Napa, CA.

County of Napa. 2012 (March). Napa County Climate Action Plan. Napa, CA. Prepared by ICF International. Sacramento, CA.

______. 2015a (March). Winery Database. March 2015. Available: http://www.countyofnapa.org/WorkArea/DownloadAsset.aspx?id=4294983283. Accessed December 10, 2015.

______. 2015b (May). *2014 Agricultural Crop Report.* May 12, 2015. Napa, CA.

______. 2016 (March). *Final Environmental Impact Report: Walt Ranch Erosion Control Plan. Volume I - Responses to Comments.* Application No. P11-00205-ECPA. Planning, Building and Environmental Services. Napa, CA.

CUFR. *See* Center for Urban Forestry Research.

DOF. *See* California Department of Finance.

DPR. *See* California Department of Pesticide Regulation.

EDD. *See* California Employment Development Department.

Gaman, T., and Firman, J. 2008. *Oaks 2040: carbon resources in California oak woodland*s. Oakland, Calif, California Oak Foundation.

ICLEI. *See* International Council for Local Environmental Initiatives.

IPCC. *See* Intergovernmental Panel on Climate Change.

International Council for Local Environmental Initiatives-Local Governments for Sustainability USA. 2012 (October). *U.S. Community Protocol for Accounting and Reporting of GHG Emissions*. Version 1.0. Available: http://icleiusa.org/ghg-protocols/. Accessed October 4, 2012.

Intergovernmental Panel on Climate Change. 2000. *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. N_2O: Direct Emissions from Agricultural Soils.* Available: http://www.ipcc-nggip.iges.or.jp/public/gp/bgp/4_5_N2O_Agricultural_Soils.pdf. Accessed January 13, 2016.

______. 2006a. Volume 4: Agriculture, Forestry and Other Land Use. In: *2006 IPCC Guidelines for National Greenhouse Gas Inventories.* Available: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html. Accessed: August 15, 2016.

______. 2006b. Volume 5: Waste. In: *2006 IPCC Guidelines for National Greenhouse Gas Inventories.* Available: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html. Accessed: January 13, 2016.

______. 2007 (February). *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the IPCC. Geneva, Switzerland

______. 2013. Fifth Assessment Report. Chapter 8, Anthropogenic and Natural Radiative Forcing. Available: < http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf >. Accessed: March 20, 2015.

Kroodsma, D. A., and Field, C. B. 2006. *Carbon Sequestration in California Agriculture, 1980 – 2000*. Ecological Applications. 16, 1975-1985.

Liang, J., J. Buongiorno, and R.A. Monserud. 2005 (June). Estimation and application of a growth and yield model for uneven-aged mixed conifer stands in California. In *International Forestry Review*, Volume 7, Number 2, 101-112. ResearchGate.

Marin Clean Energy. 2015a. Opt Out to Choose PG&E Service. Available: http://mcecleanenergy.org/opt-out/. Accessed January 26, 2016.

______. 2015b (October). *Marin Clean Energy – Integrated Resource Plan: 2015 Update.* Available: http://mcecleanenergy.org/wp-content/uploads/2016/01/Marin-Clean-Energy-2015-Integrated-Resource-Plan_FINAL-BOARD-APPROVED.pdf. Accessed January 26, 2016.

Mühle, J., et al. (2009). *Sulfuryl fluoride in the global atmosphere.* Journal of Geophysical Research: Atmospheres. 114.

Napa County. *See* County of Napa.

Napa San. *See* Napa Sanitation District.

Napa Sanitation District. 2009 (October). *Winery Waste Management – Technical Memorandum.* Prepared by Oakley Water Strategies. October 23, 2009.

Napa Valley Wine Train. Our Train. Available: http://winetrain.com/train/. Accessed October 13, 2015.

Pacific Gas & Electric. 2015a. PG&E Corporate Responsibility and Sustainability Report 2015. Available: http://www.pgecorp.com/corp_responsibility/reports/2015/bu06_renewable_energy.jsp. Accessed January 25, 2016.

______. 2015b (November). *Greenhouse Gas Emission Factors: Guidance for PG&E Customers*. November 2015. Available: https://www.pge.com/includes/docs/pdfs/shared/environment/calculator/pge_ghg_emission_factor_info_sheet.pdf. Accessed January 13, 2016.

PG&E. *See* Pacific Gas & Electric.

Proietti, S., Sdringola, P., Desideri, U., Zepparelli, F., Brunori, A., Ilarioni, L., Nasini, L., Regni, L., & Proietti, P. 2014. *Carbon footprint of an olive tree grove*. Applied Energy. 127, 115-124.

TCR. *See* The Climate Registry.

U.S. EPA. *See* U.S. Environmental Protection Agency.

USDA. See U.S. Department of Agriculture

U.S. Department of Agriculture. 2005 (February). *Oak Woodlands and Other Hardwood Forests of California, 1990s.* Forest Service. Pacific Northwest Research Station. Resource Bulletin. Prepared by K.L. Waddell and T.M. Barrett, Portland, OR.

U.S. Environmental Protection Agency. 2014 (February). eGRID 9th edition Version 1.0 Year 2010 Summary Tables. Available: http://www.epa.gov/cleanenergy/documents/egridzips/eGRID_9th_edition_V10_year_2010_Summary_Tables.pdf. Accessed: February 19, 2015.

______. 2015a. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2013.* Washington, DC. April 15, 2015. http://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2015-Chapter-7-Waste.pdf. Accessed January 13, 2016.

______. 2015b. EPA Facility Level Information on Greenhouse Gases Tool. Available: http://ghgdata.epa.gov/ghgp/main.do. Accessed October 19, 2015.

______. 2015c. Landfill CH_4 Outreach Program. Energy Projects and Candidate Landfills. Available: http://www3.epa.gov/lmop/projectscandidates/index.html#maparea. Accessed October 19, 2015.

U.S. Department of Energy. 2014 (October). Alternative Fuels Data Center – Fuel Properties Comparison. Available: http://www.afdc.energy.gov/fuels/fuel_comparison_chart.pdf. Accessed October 12, 2015.

PERSONAL COMMUNICATIONS

Bear, Greg. City of American Canyon. Development Services Engineer. Public Works Department. October 9, 2015. Email to Jason Hade of Napa County with spreadsheet attachments with water conveyed to the unincorporated County.

Brazil, Harold. Metropolitan Transportation Commission. Planner. January 14, 2016. Email to Brenda Hom of Ascent Environmental regarding demographic forecast data and revised VMT data for Napa County. February 2, 2016. Email to Brenda Hom of Ascent Environmental regarding Caltrans resources to scale boundary-based commercial VMT to RTAC-based commercial VMT.

Choi, Ben. Marin Clean Energy. Account Manager. January 25, 2016. Call to Brenda Hom of Ascent Environmental regarding future plans of Marin Clean Energy.

Damron, Andrew. Napa Sanitation District. Capital Program Manager. November 18, 2015. Email to Brenda Hom of Ascent Environmental regarding winery wastewater treatment in Napa County.

Hade, Jason. County of Napa. Planner III. September 22, 2015. Email to Erik de Kok of Ascent Environmental with land use projections.

Harrington, Louise. City of Calistoga. Administrative Assistant. Public Works. November 13, 2015. Email to Brenda Hom of Ascent Environmental with 2014 volume of water delivered to unincorporated Napa County.

Kirn, Michael. City of Calistoga. Acting City Manager/Public Works Director. November 17, 2015. Email to Brenda Hom of Ascent Environmental regarding Marin Clean Energy enrollment.

Lamborn, Matthew. County of Napa. Planner III/GIS. September 4L, 2015. Email to Erik de Kok of Ascent Environmental via Jason Hade of Napa County with land use change estimates for Napa County.

Moore, Don. Town of Yountville. Utility Operations Manager. October 26, 2015. Email to Jason Hade of Napa County with 2013 and 2014 volume of water delivered to unincorporated Napa County.

Novi, Michelle. Napa Valley Vintners. Industry Relations Manager. November 18, 2015. Email to Brenda Hom of Ascent Environmental regarding winery case production in Napa County.

Pham, Danny. East Bay Municipal Utility District. Recovery Program at EBMUD. November 23, 2015. Email to Brenda Hom of Ascent Environmental regarding winery wastewater received from Napa County in 2014.

Reed, Rochelle. Bay Area Air Quality Management District. Public Records. April 5, 2016. Email to Brenda Hom of Ascent Environmental with 2014 open burning permit data and emissions inventory methods recommendations.

Tuell, Jennifer. City of St. Helena. Water Conservation. November 24, 2015. Email to Jason Hade of Napa County and Brenda Hom of Ascent Environmental with 2013 and 2014 volume of water delivered to unincorporated Napa County.

Appendix B

Technical Memo #2 - Greenhouse Gas Emissions Reduction Targets and Gap Analysis

Memo

455 Capitol Mall, Suite 300
Sacramento, CA 95814
916.444-7301

Date: July 12, 2018

To: David Morrison, Jason Hade (County of Napa)

From: Honey Walters, Erik de Kok, Brenda Hom

Subject: Napa County Climate Action Plan – Revised Technical Memorandum #2: Greenhouse Gas Emissions Reduction Targets, Measures, and Gap Analysis

INTRODUCTION

This technical memorandum summarizes the results of the quantitative GHG reduction measures "gap analysis" process for the Napa County Climate Action Plan (CAP). This version of the memo includes revisions to GHG reduction measures since the initial gap analysis results were reported in December 2016 and published in the Draft CAP document circulated for public review in 2017, revisions to greenhouse gas (GHG) reduction measures that were incorporated into the Final CAP based on comments from the public and County staff, and additional revisions to GHG reduction measures proposed by staff in 2018.

The purpose of the gap analysis is two-fold: 1.) to ensure that all GHG-reducing actions to be incorporated in the CAP will set the community on course to meet the County's proposed GHG reduction targets; and 2.) to ensure that specific actions and associated GHG emissions reduction calculations are defensible and appropriate for the purposes of California Environmental Quality Act (CEQA) streamlining benefits for proposed projects in the future.

The gap analysis process accounts for several steps in the climate action planning process, which are listed below and addressed in subsequent sections.

1. Summary of 2014 community-wide GHG emissions inventory;
2. Summary of the GHG emissions projections for 2020, 2030 and 2050;
3. Identification and evaluation of recommended GHG emissions reduction targets for 2020 and 2030, as well as a long-term goal for 2050; and,
4. Quantification of GHG emissions reductions and evaluation of the calculated gap between the estimated GHG reductions and the recommended targets.

In addition to the quantitative GHG analysis, we qualitatively addressed the proposed GHG measures in terms of potential environmental co-benefits, cost/benefit and economic impacts, and administrative feasibility.

GREENHOUSE GAS EMISSIONS INVENTORY

The baseline GHG emissions inventory for the year 2014 includes emissions from community-wide sources in the unincorporated County. The purpose of the baseline inventory is to gain an understanding of the sources and levels of GHG emissions within a jurisdiction, as well as to establish a level of GHG emissions against which future GHG emissions can be compared. The 2014 GHG emissions inventory is summarized below in Table 1. Total emissions from all sectors in the 2014 inventory were 484,602 metric tons of carbon dioxide equivalent ($MTCO_2e$) emissions. The 2014 inventory updates a previous baseline inventory for the year 2005 and includes new emissions sources and accounts for new data sources, calculation methodologies, and an updated set of global warming potential (GWP) factors.

Further details with respect to the 2014 inventory are discussed in the Revised Final Technical Memorandum #1 to the County, dated August 25, 2016, found in Appendix A of the CAP.

Table 1 2014 Unincorporated Napa County Greenhouse Gas Emissions Inventory

Sectors	2014[1] ($MTCO_2e$/yr)
Building Energy Use	148,338
On-Road Vehicles	125,711
Solid Waste	83,086
Agriculture	52,198
Off-Road Vehicles	42,508
High GWP Gases	13,481
Wastewater	11,189
Land Use Change	7,684
Imported Water Conveyance	88
Total	**484,283**

Notes: Columns may not add to totals due to rounding.

MTCO2e = metric tons of carbon dioxide equivalent; GWP = Global Warming Potential; IPCC = Intergovernmental Panel on Climate Change

1. Uses GWP factors from IPCC's Fourth Assessment Report.

Source: Data compiled by Ascent Environmental in 2016. See Revised Final Tech. Memo #1, August 25, 2016.

Greenhouse Gas Emissions Projections

GHG emissions projections for a community are used to estimate future levels in the absence of climate action measures. Emissions projections were prepared for both "business-as-usual" (BAU) and legislative-adjusted BAU scenarios for 2020, 2030, and 2050. BAU projections were based on population, housing, and employment growth anticipated in the unincorporated County as forecasted by the Metropolitan Transportation Commission (MTC), assuming no actions would be taken to reduce emissions by Federal, State or local agencies pursuant to Assembly Bill (AB) 32 or other legislation. The BAU projections represent theoretical "worst-case" future conditions, while the legislative-adjusted forecast accounts for future emissions reductions pursuant to AB 32 and other legislation in California from a variety of regulations and programs, including the Renewable Portfolio Standard (RPS), improving vehicle fuel economy standards due to Advanced Clean Cars, and other State and Federal policies.

The legislative-adjusted BAU forecast for community-wide GHG emissions are summarized below in Table 2. Under the legislative-adjusted BAU scenario, community-wide GHG emissions are projected to decrease by approximately 4 percent by 2020, 28 percent by 2030, and 24 percent by 2050 for the unincorporated Napa County compared to 2014 emissions.

Further details with respect to the GHG emissions projections are discussed in the Revised Final Technical Memorandum #1, dated August 25, 2016, found in Appendix A of the CAP.

Table 2 Unincorporated Napa County Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/yr)

Sector and Subsector	2014	2020	2030	2050
Energy	148,338	131,643	59,150	66,184
Transportation	125,711	112,854	84,845	85,735
Waste	83,086	62,345	56,711	48,854
Agriculture	52,198	52,521	53,589	57,446
Off-Road Vehicles and Equipment	42,508	45,164	49,592	58,474
High-GWP Gases	13,481	11,828	13,169	15,867
Water and Wastewater	11,277	11,858	12,959	14,335
Land Use Change	7,684	35,608[1]	18,239	21,669
Total	**484,283**	**463,821**	**348,253**	**369,563**
Percent change from 2014 (%)	**NA**	**-4**	**-28**	**-24**

Notes: Columns may not add to totals due to rounding.

BAU = Business as usual; NA = Not Applicable; GWP = Global Warming Potential; MTCO2e = metric tons of carbon dioxide equivalent

1. The large increase in land use change "emissions" is due to sequestration and carbon storage losses associated with land use forecasts from the County that show a high rate of land use change between 2015 and 2020 compared to other years.

Source: Ascent Environmental, 2016

GREENHOUSE GAS EMISSIONS REDUCTION TARGETS

As directed in AB 32, SB 32, Executive Order (EO) B-30-15, and EO S-3-05, the State aims to reduce annual GHG emissions to:

- 1990 levels by 2020;
- 40 percent below 1990 levels by 2030; and
- 80 percent below 1990 levels by 2050.

To determine an equivalent reduction target at the local level, California's 2017 Climate Change Scoping Plan released by the California Air Resources Board (CARB) recommends community-wide GHG reduction goals for local climate action plans that would help the State achieve its 2030 and 2050 goals (CARB 2017). These goals consist of reducing emissions to 6 $MTCO_2e$ per capita and 2 $MTCO_2e$ per capita by 2030 and 2050, respectively. Considering the overall statewide emissions in 1990 and 2014 and the forecasted statewide population in 2030 and 2050, these per-capita goals would be equivalent to reducing 2014 emissions by 40 percent by 2030 and 77 percent by 2050 (CARB 2016b, DOF 2014). Although CARB did not recommend a similar community-level target for 2020, an equivalent target can be calculated by comparing the State's GHG inventories for 1990 and 2014. According to CARB's estimate of California's GHG inventory, the State emitted approximately 431 million $MTCO_2e$ ($MMTCO_2e$) in 1990 and 442 $MMTCO_2e$

in 2014, a 2 percent increase. Thus, the following 2020 and 2030 targets and long-term goal for 2050 would reduce annual community-wide GHG emissions in unincorporated Napa County consistent with CARB's recommended goals:

- 2 percent below 2014 levels by 2020;
- 40 percent below 2014 levels by 2030; and
- 77 percent below 2014 levels by 2050.

Specific assumptions and calculations for these adjusted targets are available in Attachment 1.

Based on the County's 2014 inventory shown in Table 1, the targets and long-term goal above aim to reduce annual County emissions to 474,598, 290,570, and 111,385 $MTCO_2e$ by 2020, 2030, and 2050, respectively. As shown in Figure 1, the County is already meeting the 2020 target due to existing legislative actions but would require significant additional GHG reductions to meet the 2030 and 2050 targets. The County would need to reduce annual legislative-adjusted BAU 2030 emissions by 57,683 $MTCO_2e$ (17 percent). However, meeting the long-term 2050 goal would require annual emissions reduction of 258,178 $MTCO_2e$, or 70 percent, beyond the effect of current legislative reductions.

The recommended targets, along with estimated reductions required to achieve the targets, are summarized below in Table 3.

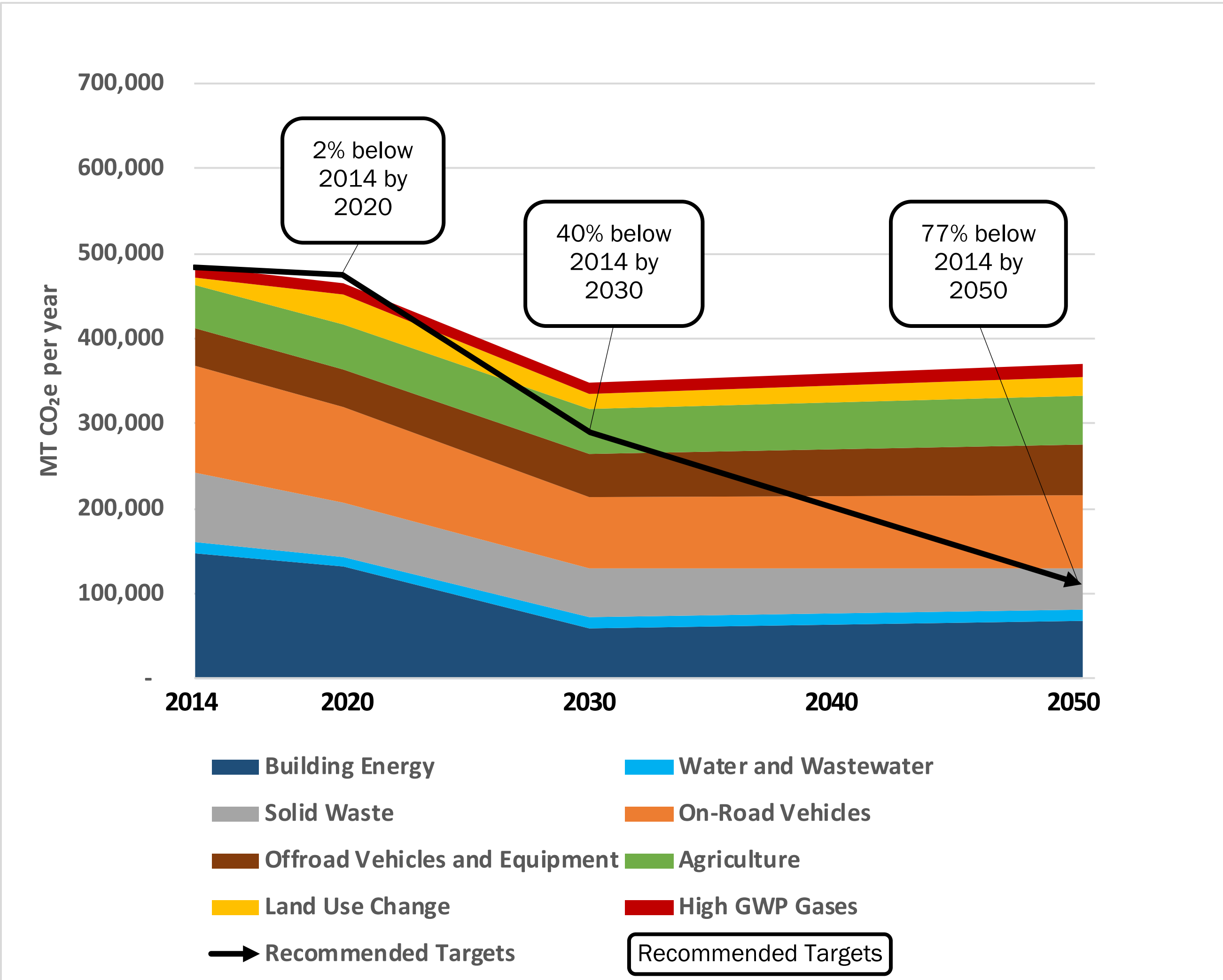
Table 3 Recommended Greenhouse Gas Emissions Reduction Targets: 2020, 2030, and 2050

Scenario or Target	2014	2020	2030	2050
Baseline and Projections				
2014 Baseline GHG Inventory ($MTCO_2e$)	484,283	NA	NA	NA
Legislative-Adjusted BAU Forecast ($MTCO_2e$)	NA	463,821	348,253	369,563
Legislative-Adjusted BAU Forecast: Percent below Baseline (%)	NA	4	28	24
Targets				
Target Percent Reduction below Baseline (%)	NA	2	40	77
Target Annual Emissions ($MTCO_2e$)	NA	474,598	290,570	111,385
Gap Analysis				
Reduction from Baseline needed to meet Target ($MTCO_2e$)	NA	9,686	193,713	372,898
Reduction from Legislative-Adjusted BAU needed to meet Target ($MTCO_2e$)	NA	0	57,683	258,178
Additional Percent Reduction below Legislative-Adjusted BAU needed to meet Target (%)[1]	NA	0	17	70

Notes: BAU = Business as usual, $MTCO_2e$ = metric tons of carbon dioxide equivalent, GHG = greenhouse gas, NA = Not Applicable

Source: Ascent Environmental, 2016

Figure 1, below, depicts the baseline and legislative-adjusted BAU GHG emissions forecasts by sector, as distinguished by colored wedges. The sum of the wedges represents annual anticipated GHG emissions in each year. Each wedge shows how an emissions sector is expected to contribute to the County's annual inventory over time. For example, the reduction in BAU building energy emissions (dark blue wedge) between 2020 and 2030 illustrates the effect of SB 350 energy efficiency and renewable energy policies on this sector. The black line indicates the recommended GHG emissions reduction targets for 2020, 2030, and 2050. The additional reductions needed to meet the 2020 and 2030 targets to close the expected "gap" between the expected legislative-adjusted BAU emissions levels and the recommended targets are also apparent in Figure 1. With respect to emissions beyond 2030, current legislation, such as SB 350 and the Federal Corporate Average Fuel Economy (CAFE) standards, have specific targets and policies that only address activities up to the year 2030. Though advances in new technologies and policy strategies may allow for additional significant reductions in the future, legislative reductions that may occur past 2030 are currently unknown.



Notes: BAU = Business as Usual; GHG = Greenhouse Gas Emissions; MT CO_2e = metric tons of carbon dioxide equivalent
Source: Ascent Environmental, 2018

Figure 1 Legislative-Adjusted Business-as-Usual Forecast Emissions by Sector and Recommended Emissions Reduction Targets: 2020 through 2050

Greenhouse Gas Emissions Reductions and Estimated Gap

As discussed above, additional GHG reductions are needed to achieve the recommended GHG reduction targets for 2020 and 2030 and long-term 2050 goal. As a local government, the County can act to adopt or update land use plans, enforce or update County ordinances, adjust municipal operations, encourage or influence County residents and business by partnering with local organizations, and work with local and regional transportation planning or other agencies that provide services or maintain infrastructure that is not directly in the County's control. The County can effectively reduce emissions in some sectors where the

County has jurisdictional control (e.g., municipal operations, land use change), but in some cases the County has limited ability to influence reductions because the County has limited jurisdictional control (e.g., on-road transportation).

Since the original Draft and Final CAP documents were circulated for public review in 2017, Ascent worked with the County to develop a revised draft list of recommended GHG reduction measures based on the County's jurisdictional influence, public input, and other measures based on best practices. These GHG reduction measures have been reorganized into "primary" and "supporting" measure categories in the Revised Draft CAP.

Primary measures include those for which GHG reductions have been quantified and are the primary measures that the County would rely upon to meet the GHG reduction targets identified. Many of the primary measures include specific and enforceable components that could be applied to future projects seeking to tier and streamline from the CAP in the future; however, not all primary measures are regulatory in nature. Some of the primary GHG reduction measures identified that will result in quantifiable GHG reductions do not rely on County regulation. All primary GHG reduction measures were quantified wherever substantial evidence and reasonable assumptions were available to support calculations.

GHG reductions associated with the primary measures were calculated in a step-wise manner for the future years of 2020, 2030, and 2050. In other words, GHG reductions (in $MTCO_2e$/year) were assessed during a snapshot in 2020, 2030, and 2050. This is a simplified method of characterizing GHG reductions, which would more realistically occur on a continuous basis. However, a step-wise method is appropriate for a planning-level document because the County's GHG reduction targets and monitoring of CAP implementation progress would be tied to these future years.

Supporting measures are qualitative and are not identified as part of the primary set of quantifiable GHG reduction measures to meet the targets. Supporting measures are still important to include because they contribute to achieving GHG reductions and may also result in other important co-benefits. However, supporting measure are not quantifiable due to lack of available data or quantification methods, or were not quantified to avoid double-counting of GHG reductions achieved by other similar measures under the same strategy. The supporting measures could be tracked for potential quantification in the future if data and/or quantification methods become available.

Although supporting measures were not quantified, implementation of supporting measures would further reduce GHG emissions depending on a variety of factors. These factors include the level of participation from the public and other partners, potential of technological improvements to reduce emissions, and changes to the regulatory environment outside of the County.

<u>Summary of Results</u>

Estimates of GHG emissions reductions, along with an estimated emissions reduction "gap," are summarized below in Table 4 and illustrated in Figure 2. Detailed measure descriptions, calculations, and assumptions supporting the GHG reduction estimates are provided in Attachment 1.

Table 4 Summary of Greenhouse Gas Emissions Reduction Measures Performance

Measure Number	Measure Name	GHG Reductions ($MTCO_2e$/year)		
		2020	2030	2050
Agriculture				
Primary Measures				
AG-1	Support the conversion of stationary diesel or gas-powered irrigation pumps to electric pumps	1,696	1,792	2,009
AG-2	Support the use of electric or alternatively-fueled agricultural equipment	1,617	8,540	19,149
AG-3	Support the use of Tier 4 final Diesel Equipment for Off-Road Agricultural Equipment	0	64	48
AG-4	Support reduced application of inorganic nitrogen fertilizer	199	420	1,130
Supporting Measures				
AG-5	Support BAAQMD in efforts to reduce open burning of removed agricultural biomass and flood debris		-	
AG-6	Encourage and support the use of carbon farming and other sustainable agricultural practices in the County		-	
	Agriculture Subtotal	3,512	10,816	22,336
Building Energy				
Primary Measures				
BE-1	Require compliance with CALGreen Tier 1 Green Building standards and Tier 1 Building Energy Efficiency Standards for eligible alterations or additions to existing buildings	28	23	24
BE-2	Require compliance with CALGreen Tier 1 Green Building standards and Tier 1 Building Energy Efficiency Standards for all new construction, and phase in ZNE standards for new construction, beginning with residential in 2020 and non-residential by 2030	1,361	2,037	4,587
BE-3	Increase participation in MCE's Deep Green option (100 percent Renewable Energy)	4,005	1,384	1,338
BE-4	Require new or replacement water heating systems to be electrically powered or alternatively fueled (e.g., solar water heating) for all residential land uses.	6,096	11,575	12,550
BE-5	Expand current renewable energy and green energy incentives and update local ordinances	1,479	1,806	1,703
BE-6	Select MCE's Deep Green Option for all County Facilities	382	170	205
BE-7	Support waste-to-energy programs at unincorporated landfills	10	5	5
Supporting Measures				
BE-8	Work with PG&E, BayREN, MCE, and PACE financing programs, and other regional partners to incentivize energy efficiency improvements in existing buildings		-	
BE-9	Require energy audits for major additions to or alterations of existing buildings		-	
BE-10	Develop a program to allow new development to offset project GHG emissions by retrofitting existing income-qualified homes and buildings		-	
BE-11	Encourage solar panel installations on commercial roof spaces		-	
	Building Energy Subtotal	13,361	16,999	20,412
Land Use Change				
Primary Measures				
LU-1	Establish targets and enhanced programs for oak woodland and coniferous forest preservation and mandatory replanting	7,077	4,544	15,360
LU-2	Refine protection guidelines for existing riparian lands	660	660	660

Table 4 Summary of Greenhouse Gas Emissions Reduction Measures Performance

Measure Number	Measure Name	GHG Reductions ($MTCO_2e$/year)		
		2020	2030	2050
LU-3	Repurpose or otherwise prevent burning of removed trees and other woody material from land use conversions of oak woodlands and coniferous forests	10,839	3,453	4,731
	Land Use Subtotal	18,576	8,657	20,751
Off-Road Transportation				
Primary Measures				
OR-1	Require Tier 4 equipment for all construction activity and mining operations as a condition for approval by 2030	-	354	386
OR-2	Promote use of alternative fuels for recreational marine vessels	1,687	7,512	22,629
	Off-Road Transportation Subtotal	1,687	7,867	23,014
On-Road Transportation				
Primary Measures				
TR-1	Update Transportation System Management Ordinance (for Employers)	4,818	3,582	3,547
TR-2	Adopt parking reduction ordinance revisions	78	58	57
TR-3	Increase affordable housing, especially workforce housing, in Napa County	31	23	23
TR-4	Support efforts to allow commuter service to operate on railroad rights-of-ways	542	605	948
TR-5	Support efforts of solid waste collection services to convert diesel solid waste collection vehicles to CNG	284	247	169
Supporting Measures				
TR-6	Support efforts of transit agencies to increase availability and accessibility of transit information		-	
TR-7	Support alternatives to private vehicle travel for visitors		-	
TR-8	Support Napa County's incorporated cities in developing transit-oriented development unique to the needs of the Napa Region		-	
TR-9	Support interregional transit solutions		-	
TR-10	Work with Napa County's incorporated cities, NVTA, and neighboring regions to increase presence of park and ride facilities near residential centers		-	
TR-11	Promote existing ride-matching services for people living and working in the unincorporated county		-	
TR-12	Increase the supply of electric vehicle charging stations		-	
TR-13	Promote telecommuting at office-based businesses		-	
TR-14	Develop and implement active transportation projects		-	
TR-15	Require new development projects to evaluate and reduce vehicle miles traveled (VMT)		-	
	On-Road Transportation Subtotal	5,753	4,514	4,745
Solid Waste				
Primary Measures				
SW-1	Encourage expansion of composting programs for both residential and commercial land uses	629	1,106	1,270
SW-2	Meet an 80 Percent Waste Diversion Goal by 2020 and a 90 Percent Goal by 2030	1,179	2,625	3,163
	Solid Waste Subtotal	1,807	3,731	4,433

Table 4 Summary of Greenhouse Gas Emissions Reduction Measures Performance

Measure Number	Measure Name	GHG Reductions ($MTCO_2e$/year)		
		2020	2030	2050
Water and Wastewater				
Supporting Measures				
WA-1	Amend or revise water conservation regulations for landscape design	-		
WA-2	Adopt a new water conservation ordinance for commercial and residential land uses limiting outdoor watering	-		
WA-3	Expedite and/or reduce permit fees associated with water conservation installations in existing facilities	-		
WA-4	Require water audits for large new commercial or industrial projects and significant expansions of existing facilities	-		
High GWP Gases				
Supporting Measures				
HG-1	Encourage registration of facilities in CARB's RMP and incentivize installation of low-GWP refrigerant systems	-		
HG-2	Incentivize the use of low-GWP refrigerants	-		
Multi-Sector Measures				
Primary Measures				
MS-1	Support efforts to increase Napa Green Certified wineries and land in the County, with a goal of achieving a 100-percent certification rate for all eligible wineries and properties by 2030	1,783	5,743	5,737
Supporting Measures				
MS-2	Work with other local jurisdictions within the County to develop a unified Climate Action Plan	-		
MS-3	Promote the sale of locally-grown foods and/or products	-		
MS-4	Establish a local carbon offset program in partnership with Sustainable Napa County	-		
Total GHG Emissions Reductions		46,479	58,327	101,427
Recommended GHG Emissions Reduction Target		0	57,683	258,178
Remaining GHG Emissions Reduction Gap (Surplus)		(57,255)[1]	(644)	156,751

Notes: "-" = Not enough data to quantify or relies on participation from external or private entities over which the County has no control, BAAQMD = Bay Area Air Quality Management District, BayREN = Bay Area Regional Energy Network, CARB = California Air Resources Board, CNG = compressed natural gas, CO_2e = carbon dioxide equivalents, GHG = greenhouse gas, GWP = global warming potential, NA = Not Applicable, NVTA = Napa Valley Transportation Authority, MCE = Marin Clean Energy, MT = metric tons, MTC = Metropolitan Transportation Commission, PACE = property assessed clean energy, PG&E = Pacific Gas and Electric, RMP = Refrigerant Management Program, ZNE = zero net energy.

1. 46,479 $MTCO_2e$ of the surplus comes from the reduction measures. 10,777 $MTCO_2e$ comes from legislative reductions at the State and federal level.

Source: Data provided by Ascent Environmental 2018.

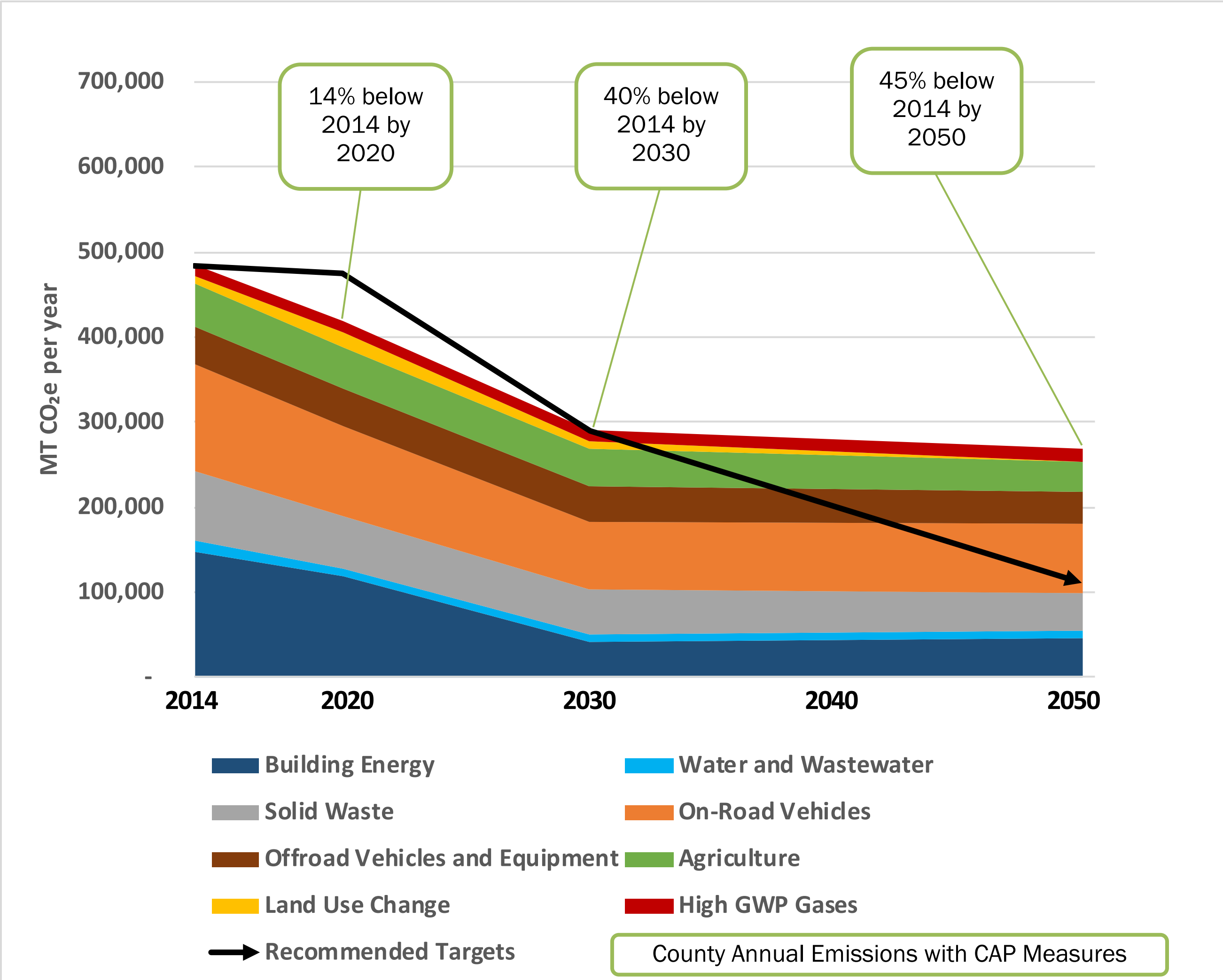


Figure 2 **Projections of Greenhouse Gases by Sector with Implementation of CAP Measures and Recommended Targets: 2020 through 2050**

The total estimated GHG emissions reductions from all measures quantified is approximately 46,479 $MTCO_2e$ in 2020, 58,327 $MTCO_2e$ in 2030, and 101,427 $MTCO_2e$ in 2050. The total estimated reductions in 2020 would be more than sufficient to meet the recommended 2020 target, with a 46,479 $MTCO_2e$ annual surplus of GHG reductions beyond legislative-adjusted forecasts. Legislative-adjusted forecasts show that the County's emissions would be 10,777 $MTCO_2e$ lower than the 2020 target. Implementation of the revised draft GHG reduction measures identified in Table 4 would also meet the recommended 2030 target, with a slight surplus of 644 $MTCO_2e$ in reductions. However, the projected GHG reductions from all measures in 2050 would fall considerably short of the long-term goal for 2050, requiring an additional 156,751 $MTCO_2e$ to be reduced per year by 2050.

Certainly, the scale of reductions required to achieve the much more aggressive longer-term 2050 goal outlined earlier will require significant improvements in the availability and/or cost of near-zero and zero-emissions technology, as well as potential increased reductions from ongoing State and Federal legislative actions that are currently unknown. The Revised Draft CAP proposes that the County update the CAP every five years, so that new legislation and new technological solutions can be incorporated into the recommended measures and future forecasts adjusted accordingly.

Ascent recommends that the County's CAP be updated at least every 5 years after adoption to periodically assess the County's progress toward meeting the GHG reduction targets, identify potential new or revised GHG measures that may be implemented as new technology and policy strategies become available, and adjust future forecasts accordingly

Additional Considerations and Co-Benefits

In addition to the GHG emissions gap analysis process identified above, we also qualitatively considered potential implementation costs and regional economic impacts, administrative feasibility of the proposed GHG reduction measures, and environmental co-benefits. Detailed results are shown in Attachment 1, with general discussion below.

The feasibility of the final GHG reduction measures described above may depend on program participation rates, cooperation from partnering agencies, available County resources, and various economic factors. For example, measure AG-5 in Table 4 requires participation and enforcement by the Bay Area Air Quality Management District (BAAQMD); implementation of BE-1 and BE-2 would depend on the size and number of alterations and new construction that would occur in the future, which are closely linked to the health of the economy; and the various transportation measures would require participation from NVTA, residents, and businesses. Many of the measures, such as ordinance revisions, may be implemented by the County, but the effectiveness of those measures would still depend on general compliance to proposed ordinances and the effectiveness of compliance efforts.

The GHG reduction measures would result in considerable environmental co-benefits, including improvements to air quality, water quality and supply reliability, biological resources, public health outcomes, and other resources.

- Air Quality: GHG reduction measures that reduce fossil fuel combustion will also help to reduce criteria air pollutants such as ozone or particulate matter, as well as toxic air contaminants, which would help to improve air quality and health risk. Several measures would reduce natural gas combustion in stationary sources or building space heating and water heating, while transportation sector measures would reduce on- and off-road mobile source emissions. Improvements in air quality helps to benefit public health, as well as improves visibility.

- Water Quality and Supply Reliability: GHG reduction measures that reduce the strain on local and State water supply or improve water quality would provide water system benefits. For example, several GHG reduction measures would improve landscape water conservation and efficiency in existing developed areas, and require new construction to comply with CALGreen Tier 1 building standards that increase indoor and outdoor water efficiency and conservation.

- Biological Resources: GHG reduction measures that improve or preserve natural ecosystems and habitats would provide co-benefits for biological resources. For example, preserving oak woodlands, forests, and other carbon-sequestering land uses would also conserve habitats for native plant and animal species, maintain water quality, prevent soil erosion, and provide other benefits to help to balance the local ecosystem.

- Public Health: Many of the GHG reduction measures would help to reduce criteria pollutants, toxic air contaminants and other hazards, and increase physical activity; thus benefitting public health. For example, transportation measures promote alternative modes of transportation such as walking and biking, which increase physical activity and can help to reduce obesity and may decrease deaths caused by cardiovascular disease, stroke, and cancer (among the top 10 causes of death in the County). Measures that improve air quality also have significant public health benefits and could decrease respiratory diseases such as asthma.

- Non-Renewable Energy Resources: several GHG reduction measures would help to reduce reliance on finite fossil fuel resources by increasing the use of alternative and renewable energy sources (e.g., solar and geothermal resources or renewable biofuels).

In addition to these environmental co-benefits, GHG reduction measures would also provide economic benefits through long-term operational cost savings and quality of life improvements. For example, reduced electricity and natural gas use through energy efficiency and conservation efforts allows utilities, residents, and businesses to require less alternative and conventional energy resources and help residents save money. Transit-oriented development and siting of affordable housing in the County would allow for residents to live closer to jobs, schools, and services; thus, reducing the amount of time and money spent on commuting and transportation.

REFERENCES

CARB. *See* California Air Resources Board.

California Air Resources Board. 2017 (November). California's 2017 Climate Change Scoping Plan. November 2017. Available: https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf. Accessed March 5, 2018.

______. 2016 (June). California Greenhouse Gas Emissions for 2000 to 2014 – Trends of Emissions and Other Indicators. Available: https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2014/ghg_inventory_trends_00-14_20160617.pdf. Accessed March 5, 2018. Last updated June 17, 2016.

California Department of Finance. 2014 (May). (December). *Report P-2. State and County Population Projections by Race/Ethnicity and Age (5-year groups). 2010 through 2060 (as of July 1).* Prepared by Walter Schwarm, Demographic Research Unit. Available: http://www.dof.ca.gov/Forecasting/Demographics/projections/. Accessed November 29, 2016.

DOF. *See* California Department of Finance.

Goldie, Scott, Co-Corporate Executive Officer. Brooks Street, Napa, CA. April 4, 2018—telephone discussion with Brenda Hom of Ascent Environmental regarding verification of assumptions to be used in the calculation of measure TR-4.

Governor's Office of Planning and Research. 2017 (November). T*echnical Advisory on Evaluation Transportation Impacts in CEQA*. Available: http://opr.ca.gov/docs/20171127_Transportation_Analysis_TA_Nov_2017.pdf. Accessed April 3, 2018.

OPR. *See* Governor's Office of Planning and Research.

Sweeney, C. 2017. Wine Train commuter service among possible Napa Valley traffic solutions. *North Bay Business Journal.* February 7, 2017. Available: http://www.northbaybusinessjournal.com/northbay/napacounty/6606349-181/wine-train-napa-valley-traffic-solutions?artslide=2. Accessed April 3, 2018.

Tang, N. W., J. S. Apte, P. T. Martien, and T. W. Kirchstetter. 2015. Measurement of Black Carbon Emissions from in-Use Diesel-Electric Passenger Locomotives in California. *Atmospheric Environment*. 115: 295-303.

This page intentionally left blank.

ATTACHMENT 1

GHG Measure Reduction Summary				
GHG Emission Reductions by Sector				
		Annual GHG Reduction ($MTCO_2e$)		
Sector	Notes	2020	2030	2050
Agriculture		3,512	10,816	22,336
Building Energy	Includes MU-1	13,361	16,999	20,412
Land Use Change		18,576	8,657	20,751
Wastewater	Includes GHG-2	1,783	5,743	5,737
On-Road Transportation		5,753	4,514	4,745
Off-Road Transportation		1,687	7,867	23,014
Solid Waste		1,807	3,731	4,433
TOTAL Reductions from Proposed Measures		**46,479**	**58,327**	**101,427**
Needed reductions to meet CAP Targets from 2014 levels (MTCO2e)		0	57,683	258,178

Forecasts with Legislative Reductions	Annual GHG Emissions ($MTCO_2e$)			
	2014	2020	2030	2050
Building Energy	148,338	131,643	59,150	67,184
Water and Wastewater	11,277	11,858	12,959	14,335
Solid Waste	83,086	62,345	56,711	48,854
On-Road Vehicles	125,711	112,854	84,845	85,735
Offroad Vehicles and Equipment	42,508	45,164	49,592	58,474
Agriculture	52,198	52,521	53,589	57,446
Land Use Change	7,684	35,608	18,239	21,669
High GWP Gases	13,481	11,828	13,169	15,867
TOTAL	**484,283**	**463,821**	**348,253**	**369,563**
Forecasted Percent Reduction from 2014		-4%	-28%	-24%
CAP Targets (adjusted for percent reduction from 2014)		-2%	-40%	-77%
CAP Targets (MTCO2e)		474,598	290,570	111,385
Needed reductions to meet CAP Targets from 2014 levels (MTCO2e)		9,686	193,713	372,898
Needed reductions to meet CAP Targets from forecasts (MTCO2e)		-10,777	57,683	258,178

Forecasts with Legislative Reductions and County CAP Measures	Annual GHG Emissions ($MTCO_2e$)			
	2014	2020	2030	2050
Building Energy	148,338	118,282	42,151	46,772
Water and Wastewater	11,277	10,075	7,216	8,598
Solid Waste	83,086	60,538	52,980	44,420
On-Road Vehicles	125,711	107,101	80,331	80,990
Offroad Vehicles and Equipment	42,508	43,477	41,725	35,460
Agriculture	52,198	49,009	42,772	35,110
Land Use Change	7,684	17,032	9,582	918
High GWP Gases	13,481	11,828	13,169	15,867
TOTAL	**484,283**	**417,342**	**289,926**	**268,136**
Percent below 2014		-14%	-40%	-45%
Additional Reductions Needed to meet CAP Targets (negative indicates surplus) (MTCO2e)		-57,255	-644	156,751

GHG Measure Reduction Summary (continued)			
Percent below 2014 by Sector. Legislative reductions only			
Sector	**2020**	**2030**	**2050**
Building Energy	-11%	-60%	-55%
Water and Wastewater	5%	15%	27%
Solid Waste	-25%	-32%	-41%
On-Road Vehicles	-10%	-33%	-32%
Offroad Vehicles and Equipment	6%	17%	38%
Agriculture	1%	3%	10%
Land Use Change	363%	137%	182%
High GWP Gases	-12%	-2%	18%
Percent below 2014 by Sector. Combined effect of legislative reductions and proposed actions			
Sector	**2020**	**2030**	**2050**
Building Energy	-20%	-72%	-68%
Water and Wastewater	-11%	-36%	-24%
Solid Waste	-27%	-36%	-47%
On-Road Vehicles	-15%	-36%	-36%
Offroad Vehicles and Equipment	2%	-2%	-17%
Agriculture	-6%	-18%	-33%
Land Use Change	122%	25%	-88%
High GWP Gases	-12%	-2%	18%
Percent below BAU by Sector. Effect of proposed actions			
Sector	**2020**	**2030**	**2050**
Building Energy	-10%	-29%	-30%
Water and Wastewater	-15%	-44%	-40%
Solid Waste	-3%	-7%	-9%
On-Road Vehicles	-5%	-5%	-6%
Offroad Vehicles and Equipment	-4%	-16%	-39%
Agriculture	-7%	-20%	-39%
Land Use Change	-52%	-47%	-96%
High GWP Gases	0%	0%	0%

Measure Details							
#	Lead Agency	Sector	Community or Municipal	Measure Name	Annual GHG Reduction (MT CO_2e)		
					2020	2030	2050
AG-1	Napa County	Agriculture	Community	Support the conversion of stationary diesel or gas-powered irrigation pumps to electric pumps	1,696	1,792	2,009
AG-2	Napa County	Agriculture	Community	Support the use of electric or alternatively-fueled agricultural equipment	1,617	8,540	19,149
AG-3	Napa County	Agriculture	Community	Support the use of Tier 4 final Diesel Equipment for Off-Road Agricultural Equipment	0	64	48
AG-4	Napa County	Agriculture	Community	Support reduced application of inorganic nitrogen fertilizer	199	420	1,130
AG-5	Napa County	Agriculture	Community	Support BAAQMD in efforts to reduce open burning of removed agricultural biomass and flood debris	NA	NA	NA
AG-6	Napa County	Agriculture	Community	Encourage and support the use of carbon farming and other sustainable agricultural practices in the County	NA	NA	NA
BE-1	Napa County	Building Energy	Community	Require compliance with CALGreen Tier 1 Green Building standards and Tier 1 Building Energy Efficiency Standards for eligible alterations or additions to existing buildings	28	23	24
BE-2	Napa County	Building Energy	Community	Require compliance with CALGreen Tier 1 Green Building standards and Tier 1 Building Energy Efficiency Standards for all new construction, and phase in ZNE standards for new construction, beginning with residential in 2020 and non-residential by 2030	1,361	2,037	4,587
BE-3	Napa County	Building Energy	Community	Increase participation in MCE's Deep Green option (100% Renewable Energy)	4,005	1,384	1,338
BE-4	Napa County	Building Energy	Community	Require new or replacement water heating systems to be electrically powered or alternatively fueled (e.g., solar water heating) for all residential land uses.	6,096	11,575	12,550
BE-5	Napa County	Building Energy	Community	Expand current renewable energy and green energy incentives and update local ordinances	1,479	1,806	1,703
BE-6	Napa County	Building Energy	Municipal	Select MCE's Deep Green Option for all County Facilities	382	170	205
BE-7	Napa County	Building Energy	Municipal	Support waste-to-energy programs at unincorporated landfills	10	5	5
BE-8	Napa County	Building Energy	Community	Work with PG&E, BayREN, MCE, and PACE financing programs, and other regional partners to incentivize energy efficiency improvements in existing buildings	NA	NA	NA
BE-9	Napa County	Building Energy	Community	Require energy audits for major additions to or alterations of existing buildings	NA	NA	NA
BE-10	Napa County	Building Energy	Community	Develop a program to allow new development to offset project GHG emissions by retrofitting existing income-qualified homes and buildings	NA	NA	NA
BE-11	Napa County	Building Energy	Community	Encourage solar panel installations on commercial roof spaces	NA	NA	NA
HG-1	Napa County	High GWP	Community	Encourage registration of facilities in CARB's RMP and incentivize installation of low-GWP refrigerant systems	NA	NA	NA
HG-2	Napa County	High GWP	Community	Incentivize the use of low-GWP refrigerants	NA	NA	NA
LU-1	Napa County	Land Use Change	Community	Establish targets and enhanced programs for oak woodland and coniferous forest preservation and mandatory replanting	7,077	4,544	15,360
LU-2	Napa County	Land Use Change	Community	Refine protection guidelines for existing riparian lands	660	660	660
LU-3	Napa County	Land Use Change	Community	Repurpose or otherwise prevent burning of removed trees and other woody material from land use conversions of oak woodlands and coniferous forests	10,839	3,453	4,731
MS-1	Napa County	Wastewater	Community	Support efforts to increase Napa Green Certified wineries and land in the County, with a goal of achieving a 100-percent certification rate for all eligible wineries and properties by 2030	1,783	5,743	5,737
MS-2	Napa County and Cities in Napa County	Multiple	Community	Work with other local jurisdictions within the County to develop a unified Climate Action Plan	NA	NA	NA
MS-3	Napa County	Multiple	Community	Promote the sale of locally-grown foods and/or products	NA	NA	NA
MS-4	Napa County	Multiple	Community	Establish a local carbon offset program in partnership with Sustainable Napa County	NA	NA	NA
OR-1	Napa County	Off-Road Transportation	Community	Require Tier 4 equipment for all construction activity and mining operations as a condition for approval by 2030	-	354	386
OR-2	Napa County	Off-Road Transportation	Community	Promote use of alternative fuels for recreational marine vessels	1,687	7,512	22,629

Measure Details							
#	Lead Agency	Sector	Community or Municipal	Measure Name	Annual GHG Reduction (MT CO_2e)		
					2020	2030	2050
SW-1	Napa County/ Landfill Owners Operators	Solid Waste	Municipal	Encourage expansion of composting program for both residential and commercial land uses	629	1,106	1,270
SW-2	Napa County/ Waste Management Companies	Solid Waste	Community	Meet an 80 Percent Waste Diversion Goal by 2020 and a 90 Percent Goal by 2030	1,179	2,625	3,163
TR-1	NVTA/Napa County	On-Road Transportation	Community	Update Transportation System Management Ordinance (for Employers)	4,818	3,582	3,547
TR-2	Napa County	On-Road Transportation	Community	Adopt parking reduction ordinance revisions	78	58	57
TR-3	NVTA/Napa County	On-Road Transportation	Community	Increase affordable housing, especially workforce housing, in Napa County	31	23	23
TR-4	NVTA/Napa County	On-Road Transportation	Community	Support efforts to allow commuter service to operate on railroad rights-of-ways	542	605	948
TR-5	Napa County	On-Road Transportation	Municipal	Support efforts of solid waste collection services to convert diesel solid waste collection vehicles to CNG	284	247	169
TR-6	NVTA/Napa County	On-Road Transportation	Community	Support efforts of transit agencies to increase availability and accessibility of transit information	NA	NA	NA
TR-7	Napa County	On-Road Transportation	Community	Support alternatives to private vehicle travel for visitors	NA	NA	NA
TR-8	NCTPA/Napa County	On-Road Transportation	Community	Support Napa County's incorporated cities in developing transit-oriented development unique to the needs of the Napa Region	NA	NA	NA
TR-9	NVTA/Napa County	On-Road Transportation	Community	Support interregional transit solutions	NA	NA	NA
TR-10	NCTPA/Napa County	On-Road Transportation	Community	Work with Napa County's incorporated cities, NVTA, and neighboring regions to increase presence of park and ride facilities near residential centers	NA	NA	NA
TR-11	NCTPA/Napa County	On-Road Transportation	Community	Promote existing ride-matching services for people living and working in the unincorporated county	NA	NA	NA
TR-12	NVTA/Napa County	On-Road Transportation	Community	Increase the supply of electric vehicle charging stations	NA	NA	NA
TR-13	NCTPA/Napa County	On-Road Transportation	Community	Promote telecommuting at office-based businesses	NA	NA	NA
TR-14	NCTPA/Napa County	On-Road Transportation	Community	Develop and implement active transportation projects	NA	NA	NA
TR-15	Napa County	On-Road Transportation	Community	Require new development projects to evaluate and reduce VMT	NA	NA	NA
WA-1	Napa County	Water	Community	Amend or revise water conservation regulations for landscape design	NA	NA	NA
WA-2	Napa County	Water	Community	Adopt a new water conservation ordinance for commercial and residential land uses limiting outdoor watering	NA	NA	NA
WA-3	Napa County	Water	Community	Expedite and/or reduce permit fees associated with water conservation installations in existing facilities	NA	NA	NA
WA-4	Napa County	Water	Community	Require water audits for large new commercial or industrial projects and significant expansions of existing facilities	NA	NA	NA

Environmental Co-Benefit Potential						
#	Measure Name	**Air Quality** *Reduces criteria air pollutants directly or indirectly*	**Water** *Reduces strain on local and state water supply or improves water quality*	**Biological Resources** *Improves or preserves natural ecosystems and habitats*	**Health** *Improves public health through reduced pollutants and hazards, and increasing physical activity*	**Non-Renewable Energy Resources** *Reduces reliance on finite fossil fuel resources*
AG-1	Support the conversion of stationary diesel or gas-powered irrigation pumps to electric pumps	Yes	No	Yes	Yes	Yes
AG-2	Support the use of electric or alternatively-fueled agricultural equipment	Yes	No	Yes	Yes	Yes
AG-3	Support the use of Tier 4 final Diesel Equipment for Off-Road Agricultural Equipment	Yes	No	Yes	Yes	Yes
AG-4	Support reduced application of inorganic nitrogen fertilizer	Yes	Yes	Yes	Yes	No
AG-5	Support BAAQMD in efforts to reduce open burning of removed agricultural biomass and flood debris	Yes	No	Yes	Yes	No
AG-6	Encourage and support the use of carbon farming and other sustainable agricultural practices in the County	Yes	Yes	Yes	Yes	Yes
BE-1	Require compliance with CALGreen Tier 1 Green Building standards and Tier 1 Building Energy Efficiency Standards for eligible alterations or additions to existing buildings	Yes	Yes	Yes	Yes	Yes
BE-2	Require compliance with CALGreen Tier 1 Green Building standards and Tier 1 Building Energy Efficiency Standards for all new construction, and phase in ZNE standards for new construction, beginning with residential in 2020 and non-residential by 2030	Yes	Yes	Yes	Yes	Yes
BE-3	Increase participation in MCE's Deep Green option (100% Renewable Energy)	Yes	No	No	No	Yes
BE-4	Require new or replacement water heating systems to be electrically powered or alternatively fueled (e.g., solar water heating) for all residential land uses.	Yes	No	No	No	Yes
BE-5	Expand current renewable energy and green energy incentives and update local ordinances	Yes	No	No	No	Yes
BE-6	Select MCE's Deep Green Option for all County Facilities	Yes	No	No	No	Yes
BE-7	Support waste-to-energy programs at unincorporated landfills	Yes	Yes	No	Yes	Yes
BE-8	Work with PG&E, BayREN, MCE, and PACE financing programs, and other regional partners to incentivize energy efficiency improvements in existing buildings	Yes	No	No	No	Yes
BE-9	Require energy audits for major additions to or alterations of existing buildings	Yes	No	No	No	Yes
BE-10	Develop a program to allow new development to offset project GHG emissions by retrofitting existing income-qualified homes and buildings	Yes	Yes	No	Yes	Yes

#	Measure Name	Environmental Co-Benefit Potential				
		Air Quality *Reduces criteria air pollutants directly or indirectly*	**Water** *Reduces strain on local and state water supply or improves water quality*	**Biological Resources** *Improves or preserves natural ecosystems and habitats*	**Health** *Improves public health through reduced pollutants and hazards, and increasing physical activity*	**Non-Renewable Energy Resources** *Reduces reliance on finite fossil fuel resources*
BE-11	Encourage solar panel installations on commercial roof spaces	Yes	No	No	Yes	Yes
HG-1	Encourage registration of facilities in CARB's RMP and incentivize installation of low-GWP refrigerant systems	Yes	No	No	No	No
HG-2	Incentivize the use of low-GWP refrigerants	Yes	No	No	No	No
LU-1	Establish targets and enhanced programs for oak woodland and coniferous forest preservation and mandatory replanting	Yes	Yes	Yes	Yes	No
LU-2	Refine protection guidelines for existing riparian lands	No	Yes	Yes	Yes	No
LU-3	Repurpose or otherwise prevent burning of removed trees and other woody material from land use conversions of oak woodlands and coniferous forests	Yes	No	No	Yes	No
MS-1	Support efforts to increase Napa Green Certified wineries and land in the County, with a goal of achieving a 100-percent certification rate for all eligible wineries and properties by 2030	Yes	Yes	Yes	Yes	Yes
MS-2	Work with other local jurisdictions within the County to develop a unified Climate Action Plan	Yes	Yes	Yes	Yes	Yes
MS-3	Promote the sale of locally-grown foods and/or products	Yes	Yes	No	Yes	No
MS-4	Establish a local carbon offset program in partnership with Sustainable Napa County	Yes	Yes	Yes	Yes	Yes
OR-1	Require Tier 4 equipment for all construction activity and mining operations as a condition for approval by 2030	Yes	No	Yes	Yes	Yes
OR-2	Promote use of alternative fuels for recreational marine vessels	Yes	Yes	Yes	Yes	Yes
SW-1	Encourage expansion of composting program for both residential and commercial land uses	Yes	Yes	Yes	No	No
SW-2	Meet an 80 Percent Waste Diversion Goal by 2020 and a 90 Percent Goal by 2030	No	Yes	Yes	Yes	No
TR-1	Update Transportation System Management Ordinance (for Employers)	Yes	No	No	Yes	Yes
TR-2	Adopt parking reduction ordinance revisions	Yes	No	No	Yes	Yes
TR-3	Increase affordable housing, especially workforce housing, in Napa County	Yes	No	No	Yes	Yes
TR-4	Support efforts to allow commuter service to operate on railroad rights-of-ways	Yes	No	No	Yes	Yes
TR-5	Support efforts of solid waste collection services to convert diesel solid waste collection vehicles to CNG	Yes	No	No	No	No

Environmental Co-Benefit Potential						
#	Measure Name	**Air Quality** *Reduces criteria air pollutants directly or indirectly*	**Water** *Reduces strain on local and state water supply or improves water quality*	**Biological Resources** *Improves or preserves natural ecosystems and habitats*	**Health** *Improves public health through reduced pollutants and hazards, and increasing physical activity*	**Non-Renewable Energy Resources** *Reduces reliance on finite fossil fuel resources*
TR-6	Support efforts of transit agencies to increase availability and accessibility of transit information	Yes	No	No	Yes	Yes
TR-7	Support alternatives to private vehicle travel for visitors	Yes	No	No	Yes	Yes
TR-8	Support Napa County's incorporated cities in developing transit-oriented development unique to the needs of the Napa Region	Yes	No	No	Yes	Yes
TR-9	Support interregional transit solutions	Yes	No	No	Yes	Yes
TR-10	Work with Napa County's incorporated cities, NVTA, and neighboring regions to increase presence of park and ride facilities near residential centers	Yes	No	No	Yes	Yes
TR-11	Promote existing ride-matching services for people living and working in the unincorporated county	Yes	No	No	Yes	Yes
TR-12	Increase the supply of electric vehicle charging stations	Yes	No	No	Yes	Yes
TR-13	Promote telecommuting at office-based businesses	Yes	No	No	Yes	Yes
TR-14	Develop and implement active transportation projects	Yes	No	No	Yes	Yes
TR-15	Require new development projects to evaluate and reduce VMT	Yes	No	No	Yes	Yes
WA-1	Amend or revise water conservation regulations for landscape design	Yes	Yes	Yes	No	Yes
WA-2	Adopt a new water conservation ordinance for commercial and residential land uses limiting outdoor watering	Yes	Yes	Yes	No	Yes
WA-3	Expedite and/or reduce permit fees associated with water conservation installations in existing facilities	Yes	Yes	Yes	No	Yes
WA-4	Require water audits for large new commercial or industrial projects and significant expansions of existing facilities	No	Yes	No	No	No

Measure Cost and Administrative Feasibility						
#	Measure Name	Estimated Cost/Benefit and Regional Economic Impact Considerations		Administrative Feasibility		
		High-Level Cost Assessment	Detail	Coordination Level	Detail	
AG-1	Support the conversion of stationary diesel or gas-powered irrigation pumps to electric pumps	Medium	May involve costs with respect to rebates or other incentives provided to operators who choose to convert the pumps.	County and BAAQMD	County may work with BAAQMD to acquire funds and possibly administration to support this measure.	
AG-2	Support the use of electric or alternatively-fueled agricultural equipment	Low	Some costs to the County associated with program-level management	County and BAAQMD	County may work with BAAQMD to acquire funds and possibly administration to support this measure.	
AG-3	Support the use of Tier 4 final Diesel Equipment for Off-Road Agricultural Equipment	Medium	Some costs to the County associated with program-level management. May involve increased costs to equipment operators.	County and Agricultural Community	County would need to establish code or program to enforce requirement. Requires collaboration with agricultural equipment operators.	
AG-4	Support reduced application of inorganic nitrogen fertilizer	Medium	Some costs to the County associated with program-level management	County and Agricultural Community	Requires County to establish a new program. County would need to work with agricultural community to establish program goals.	
AG-5	Support BAAQMD in efforts to reduce open burning of removed agricultural biomass and flood debris	Medium	Some costs to the County associated with program-level management	County and BAAQMD	Requires collaboration with BAAQMD. County does not have direct jurisdiction over open burning activities related to agriculture, but may have some jurisdiction over burning of flood control and forest debris.	
AG-6	Encourage and support the use of carbon farming and other sustainable agricultural practices in the County	Medium	Some costs to the County associated with program-level management	County and Agricultural Community	Requires County to establish a new program. County would need to work with agricultural community to establish program goals.	
BE-1	Require compliance with CALGreen Tier 1 Green Building standards and Tier 1 Building Energy Efficiency Standards for eligible alterations or additions to existing buildings	Low	Potential increased costs to building applicants associated with green building and efficiency requirements. Low additional cost to the county due to current code enforcement.	County only	Requires updating current building code ordinances. County already does building code enforcements.	
BE-2	Require compliance with CALGreen Tier 1 Green Building standards and Tier 1 Building Energy Efficiency Standards for all new construction, and phase in ZNE standards for new construction, beginning with residential in 2020 and non-residential by 2030	Low	Potential increased costs to building applicants associated with green building and efficiency requirements. Low additional cost to the county due to current code enforcement.	County only	Requires updating current building code ordinances. County already does building code enforcements.	

Measure Cost and Administrative Feasibility						
#	Measure Name	Estimated Cost/Benefit and Regional Economic Impact Considerations		Administrative Feasibility		
		High-Level Cost Assessment	Detail	Coordination Level	Detail
BE-3	Increase participation in MCE's Deep Green option (100% Renewable Energy)	Medium	This measure would cost the County between approximately $282,000 and $343,000 per year. See quantification in separate spreadsheet. Some funding could be available through BAAQMD, who currently funds a similar program in the City of Fairfax through a grant.	County, MCE, and potential funding sources	Requires starting and maintaining an annual subsidy program. May require proposal development to request grant funding.
BE-4	Require new or replacement water heating systems to be electrically powered or alternatively fueled (e.g., solar water heating) for all residential land uses.	Low	Potential increased costs to building applicants associated with efficiency requirements. Low additional cost to the county due to current code enforcement.	County only	Requires updating current building code ordinances. County already does building code enforcements.
BE-5	Expand current renewable energy and green energy incentives and update local ordinances	Varies	Potential increased costs associated with monetary incentives. Cost would depend on any changes in level of incentives.	County only	Requires maintaining current program and monitoring total kW of approved solar permits
BE-6	Select MCE's Deep Green Option for all County Facilities	Low	Assuming an additional cost of $0.01 per kWh, this would cost the County approximately $30,000 per year. See quantification in separate spreadsheet.	County and MCE	Requires a one-time selection of Deep Green for all facilities located in the unincorporated County.
BE-7	Support waste-to-energy programs at unincorporated landfills	High	Costs would be associated with construction and operation of the new facility	Landfills and County	Requires coordination with landfill operators located in the unincorporated County.
BE-8	Work with PG&E, BayREN, MCE, and PACE financing programs, and other regional partners to incentivize energy efficiency improvements in existing buildings	Medium	Some costs to the County associated with program-level management	County, PG&E, BayREN, and MCE	Requires collaboration with PG&E, BayREN, MCE, California Energy Commission to determine applicable energy efficiency incentives.
BE-9	Require energy audits for major additions to or alterations of existing buildings	Medium	Some costs to the County associated with program-level management.	County only	May require County to establish a new energy audit program.
BE-10	Develop a program to allow new development to offset project GHG emissions by retrofitting existing income-qualified homes and buildings	Medium	Some costs to the County associated with program-level management	County Only	Requires County to establish a new program.
BE-11	Encourage solar panel installations on commercial roof spaces	Medium	Some costs to the County associated with program-level management	County Only	Requires County to establish a new program.

Measure Cost and Administrative Feasibility					
#	Measure Name	Estimated Cost/Benefit and Regional Economic Impact Considerations		Administrative Feasibility	
		High-Level Cost Assessment	Detail	Coordination Level	Detail
HG-1	Encourage registration of facilities in CARB's RMP and incentivize installation of low-GWP refrigerant systems	Medium	Some costs to the County associated with program-level management and potential incentives.	County, CARB, and eligible businesses/ organizations	Requires County to establish a new incentive program and coordinate with CARB's RMP representatives.
HG-2	Incentivize the use of low-GWP refrigerants	Medium	Some costs to the County associated with program-level management and potential incentives.	County and eligible businesses/ organizations	Requires County to establish a new incentive program.
LU-1	Establish targets and enhanced programs for oak woodland and coniferous forest preservation and mandatory replanting	Low	Costs associated with code enforcement, project design to prioritize preservation, and replanting efforts	County, Project Applicants, and Volunteers	Requires updating code and enforcement of code and coordination with volunteer replanting efforts.
LU-2	Refine protection guidelines for existing riparian lands	Low	Costs associated with code enforcement	County Only	Requires updating code and enforcement of code.
LU-3	Repurpose or otherwise prevent burning of removed trees and other woody material from land use conversions of oak woodlands and coniferous forests	Low	Costs associated with developing, maintaining, and operating a new program and research. Some costs also associated with contracts with eligible businesses and services.	County and eligible businesses/ organizations	May require dedicated staff time to research feasible repurposing pathways and contracts with eligible businesses or services.
MS-1	Support efforts to increase Napa Green Certified wineries and land in the County, with a goal of achieving a 100-percent certification rate for all eligible wineries and properties by 2030	Medium	Potential costs to winery and land owners to pay certification costs. Costs to County associated with target monitoring. Potential County costs associated with monetary or other incentives (e.g. increased presence on Napa Visitors website).	County, Napa Green, and Businesses	Requires coordination with Napa Green and Napa wineries and land owners and operators. May require discussion with Napa Green on feasibility of 2030 target.
MS-2	Work with other local jurisdictions within the County to develop a unified Climate Action Plan	High	Costs associated with coordination and CAP development. May take over a year to complete and require dedicated staff resources to manage technical studies and public participation.	County and Cities	Requires working with local jurisdictions.
MS-3	Promote the sale of locally-grown foods and/or products	Low	Costs associated with promotion of locally grown foods/products	County Only	May require establishment and promotion program and dedicated staff time to achieve measure goals.
MS-4	Establish a local carbon offset program in partnership with Sustainable Napa County	High	Costs associated with developing, maintaining, and operating a new program	County and Sustainable Napa County	May require establishment and promotion program and dedicated staff time to manage carbon offsets.

Measure Cost and Administrative Feasibility					
#	Measure Name	Estimated Cost/Benefit and Regional Economic Impact Considerations		Administrative Feasibility	
		High-Level Cost Assessment	Detail	Coordination Level	Detail
OR-1	Require Tier 4 equipment for all construction activity and mining operations as a condition for approval by 2030	Medium	Some costs to the County associated with program-level management. May involve increased costs to project applicants.	County and Project Applicants	County would need to establish code or program to enforce requirement. Requires participation from and collaboration with developers or project applicants.
OR-2	Promote use of alternative fuels for recreational marine vessels	Medium	Some costs to the County associated with promotion and coordination efforts, as well as program management.	County, Dock operators, Local Businesses, and Cities	County would need to coordinate with operators at County and City waterways to encourage use of alternative fuels, especially biodiesel. County would need to do some research related to best implementation methods.
SW-1	Encourage expansion of composting program for both residential and commercial land uses	Medium	Some increased costs associated with promotion of composting.	County and Waste Management Companies	Requires increased County efforts to promote composting of food and yard waste generated in the County.
SW-2	Meet an 80 Percent Waste Diversion Goal by 2020 and a 90 Percent Goal by 2030	Medium	Some increased costs associated with promotion of waste reduction options (e.g. recycling, composting, reuse).	County and Waste Management Companies	Requires increased County efforts to promote recycling, composting, and reuse of waste materials generated in the County.
TR-1	Update Transportation System Management Ordinance (for Employers)	Medium	Increased costs associated with enforcement and monitoring of ordinance.	County and MTC	Requires ordinance update and a new program to be established to monitor progress of and enforce the new ordinance. Some coordination may be needed with MTC to synergize with Bay Area's Commuter Benefits Program.
TR-2	Adopt parking reduction ordinance revisions	Medium	Increased costs associated with enforcement and monitoring of ordinance.	County Only	Requires ordinance update and regular enforcement of ordinance.
TR-3	Increase affordable housing, especially workforce housing, in Napa County	Medium	Costs to be shared throughout the region, depending on location of affordable housing.	County, Cities, and NVTA	The County has land use authority and can influence design and approval of projects for affordable workforce housing.
TR-4	Support efforts to allow commuter service to operate on railroad rights-of-ways	Medium	High initial capital costs associated with new commuter train cars and annual costs from regular service operation. Train would not be operated by the County. Operation costs would need to be negotiated between agencies (e.g. cities, NVTA, Napa Wine Train).	County, NVTA, and Private Railroad Entities	The County has seats on the NVTA Board and can influence transportation planning decisions.

Measure Cost and Administrative Feasibility					
#	Measure Name	Estimated Cost/Benefit and Regional Economic Impact Considerations		Administrative Feasibility	
		High-Level Cost Assessment	Detail	Coordination Level	Detail
TR-5	Support efforts of solid waste collection services to convert diesel solid waste collection vehicles to CNG	High	High capital cost of performing the vehicle conversions to CNG. May rely on grant funding.	Solid Waste Collection Services and County	Requires coordination with solid waste collection services located in the unincorporated County.
TR-6	Support efforts of transit agencies to increase availability and accessibility of transit information	Low	Low initial costs associated with linking current transit data with transit information providers, such as Google.	County, NVTA, and Regional Transit Agencies	The County has seats on the NVTA Board and can influence transportation planning decisions. Would require some coordination with Google and other transit information providers.
TR-7	Support alternatives to private vehicle travel for visitors	Low	Low costs associated with updating and maintaining visitor bureau website to include focus on private vehicle alternatives.	County and Visit Napa Valley	County funds the VisitNapaValley.com website through Napa County Special Projects Funding. County has some influence over the contents of the website. Requires coordination with Visit Napa Valley.
TR-8	Support Napa County's incorporated cities in developing transit-oriented development unique to the needs of the Napa Region	Varies	Costs associated with land use planning and development. Funding sources would depend on the location of proposed developments.	County, Cities, and NVTA	The County has seats on the NVTA Board and can influence transportation planning decisions related to transit oriented development.
TR-9	Support interregional transit solutions	Varies	Costs may vary depending on the solutions needed. Higher costs would be associated with developments of new transit infrastructure, stations, or fleet. Lower costs would be associated with coordination of schedules, routes, and information between transit agencies.	County, Cities, NVTA, and Regional Transit Agencies	The County has seats on the NVTA Board and can influence transportation planning decisions related to transit solutions. A more aggressive approach requires coordination with local and regional transit agencies to promote synergy across transit service areas.
TR-10	Work with Napa County's incorporated cities, NVTA, and neighboring regions to increase presence of park and ride facilities near residential centers	Medium	Costs associated with coordination and development of a pilot project. Project moves foreword, may require regular monitoring of program progress.	County and NVTA	The County has seats on the NVTA Board and can influence transportation planning decisions related to transit solutions. A more aggressive approach requires coordination with vineyards and Vine or private ridesharing companies, such as Enterprise, to explore the ridership potential of and best schedule for harvest season ride services.

Measure Cost and Administrative Feasibility					
		Estimated Cost/Benefit and Regional Economic Impact Considerations		Administrative Feasibility	
#	Measure Name	High-Level Cost Assessment	Detail	Coordination Level	Detail
TR-11	Promote existing ride-matching services for people living and working in the unincorporated county	Varies	Some costs associated with coordination. Cost of park and ride facilities will depend on whether the facilities are located in the unincorporated area or not.	County, Cities, and NVTA	The County has seats on the NVTA Board and can influence transportation planning decisions related to park and ride facilities. Most facilities would likely be located in Cities where the greatest concentration of residential units are. Park and ride facilities could be located in the unincorporated County if located close to nearby residential concentrations.
TR-12	Increase the supply of electric vehicle charging stations	High	High capital costs associated with construction of EV charging stations, signage, and related infrastructure throughout County. Some costs associated with maintenance.	County and County businesses	Requires coordination with businesses and multi-family complexes to install EV chargers. May require routine maintenance that can be contracted out.
TR-13	Promote telecommuting at office-based businesses	Low	Costs associated with identifying eligible businesses and promotion of telecommuting.	County only	Requires some staff time dedicated to achieving measure goals.
TR-14	Develop and implement active transportation projects	Medium	Costs associated with project research, program funding, and project funding.	County and NVTA	The County would work with NVTA to develop and fund projects, as part of countywide efforts to implement bicycle and pedestrian master plans that exist.
TR-15	Require new development projects to evaluate and reduce VMT	High	Costs associated with project review, program funding, and project funding.	County and NVTA	Requires staff time dedicated to reviewing project applications and determining whether projects meets VMT reduction goals.
WA-1	Amend or revise water conservation regulations for landscape design	Low	Low additional cost to the county due to current code enforcement.	County only	Requires updating current water conservation ordinance. County already does code enforcements.
WA-2	Adopt a new water conservation ordinance for commercial and residential land uses limiting outdoor watering	Low	Low additional cost to the county due to current code enforcement.	County only	Requires updating current water conservation ordinance. County already does code enforcements.
WA-3	Expedite and/or reduce permit fees associated with water conservation installations in existing facilities	Low	Low additional cost for expedited permits. Slightly reduced revenue from lowered permit fees.	County only	Requires updating County permit fee list.
WA-4	Require water audits for large new commercial or industrial projects and significant expansions of existing facilities	Medium	Some costs associated with developing water audit methods, performing audits themselves, providing feedback to businesses, and recommending solutions.	County only	Requires some staff time dedicated to achieving measure goals. May require establishing a water audit program.

Quantification Assumptions		
#	Measure Name	Calculation Assumptions
AG-1	Support the conversion of stationary diesel or gas-powered irrigation pumps to electric pumps	Assumes all pumps are diesel-powered and all are converted to electric, and any future pumps associated with growth in ag sector would be electric
AG-2	Support the use of electric or alternatively-fueled agricultural equipment	Assumes 5% of emissions from agricultural equipment would be reduced.
AG-3	Support the use of Tier 4 final Diesel Equipment for Off-Road Agricultural Equipment	See separate calculation spreadsheet
AG-4	Support reduced application of inorganic nitrogen fertilizer	See separate calculation spreadsheet
AG-5	Support BAAQMD in efforts to reduce open burning of removed agricultural biomass and flood debris	Not quantified
AG-6	Encourage and support the use of carbon farming and other sustainable agricultural practices in the County	Not quantified
BE-1	Require compliance with CALGreen Tier 1 Green Building standards and Tier 1 Building Energy Efficiency Standards for eligible alterations or additions to existing buildings	See separate calculation spreadsheet
BE-2	Require compliance with CALGreen Tier 1 Green Building standards and Tier 1 Building Energy Efficiency Standards for all new construction, and phase in ZNE standards for new construction, beginning with residential in 2020 and non-residential by 2030	See separate calculation spreadsheet
BE-3	Increase participation in MCE's Deep Green option (100% Renewable Energy)	See separate calculation spreadsheet
BE-4	Require new or replacement water heating systems to be electrically powered or alternatively fueled (e.g., solar water heating) for all residential land uses.	See separate calculation spreadsheet
BE-5	Expand current renewable energy and green energy incentives and update local ordinances	Not quantified
BE-6	Select MCE's Deep Green Option for all County Facilities	See separate calculation spreadsheet
BE-7	Support waste-to-energy programs at unincorporated landfills	See separate calculation spreadsheet
BE-8	Work with PG&E, BayREN, MCE, and PACE financing programs, and other regional partners to incentivize energy efficiency improvements in existing buildings	Not quantified
BE-9	Require energy audits for major additions to or alterations of existing buildings	Not quantified
BE-10	Develop a program to allow new development to offset project GHG emissions by retrofitting existing income-qualified homes and buildings	Not quantified
BE-11	Encourage solar panel installations on commercial roof spaces	Not quantified
HG-1	Encourage registration of facilities in CARB's RMP and incentivize installation of low-GWP refrigerant systems	Not quantified
HG-2	Incentivize the use of low-GWP refrigerants	Not quantified
LU-1	Establish targets and enhanced programs for oak woodland and coniferous forest preservation and mandatory replanting	Assumes 30% of trees forecasted to be lost would be conserved and up to 2,500 oak and coniferous trees would be planted per year to replace lost trees. Replanting efforts assume a 20% mortality rate. Original forecasts assume a certain reduction in oak woodland based on land use forecasts. See separate calculation spreadsheet.
LU-2	Refine protection guidelines for existing riparian lands	Assumes all riparian land in 2014 would remain in future years. Original forecasts assume a certain reduction in these land uses based on land use forecasts. Reductions associated with this measure assume that any forecasted removal of riparian lands would not occur. See separate calculation spreadsheet.
LU-3	Repurpose or otherwise prevent burning of removed trees and other woody material from land use conversions of oak woodlands and coniferous forests	Assumes 80% of the lumber from removed oak and coniferous trees would be repurposed, buried, or otherwise unburned and prevented from releasing stored CO2 back into the atmosphere.

#	Measure Name	Calculation Assumptions
MS-1	Support efforts to increase Napa Green Certified wineries and land in the County, with a goal of achieving a 100-percent certification rate for all eligible wineries and properties by 2030	Currently, 56% of wineries and 40% of vineyard land are Napa Green Certified. Although this measure would theoretically reduce emissions across all sectors, there is not enough information available to determine the average savings associated with being Napa Green Certified. Only reductions in wastewater emissions from wineries were accounted for in this measure because the inventory assumed that all Napa Green Wineries treat their wastewater aerobically. Calculations assumes a 60% certification rate by 2020 and an 100% certification rate for wineries by 2030 by production volume. See separate calculation spreadsheet. For all certified businesses, it is assumed that 75% of businesses already undergoing energy retrofits pursuant to SB350 programs would seek to be or are already Napa Green Certified.
MS-2	Work with other local jurisdictions within the County to develop a unified Climate Action Plan	Not quantified
MS-3	Promote the sale of locally-grown foods and/or products	Not quantified
MS-4	Establish a local carbon offset program in partnership with Sustainable Napa County	Not quantified
OR-1	Require Tier 4 equipment for all construction activity and mining operations as a condition for approval by 2030	This measure assumes that emissions and fuel efficiency are directly proportional. Assume a 5% efficiency improvement because efficiency gains are likely higher when compared to older models.
OR-2	Promote use of alternative fuels for recreational marine vessels	Assumes a plan would successfully reduce emissions from pleasure craft by 5% by 2020, 20% by 2030, and 50% by 2050 due to shifts to alternative fuels, including biodiesel.
SW-1	Encourage expansion of composting program for both residential and commercial land uses	See separate calculation spreadsheet.
SW-2	Meet an 80 Percent Waste Diversion Goal by 2020 and a 90 Percent Goal by 2030	See separate calculation spreadsheet.
TR-1	Update Transportation System Management Ordinance (for Employers)	Applies CAPCOA measures TRT-1/TRT-3/TRT-11 (Commute Trip Reduction measures) and TRT-2 (Commute Trip Reduction Monitoring Program), which have a minimum VMT reduction of 1-2% and 4.2%, respectively. Calculations assume a rural context and applicability to large employers in the unincorporated area. Measure applies only to commute VMT, available from MTC. See separate calculation spreadsheet.
TR-2	Adopt parking reduction ordinance revisions	Applies CAPCOA TRT-14 and TRT-15 measures which assume a 0.1-19.7% reduction in VMT. This measures assumes a low rate of VMT reduction due to rural nature of Napa County. See separate calculation spreadsheet.
TR-3	Increase affordable housing, especially workforce housing, in Napa County	Applies CAPCOA LUT-6 measure which assumes a 0.4 - 1.2% reduction in VMT. This measure assumes a low rate of VMT reduction due to distance from cities in Napa County to destinations in the unincorporated area. Commute from cities is closer than commuting from neighboring counties, depending on work locations. See separate calculation spreadsheet.
TR-4	Support efforts to allow commuter service to operate on railroad rights-of-ways	Pilot program information from Napa Valley Wine Train. See separate calculation spreadsheet.
TR-5	Support efforts of solid waste collection services to convert diesel solid waste collection vehicles to CNG	See separate calculation spreadsheet.
TR-6	Support efforts of transit agencies to increase availability and accessibility of transit information	Not quantified
TR-7	Support alternatives to private vehicle travel for visitors	Not quantified
TR-8	Support Napa County's incorporated cities in developing transit-oriented development unique to the needs of the Napa Region	Not quantified
TR-9	Support interregional transit solutions	Not quantified
TR-10	Work with Napa County's incorporated cities, NVTA, and neighboring regions to increase presence of park and ride facilities near residential centers	Not quantified
TR-11	Promote existing ride-matching services for people living and working in the unincorporated county	Not quantified
TR-12	Increase the supply of electric vehicle charging stations	Not quantified
TR-13	Promote telecommuting at office-based businesses	Not quantified

#	Measure Name	Calculation Assumptions
TR-14	Develop and implement active transportation projects	Not quantified
TR-15	Require new development projects to evaluate and reduce VMT	Not quantified
WA-1	Amend or revise water conservation regulations for landscape design	Not quantified
WA-2	Adopt a new water conservation ordinance for commercial and residential land uses limiting outdoor watering	Not quantified
WA-3	Expedite and/or reduce permit fees associated with water conservation installations in existing facilities	Not quantified
WA-4	Require water audits for large new commercial or industrial projects and significant expansions of existing facilities	Not quantified

Reduction Measure Quantification

Building Energy Assumptions

	2020	2030	2050
Napa County Average Electricity Emissions Factor (MTCO2e/MWh)	1.29E-01	5.91E-02	5.58E-02
Natural Gas Emissions Factor (MTCO2e/therm)		0.00685	

Source: Final Technical Memorandum #1: 2014 Greenhouse Gas Emissions Inventory and Forecasts

AG-1

Support the conversion of stationary diesel or gas-powered irrigation pumps to electric pumps		2014	2020	2030	2050
Number of Diesel Pumps in Napa County		25.9	26.5	28.0	31.4
Emissions from Diesel Pumps (MTCO2)		1,657	1,697	1,792	2,009
Assume all diesel pumps are converted to electric					
Diesel Emission Factor (kg CO2/gal)	10.21				
Calculated fuel use (gal)		162,302	166,231	175,614	196,880
Energy content of diesel (kBTU/gal) - lower heating value		128	128	128	128
Efficiency of diesel pump (%)		35%	35%	35%	35%
Energy required by pumps (kBTU)		7,299	7,476	7,898	8,854
Efficiency of electric pump (%)		75%	75%	75%	75%
Calculated electricity use in electric pumps (kBTU)		9,732	9,967	10,530	11,805
Calculated electricity use in electric pumps (kWh)		2,852	2,921	3,086	3,460
Emissions from electricity use (MTCO2e)			0.38	0.18	0.19
Net GHG Reduction from AG-1 (MTCO2e)			1,696	1,792	2,009

AG-2

Support the use of electric or alternatively-fueled agricultural equipment	2014	2020	2030	2050
Emissions from Agricultural Equipment Except for Irrigation Pumps. Scaled by change in cropland. (MTCO2e)	31,571	32,336	34,161	38,297
Percent of Equipment Converted to Electric or Alternative Fuel		5%	25%	50%
Net GHG Reduction from AG-2 (MTCO2e)		1,617	8,540	19,149

AG-3

Support the use of Tier 4 final Diesel Equipment for Off-Road Agricultural Equipment	2014	2020	2030	2050
Emissions from Agricultural Equipment **Except** for Irrigation Pumps (MTCO2e)	31,571	32,336	34,161	38,297
Emissions Reduced from AG-3		1,617	8,540	19,149
Remaining emissions from diesel agricultural equipment		30,719	25,621	19,149
Participation rate of equipment that are Tier 4 Final		-	5%	5%
Average percent improvement in fuel efficiency with Tier 4 Final equipment		5.00%	5.00%	5.00%
Net GHG Reduction from AG-3 (MTCO2e)		-	64	48

Reduction Measure Quantification (continued)

AG-4				
Support reduced application of inorganic nitrogen fertilizer	2014	2020	2030	2050
Existing N2O Emissions from Nitrogen Fertilizer Use (MTCO2e)	2,683			
Cropland inventory and forecast (acres)	70,005	71,699	73,956	78,482
Forecasted N2O Emissions from Nitrogen Fertilizer Use (MTCO2e)		2,748	2,835	3,008
Percent reduced or displaced by organic fertilizers from 2014 levels		5%	10%	30%
Forecasted N2O Emissions from Nitrogen Fertilizer Use after reduction (MTCO2e)		2,549	2,415	1,878
Net GHG Reduction from AG-4 (MTCO2e)		199	420	1,130

BE-1				
Require compliance with CALGreen Tier 1 Green Building standards and Tier 1 Building Energy Efficiency Standards for eligible alterations or additions to existing buildings		2020	2030	2050
From Inventory Demographics Assumptions (Unincorporated County)	***2014***	***2020***	***2030***	***2050***
Households (HH)	12,356	12,931	13,890	15,844
Population	26,665	28,612	31,857	38,384
Jobs	11,400	11,732	12,284	13,372
Source: Fehr and Peers 2015 (Technical Memorandum to Ascent dated November 5, 2015)				
Residential				
Average number of eligible residential permits per year scaled by population growth	50	52	56	64
Average electricity use per HH (from County HH data and PGE estimates for 2013) (kWh)	9,406	9,406	9,406	9,406
Average natural gas use per HH (from County HH data and PGE estimates for 2013) (therms)	308	308	308	308
Percent of HH applicable to energy audit (conservative assumption)	50%			
CalGreen Tier 1 Percent Reduction from 2008 standards (conservative assumption)	15%			
Electricity Savings per year (kWh)	35,273	36,915	39,653	45,230
Natural Gas Savings per year (therms)	1,155	1,209	1,298	1,481
Emissions savings per year (MTCO2e)		**13.05**	**11.24**	**12.67**
Commercial				
Average number of eligible non-residential permits per year	50	51	54	59
Sqft of new or improved space per permit	1,000	1,001	1,002	1,003
Total SQFT of new or improved existing building space	50,000	51,506	53,986	58,823
Percent of Commercial area applicable to energy audit	50%			
CalGreen Tier 1 Percent Reduction from 2008 standards (conservative assumption)	15%			
Average kwh per commercial sqft (kwh/sqft)	14			
Average therm per commercial sqft (therms/sqft)	0.30			
Electricity Savings per year (kWh)		54,307	56,922	62,022
Natural Gas Savings per year (therms)		1,177	1,233	1,344
Emissions savings per year (MTCO2e)		**15.07**	**11.27**	**11.09**
Net GHG Reduction from BE-1 (MTCO2e)		28	23	24

Reduction Measure Quantification (continued)

BE-2				
Require compliance with CALGreen Tier 1 Green Building standards and Tier 1 Building Energy Efficiency Standards for all new construction, and phase in ZNE standards for new construction, beginning with residential in 2020 and non-residential by 2030	2014	2020	2030	2050
Residential				
Forecast energy usage (w/o SB350)				
Electricity (kWh)	116,340,405	121,689,479	130,714,390	149,098,861
Natural Gas (therms)	3,809,649	3,984,808	4,280,335	4,882,347
New Energy Use Only (w/o SB350)				
Electricity (kWh)		5,349,074	14,373,986	32,758,457
Natural Gas (therms)		175,159	470,686	1,072,699
New Energy Use Only (w/ SB350)				
Electricity (kWh)		3,851,334	7,186,993	16,379,228
Natural Gas (therms)		126,115	235,343	536,349
Percent Reduction from CalGreen Tier 1 or ZNE from prior set of standards		100%	100%	100%
Calgreen Tier 1 or ZNE		ZNE	ZNE	ZNE
New Energy Use Only (w/ SB350 + CalGreen Tier 1 or ZNE)				
Electricity (kWh)		-	-	-
Natural Gas (therms)		-	-	-
Energy Reductions				
Electricity (kWh)		3,851,334	7,186,993	16,379,228
Natural Gas (therms)		126,115	235,343	536,349
Emissions Reductions (MTCO2e)				
Electricity		**497**	**425**	**913**
Natural Gas		**864**	**1,612**	**3,674**
Commercial				
Forecast energy usage (w/o SB350)				
Electricity (kWh)	214,162,060	220,391,174	230,773,030	251,200,573
Natural Gas (therms)	8,626,723	8,877,640	9,295,835	10,118,682
New Energy Use Only (w/o SB350)				
Electricity (kWh)		6,229,114	16,610,971	37,038,513
Natural Gas (therms)		250,917	669,111	1,491,959
New Energy Use Only (w/ SB350)				
Electricity (kWh)		4,484,962	8,305,485	18,519,256
Natural Gas (therms)		180,660	334,556	745,979
Percent Reduction from CalGreen Tier 1 or ZNE from prior set of standards		15%	100%	100%
Calgreen Tier 1 or ZNE		ZNE	ZNE	ZNE
New Energy Use Only (w/ SB350 + CalGreen Tier 1 or ZNE)				
Electricity (kWh)		3,812,218	-	-
Natural Gas (therms)		153,561	-	-

Reduction Measure Quantification (continued)

		2020	2030	2050
Energy Reductions				
Electricity (kWh)		672,744	8,305,485	18,519,256
Natural Gas (therms)		27,099	334,556	745,979
Emissions Reductions (MTCO2e)				
Electricity		**87**	**491**	**1,033**
Natural Gas		**186**	**2,292**	**5,110**
Commercial and Residential				
Emissions Reductions (MTCO2e)				
Electricity		**584**	**916**	**1,946**
Natural Gas		**1,050**	**3,904**	**8,784**
Net GHG Reduction from BE-2 (MTCO2e)		1,361	2,037	4,587
w/o ZNE		*479*	*725*	*1,613*
Difference		*882*	*1,312*	*2,974*

BE-3				
Increase participation in MCE’s Deep Green option (100% Renewable Energy)		2020	2030	2050
City of Fairfax's current participation rate with similar subsidy program for Deep Green which is limited to 100 households	6%			
Target Participation Rate under BE-5		10%	15%	15%
County electricity use prior to measures (with Legislative Reductions) (kWh)		344,385,969	190,832,440	219,495,859
Reductions from other measures (kWh)				
BE-3		54,307	54,307	54,307
BE-4		4,524,078	15,492,478	34,898,485
BE-6		(3,630)	(2,386)	(2,411)
BE-10		75,353	78,914	85,904
Adjusted County Electricity Use (kWh)		339,735,862	175,209,127	184,459,575
Emissions from Electricity use under MCE/PGE (MTCO2e)		43,868	10,361	10,286
Emissions removed under Deep Green (MTCO2e)		4,387	1,554	1,543
Reductions from MU-1 (assumes that County's participation is accounted for in County's total participation rate)		382	170	205
Net GHG Reduction from BE-3 (MTCO2e)		4,005	1,384	1,338

Reduction Measure Quantification (continued)

BE-4

Require new or replacement water heating systems to be electrically powered or alternatively fueled (e.g., solar water heating) for all residential land uses.		2020	2030	2050
Percent of natural gas use in homes by end use in California	***2009***			
Space Heating	25%			
Water Heating	34%			
Cooking	25%			
Other	16%			
Water heating usage by fuel type	***2009***			
Natural Gas	85%			
Electric	11%			
Propane	4%			
Source: EIA 2009. http://www.eia.gov/consumption/residential/data/2009/				
Average age of natural gas water heater at replacement (years)	13			
		Percent of existing water heaters replaced by this year		
Percent of current main water heaters by age	***2009***	***2020***	***2030***	***2050***
Less Than 2 Years	16%	0	100%	100%
2 to 4 Years	16%	0	100%	100%
5 to 9 Years	30%	50%	100%	100%
10 to 14 Years	18%	100%	100%	100%
15 to 19 Years	7%	100%	100%	100%
20 Years or More	14%	100%	100%	100%
	2014	***2020***	***2030***	***2050***
Annual Residential Natural Gas Use in Napa with Legislative Reductions (therms)	3,809,649	3,937,389	2,245,464	2,679,159
Savings from BE-3 (therms)		1,177	1,233	1,344
Adjusted Residential Natural Gas Use (therms)		3,936,212	2,244,231	2,677,815
		2020	2030	2050
Natural Gas Savings from replacement of Existing Water Heaters				
Natural gas usage in existing water heaters with replacement (therms)	1,282,332.72	593,867	-	-
Natural Gas Savings from replacement of Existing Water Heaters (therms)		688,466	1,282,333	1,282,333
Natural Gas Savings from elimination of new Natural Gas water heaters				
Water heater usage in all residences (therms)		1,325,330	755,826	901,808
Eliminated new water heater usage (therms)		731,463	755,826	901,808
Total reduction in Natural Gas Use due to Measure (therms)		1,419,928	2,038,159	2,184,141
GHG Reductions from Natural Gas Savings (MTCO2e)		9,727	13,961	14,961
Assuming all natural gas replaced by electric water heaters (conservative)				
Therms needed to heat 45 gallons of hot water (61% efficiency)	0.333333			
kWh needed to heat 45 gallons of hot water (99% efficiency)	6.6			
kwh per therm conversion for water heating	19.8000198			
Total electricity use needed to offset natural gas water heating (kWh)		28,114,612	40,355,588	43,246,038
Additional GHG emissions from Electricity Use (discounted from reductions) (MTCO2e)		3,630	2,386	2,411
Net GHG Reduction from BE-4 (MTCO2e)		6,096	11,575	12,550

Reduction Measure Quantification (continued)

BE-5				
Expand current renewable energy and green energy incentives and update local ordinances	2014	2020	2030	2050
The quantification of this measure only accounts for the GHG reductions associated with solar installations. Measure assumes that homes/businesses that choose to install solar would not opt into MCE's Deep Green Option.				
Target size of all solar permits approved starting from 2014 (kW)		7,500	20,000	20,000
Annual electricity generated for a 10 kW rooftop system *(based on National Renewable Energy Laboratory's PV Watts Calculator for a rooftop system in Napa)*		15,271	15,271	15,271
Annual Electricity Generated by new Solar PVs from new permits (kWh)		11,453,250	30,542,000	30,542,000
Annual Electricity Generated by new Solar PVs from new permits (MWh)		11,453	30,542	30,542
Additional GHG emissions from Electricity Use (discounted from reductions) (MTCO2e)		1,479	1,806	1,703
Feasibility Check				
Annual Electricity Demand in the County after BE-1, BE-2, BE-4, and BE-7 (MWh)		339,736	175,209	184,460
Percent of County Electricity offset by additional solar under BE-5		3%	17%	17%
Percent of County Electricity generated by MCE's Deep Green option under BE-6		10%	15%	15%
Net GHG Reduction from BE-5 (MTCO2e)		1,479	1,806	1,703

BE-6				
Select MCE's Deep Green Option for all County Facilities		2020	2030	2050
	2015			
County unincorporated population	26,899	28,612	31,857	38,384
County's Facility Electricity Usage (kWh)	7,425,183	7,898,067	8,793,861	10,595,445
County's Facility Electricity Usage in the Unincorporated Area Only (kWh)	2,789,619	2,967,280	3,303,827	3,980,677
MCE Light Green Emission Factors (MTCO2e/MWh)		1.29E-01	5.15E-02	5.15E-02
MCE Deep Green Emission Factors (MTCO2e/MWh)		0	0	0
BAU Emissions Associated with Electricity Consumption at County Facilities (MTCO2e)		382.08	170.17	205.03
Reduced Emissions Associated with Electricity Consumption at County Facilities (MTCO2e)		-	-	-
Net GHG Reduction from BE-6 (MTCO2e)		382	170	205
Additional GHG Reduction if County uses Deep Green at County facilities located within cities.		638	350	386

Reduction Measure Quantification (continued)

BE-7

Support waste-to-energy programs at unincorporated landfills	2014	2020	2030	2050
This measure quantifies the potential of having a waste-to-energy program at Clover Flat Landfill				
BAU Electricity Demand at CFL (scaled by incorporated population because CFL served incorporated area) (kWh)	73,216	75,353	78,914	85,904
Electricity Demand from Grid with Waste-to-Energy (assumes no sell back to grid. See note.)		0	0	0

Source: *Egdar & Associates 2016 ("Climate Action Management Plan to 2020 for Clover Flat Landfill and Upper Valley Recycling"*

Note: This does not count reductions from electricity sold back to the grid because those reductions are already accounted for in the RPS targets. Also, the waste-to-energy facility began operations in 2014, which means the project is already accounted for in the inventory. The facility is anticipated to ramp up production in the future.)

	2014	2020	2030	2050
Incorporated Population based on MTC forecasts	112,409	115,690	121,157	131,889
Electricity Reduction (kWh)		75,353	78,914	85,904
Net GHG Reduction from BE-7 (MTCO2e)		10	5	5

MS-1

Support efforts to increase Napa Green Certified wineries and land in the County, with a goal of achieving a 100-percent certification rate for all eligible wineries and properties by 2030	2014	2020	2030	2050
Wastewater Emissions Reductions				
Winery wastewater emissions (Napa Green Certified Wineries are assumed to have no wastewater emissions)	5,087	5,348	5,743	5,737
Percent of Napa Green Certified Wineries under current projections	40%	40%	40%	40%
Percent of Napa Green Certified Wineries under MS-2		60%	100%	100%
Emissions reductions from winery wastewater		***1,783***	***5,743***	***5,737***
Net GHG Reduction from MS-1 (MTCO2e)		1,783	5,743	5,737

LU-1

Establish targets and enhanced programs for oak woodland and coniferous forest preservation and mandatory replanting	2014	2020	2030	2050
Target minimum percent of trees preserved under project-level avoidance (%)		30%	30%	30%
Oak and Coniferous Tree Conservation				
Forecasted number of trees removed per year		21,039	6,701	9,181
Forecasted Annual Emissions from lost Oak and Coniferous Trees (MT CO2e)		22,757	8,475	14,032
Emissions saved from conserved trees (MT CO2e)		***6,827***	***2,543***	***4,210***
Replacement of Lost Trees				
Post-conservation number of trees lost per year		14,727	4,691	6,427
Maximum number of trees to be planted per year		2,500	2,500	2,500
Mortality Rate (%)	20%			
Number of surviving trees planted per year		2,000	2,000	2,000
Emissions sequestered from planted trees (MT CO2e)		***249***	***2,002***	***11,150***
Net GHG Reduction from LU-1 (MTCO2e)		7,077	4,544	15,360

Reduction Measure Quantification (continued)

LU-2				
Refine protection guidelines for existing riparian lands	2014	2020	2030	2050
Assumes that future losses in riparian lands would not occur. Thus, reductions are equivalent to forecasted losses in annual carbon sequestration from riparian woodlands.				
Net GHG Reduction from LU-2 (MTCO2e)		660	660	660

LU-3				
Repurpose or otherwise prevent burning of removed trees and other woody material from land use conversions of oak woodlands and coniferous forests	2014	2020	2030	2050
This measure would require repurposing of usable timber from trees removed due to land use conversion and burying or chipping of non-usable timber. Repurposed wood may be either be used in construction or sold to local woodworking businesses or collectives with proceeds funding the administration of this measure. A minimum of 80% of total removed weight of trees shall be repurposed, buried, chipped, or otherwise prevented from burning. This measure only quantifies trees removed due to land use conversion of oak woodlands and coniferous forests. This measure prioritizes wood repurposing. If any portion of removed tree material cannot be repurposed due to disease or structural limitations, dispose of material either through burial, chipping, or other non-burning measures.				
Preservation of Removed Tree Carbon				
Post-conservation number of trees lost per year (LU-1)		14,727	4,691	6,427
Weighted average carbon storage rate per oak/coniferous tree removed (MTCO2/tree)		0.92	0.92	0.92
Emissions from lost trees, if burned (MTCO2)		13,549	4,316	5,914
Percent of tree mass prevented from burning		80%	80%	80%
Net GHG Reduction from LU-3 (MTCO2e)		10,839	3,453	4,731

OR-1				
Require Tier 4 equipment for all construction activity and mining operations as a condition for approval by 2030		2020	2030	2050
Offroad Construction and Mining Emissions (MTCO2e)		6,766	7,085	7,712
Percent of equipment that are Tier 4 Final		No Change	100%	100%
Average percent improvement in fuel efficiency with Tier 4 equipment		5%	5%	5%
Net GHG Reduction from OR-1 (MTCO2e)		-	354	386

OR-2			
Promote use of alternative fuels for recreational marine vessels	2020	2030	2050
Pleasure Craft Emissions from OFFROAD 2007 model, assuming all occur within the Unincorporated County	33,736	37,562	45,258
Percent reduction in emissions based on biofuel targets (%)	5%	20%	50%
Net GHG Reduction from OR-2 (MTCO2e)	1,687	7,512	22,629

Reduction Measure Quantification (continued)

SW-1				
Encourage expansion of composting program for both residential and commercial land uses	2014	2020	2030	2050
Generation of Organic Waste In Unincorporated Napa County (Ascent Adjusted)				
Disposal	20,156	14,099	15,698	18,914
Commercial				
*Percentage of Disposal that is Commercial**	71.4%	71.4%	71.4%	71.4%
Commercial Disposal	14,396	10,070	11,212	13,509
Percentage of Commercial Disposal that is Organic †*	32.8%	32.8%	32.8%	32.8%
Commercial Organic Disposal	4,716	3,299	3,673	4,425
Residential				
*Percentage of Disposal that is Residential**	28.6%	28.6%	28.6%	28.6%
Residential Disposal	5,760	4,029	4,486	5,405
Percentage of Residential Disposal that is Organic †*	39.8%	39.8%	39.8%	39.8%
Residential Organic Disposal	2,291	1,603	1,784	2,150

*Based on 1999 Waste Characterization Study for the Unincorporated Napa County. Same source used for the inventory. Newer sources unavailable. Split between commercial and residential is unlikely to change much over time due to the focus of Napa County on the wine industry.

† This is a conservative assumption because the success of the 75% diversion target would most likely reduce the number of landfilled recyclables and increase the percentage of overall organics per ton of disposal. However, the BAU forecast is also conservative because it assumes the percent organics does not change.

COMMERCIAL COMPOSTING

Tons to Be Landfilled, Which Will Be Composted Instead	2014	2020	2030	2050
AB 1826's Commercial Organic Waste Disposal Limit		2,358	2,358	2,358
Tons Composted Instead of Landfilled		941	1,315	2,067

Organic Breakdown	Residential	Commercial
Food	45%	50%
Green	39%	19%
Lumber	4%	17%
Paper	12%	13%
Manure	0%	1%

Composition of Composted Commercial Tons per AB1826 (no less than 50% of 2014 organics) (For reference only)	2014	2020	2030	2050
Food		466	651	1,023
Green		181	253	398
Lumber		160	223	351
Paper		126	176	277
Manure		8	11	18

Percent of organics composted under SW-1	2014	2020	2030	2050
Food		50%	85%	80%
Green		80%	100%	100%

Composted Commercial Tons	2014	2020	2030	2050
Food		816	1,545	1,752
Green		508	707	852

Reduction Measure Quantification (continued)

RESIDENTIAL COMPOSTING		2020	2030	2050
Percent of organics composted under SW-1				
Food		50%	85%	80%
Green		80%	100%	100%
Composted Residential Tons				
Food		361	683	774
Green		499	695	837
TOTAL ORGANICS COMPOSTED INSTEAD OF LANDFILLED under SW-1				
Food		1,177	2,228	2,527
Green		1,007	1,402	1,689
Total		2,184	3,630	4,216
EMISSIONS CALCULATIONS				
Emissions reductions per ton of food waste composted instead of landfilled (MTCH4/ton)		1.566E-02	1.566E-02	1.566E-02
Emissions reductions per ton of green waste composted instead of landfilled (MTCH4/ton)		6.659E-03	6.659E-03	6.659E-03
Emissions reductions from food waste composted instead of landfilled (MTCH4)		18.433	34.891	39.566
Emissions reductions from green waste composted instead of landfilled (MTCH4)		6.707	9.335	11.247
Emissions reductions from food waste composted instead of landfilled (MTCO2e)		461	872	989
Emissions reductions from green waste composted instead of landfilled (MTCO2e)		168	233	281
Total Emissions Reduction (MTCO2e)		629	**1,106**	**1,270**
Net GHG Reduction from SW-1 (MTCO2e)		629	1,106	1,270

SW-2

Meet an 80 Percent Waste Diversion Goal by 2020 and a 90 Percent Goal by 2030	2014	2020	2030	2050
Current Diversion Rate	70%			
Target Diversion Rate		80%	90%	90%
Legislative-Adjusted Forecasted Emissions from Solid Waste Generation	19,961	3,537	3,938	4,744
Reduced Solid Waste Emissions with New Diversion Rate		2,358	1,313	1,581
Net GHG Reduction from Net GHG Reduction from SW-1 (MTCO2e) (MTCO2e)		1,179	2,625	3,163

Reduction Measure Quantification (continued)

TR-1				
Update Transportation System Management Ordinance (for Employers)		2020	2030	2050
Work-related, or Commute, VMT (from MTC)		547,462	567,609	570,091
Total Daily Passenger VMT (MTC only provided forecasts through 2040. This assumes 2040 VMT sufficiently represents 2050 VMT.)		747,377	782,909	800,945
Percent Commute		73%	72%	71%
Total Legislative Adjust BAU On-Road Transportation Emissions (MTCO2e)		112,854	84,846	85,735
Percent Passenger		94%	94%	94%
Total Legislative Adjust BAU On-Road Transportation Emissions (MTCO2e) (Commute Passenger Only)		77,703	57,768	57,213
CAPCOA TRT-1/TRT-2/TRT-3 Minimum percent reduction in VMT from Commute Trip Reduction Measures	2%			
CAPCOA TRT-1/TRT-2/TRT-3 Minimum percent reduction in VMT from Commute Trip Reduction Monitoring	4.20%			
Net GHG Reduction from TR-1 (MTCO2e)		4,818	3,582	3,547

TR-2				
Adopt parking reduction ordinance revisions		2020	2030	2050
Total Legislative Adjust BAU On-Road Transportation Emissions (MTCO2e) (Commute Passenger Only)		77,703	57,768	57,213
CAPCOA TRT-14 and TRT-15 Minimum percent reduction in VMT from Pricing Workplace Parking and Implementing Employee Parking Cash-Out	0.10%			
Net GHG Reduction from TR-2 (MTCO2e)		78	58	57

TR-3				
Increase the supply of electric vehicle charging stations		2020	2030	2050
Total Legislative Adjust BAU On-Road Transportation Emissions (MTCO2e) (Commute Passenger Only)		77,703	57,768	57,213
CAPCOA LUT-6 Minimum percent reduction in VMT from Integrating Affordable and Below Market Rate Housing	0.04%			
Net GHG Reduction from Increase the supply of electric vehicle charging stations (MTCO2e)		31.08	23.11	22.89

Reduction Measure Quantification (continued)

TR-4				
Support efforts to allow commuter service to operate on railroad rights-of-ways		2020	2030	2050
Number of rail cars in use for commuters		4	6	8
Number of passengers per rail car	80			
Round trip miles per day per passenger	40			
Commuting days per year	260			
Total Passenger Miles Travelled per year		3,328,000	4,992,000	6,656,000
Assumed occupancy rate of offset vehicles trips (persons per vehicle)	1			
Average light duty gasoline vehicle emissions per mile (g CO2e/mi) (EMFAC 2014)		246	183	215
Ratio of Caltrain locomotive to light duty gasoline vehicle emissions	0.20			
Caltrain passengers per train car (based on 677 passengers per locomotive and 5 rail cars per locomotive)	135.40			
Source: Tang et. al. 2015 (https://www.sciencedirect.com/science/article/pii/S1352231015300741?via%3Dihub) Caltrain.com (http://www.caltrain.com/about/statsandreports/commutefleets.html)				
Adjusted Ratio of Napa Valley Wine Train locomotive to light duty gasoline vehicle emissions based on difference in passengers per rail car	0.34			
Emissions from locomotives per passenger mi (g CO2e/mi)		83.38	61.98	72.89
Emissions reduced per year (MTCO2e/year)		542.26	604.68	948.03
Net GHG Reduction from TR-4 (MTCO2e)		542.26	604.68	948.03

Reduction Measure Quantification (continued)

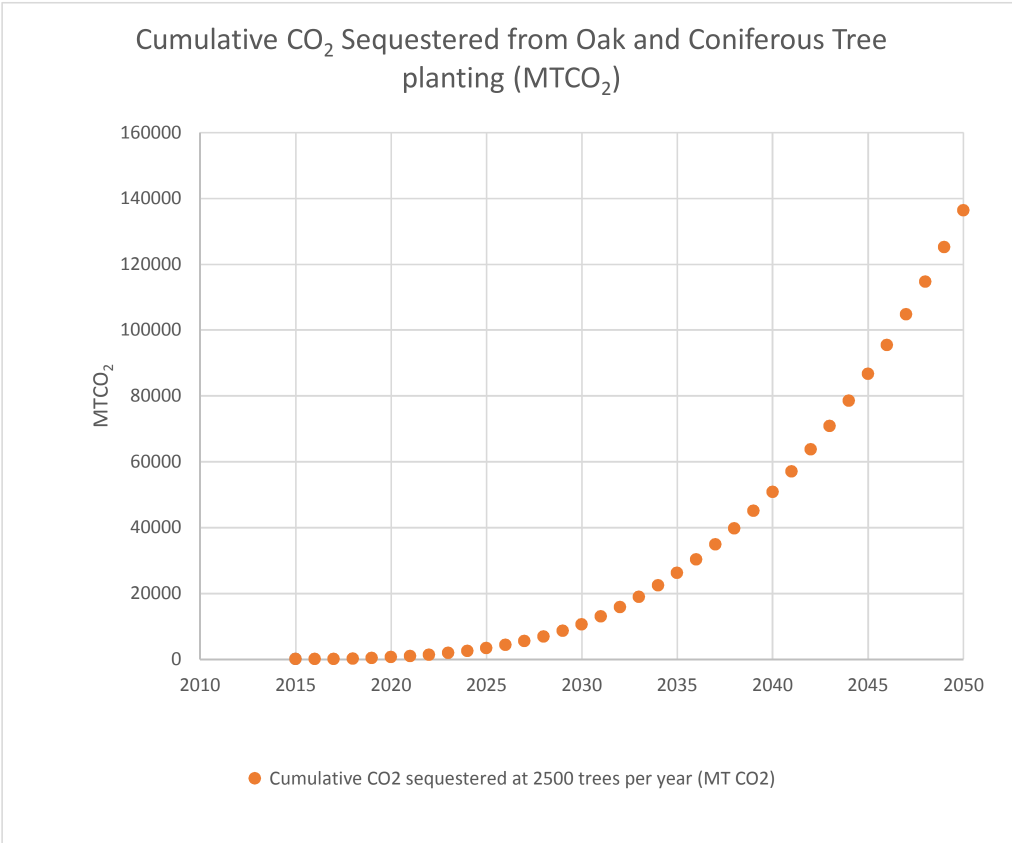
TR-5				
Support efforts of solid waste collection services to convert diesel solid waste collection vehicles to CNG		2020	2030	2050
Quantification of this measure is based on fuel use Clover Flat Landfill and UVDS in 2014			Scaled by incorporated population	
BAU Diesel Use (Gallons)		203,700	213,327	232,224
Equivalent CNG (MMBTU)		28,858	30,221	32,898
Equivalent CNG (scf)		28,098,892	31,285,854	37,695,336
Incorporated Population based on MTC forecasts		115,690	121,157	131,889
Diesel Emission Factor (kg CO2/gal)	10.21			
Diesel Emission Factor (kg CH4/gal)	5.04E-04			
Diesel Emission Factor (kg N2O/gal)	3.60E-04			
CNG Emission Factor (kg CO2/scf)	0.05			
CNG Emission Factor (kg CH4/scf)	2.67E-06			
CNG Emission Factor (kg N2O/scf)	1.91E-06			
Factor sources: The Climate Registry 2015 and SEMS (as sourced by Edgar & Associates 2016)				
BAU Diesel Emissions (MTCO2e)		2,104	2,203	2,398
Project CNG Emissions (MTCO2e)		1,535	1,709	2,059
Emissions Difference from BAU		568	494	339
50% Apportionment to account for customers in the incorporated areas, consistent with the RTAC method used in the Transportation Sector.		284.16	246.81	169.29
Net GHG Reduction from TR-5 (MTCO2e)		284.16	246.81	169.29

LU-1: Carbon Storage Loss and Potential Associated with Loss and Replanting of Oak and Coniferous Trees

Calculation of Equivalent New Tree Planting to Offset Lost Carbon Storage/Sequestration		
preserved under project-level avoidance (%)	30%	
Forecasted Annual Emissions from Lost Oak and Coniferous Trees (MT CO2e)		
2020	22,757	
2030	8,475	
2050	14,032	
Emissions saved from conserved trees (MT CO2e)		
2020	6,827	
2030	2,543	
2050	4,210	
Replaced Trees		
Maximum number of trees replanted **per year** (trees)	2,500	Assumes constant rate of tree removal
Mortality Rate (%)	20%	
Annual Emissions Sequestered from Planted Trees (MT CO2e)		Accounts for growth rates over time
2020	249	
2030	2,002	
2050	11,150	
Total Emissions Reductions from LU-1 (MT CO2e)		
2020	7,077	
2030	4,544	
2050	15,360	

Cumulative Carbon Storage

Year	Annual Oak Trees Lost (Forecasted)	Annual Coniferous Trees Lost (Forecasted)	Annual Oak and Coniferous Trees Replanted	Cumulative CO2 sequestered at 2500 trees per year (MT CO2)	Annual Sequestration from Replanted Trees (MTCO2/year)
2015	5203	529		-	
2016	6808	1986		-	-
2017	8412	3443	2500	4	4
2018	10016	4901	2500	150	146
2019	11620	6358	2500	342	191
2020	13224	7815	2500	591	249
2021	12568	7038	2500	911	320
2022	11911	6261	2500	1,315	404
2023	11255	5483	2500	1,832	518
2024	10598	4706	2500	2,483	651
2025	9942	3929	2500	3,288	805
2026	9285	3151	2500	4,270	982
2027	8629	2374	2500	5,456	1,186
2028	7972	1597	2500	6,876	1,420
2029	7316	819	2500	8,565	1,689
2030	6659	42	2500	10,567	2,002
2031	6696	130	2500	12,939	2,372
2032	6732	217	2500	15,764	2,825
2033	6769	305	2500	18,892	3,129
2034	6805	392	2500	22,342	3,450
2035	6842	479	2500	26,131	3,789
2036	6878	567	2500	30,276	4,145
2037	6915	654	2500	34,795	4,520
2038	6951	742	2500	39,707	4,912
2039	6988	829	2500	45,031	5,324
2040	7025	917	2500	50,785	5,754
2041	7061	1004	2500	56,989	6,204
2042	7098	1092	2500	63,661	6,672
2043	7134	1179	2500	70,822	7,161
2044	7171	1267	2500	78,492	7,669
2045	7207	1354	2500	86,690	8,198
2046	7244	1442	2500	95,437	8,747
2047	7280	1529	2500	104,753	9,316
2048	7317	1617	2500	114,660	9,907
2049	7353	1704	2500	125,178	10,518
2050	7390	1791	2500	136,328	11,150



Cumulative CO_2 Sequestered from Oak and Coniferous Tree planting ($MTCO_2$)
$MTCO_2$
160000
140000
120000
100000
80000
60000
40000
20000
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
Cumulative CO2 sequestered at 2500 trees per year (MT CO2)

GHG Reduction Target Calculations		
Year	**State Emissions (million metric tons of CO_2 equivalent based upon IPCC Fourth Assessment Report's Global Warming Potentials - all sectors) (1)**	**State Population (2)**
1990	431	
2013	459	38,030,609
2014 (Emissions scaled by population from 2013)	463	38,357,121
State Targets		**Applicable Rule**
Percent below 1990 emissions by 2020	0%	AB 32
Percent below 1990 emissions by 2030	40%	EO B-30-15
Percent below 1990 emissions by 2050	80%	EO B-30-15
Equivalent State Targets for Reduction below 2014		**Applicable Rule**
Percent below 2014 emissions by 2020	7%	AB 32
Percent below 2014 emissions by 2030	44%	EO B-30-15
Percent below 2014 emissions by 2050	81%	EO B-30-15
Source: (1) ARB 2015 applies to 1990 and 2013 inventories only (http://www.arb.ca.gov/cc/inventory/data/data.htm), (2) DOF 2015 (http://www.dof.ca.gov/research/demographic/reports/estimates/e-7/view.php)		

Legislative Reductions and Existing Programs					
Lead Agency	**Sector**	**Measure Name**	**Measure Description**	**Current or Recommended**	**Included in Inventory Forecasts?**
State	Building Energy	Renewable Portfolio Standard	The State has a goal of achieving a 33% renewable portfolio standard (RPS) for electricity generated and sold to retail customers in the State by 2020.	Current	Yes
State	Building Energy	Senate Bill (SB) 350	Signed into law in October 2015, Senate Bill (SB) 350 extends the State's Renewable Portfolio Standard (RPS) target from 33% by 2020 to 50% renewables by 2030. In addition, SB 350 calls for a doubling of building energy efficiency by 2030.	Current	Yes
State	Building Energy	Title 24 Building Energy Efficiency Standards	The 2016 Title 24 building energy efficiency standards were adopted in December 2015 and will go into effect January 2017. The California Energy Commission (CEC) estimates that new residential buildings built to these standards would be 28 percent more efficient than buildings built to the current 2013 Title 24 standard. Relative savings for non-residential buildings was not readily available from the CEC; thus, it was assumed that non-residential buildings built to 2016 standards would have similar improvements as the residential standards.	Current	Yes
PG&E	Building Energy	Napa County Energy Watch Program	Free evaluation of energy usage from residences and businesses. Connects utility customers with available financing and low cost options for energy upgrades.	Current	No
Napa County / MCE	Building Energy	Participation in Marin Clean Energy (MCE)	In February 2015, Marin Clean Energy (MCE), a local Community Choice Aggregator, began serving the unincorporated portions of Napa County. MCE automatically provides customers within its service area with 50 percent renewable electricity, although customers are allowed to opt out of MCE's service or pay into MCE's "Dark Green" program that would allow for a higher percentage renewable mix. Those that opt out would remain under PG&E's electricity service, which is currently 27% renewable. MCE currently has an average participation rate of 89%. According to MCE's Integrated Resource Plan, MCE plans to increase the minimum renewable energy supply of the program from 50 to 80% by 2025.	Current	Yes
State	High GWP Gases	Refrigerant Management Program (RMP)	The RMP requires facilities with refrigeration systems with more than 50 pounds of high-global warming potential (GWP) refrigerant to conduct and report periodic leak inspections; promptly repair leaks; and keep service records on site. Small facilities are to begin reporting in March 2016. Applicable facilities are required to pay fees to ARB with the fee amount determined by the facility's size category (small, medium, or large) and amount of high-GWP refrigerant used.	Current	Yes
Federal	High GWP Gases	Federal Ban on Certain Hydrofluorocarbons (HFCs)	On August 19, 2015, the EPA enacted a national ban on a variety of HFC emissions with very high-GWP values (many over 2,500) under 40 CFR Part 82. ARB estimates that this ban would reduce California's HFC emissions by ten percent annually below current emission rates by 2025.	Current	Yes

Lead Agency	Sector	Measure Name	Measure Description	Current or Recommended	Included in Inventory Forecasts?
BAAQMD/Napa County	On-Road Transportation	Commuter Benefits Program	Under the purview of MTC, Bay Area employers with 50 or more employees are now required to register and offer commuter benefits to their employees in order to comply with the Bay Area Commuter Benefits Program. Through this program, employers must offer their employees one of four Commuter Benefit options in order to comply with BAAQMD Regulation 14, Rule 1. Commuter benefits encourage employees to take transit, vanpool, carpool, bicycle and walk rather than drive alone to work. Certain federal tax benefits apply. Napa County offers additional incentives for vanpool drivers, bike commuters, and emergency ride home programs.	Current	No
Napa County	On-Road Transportation	County Employee Local Housing Fund	The County's existing program encourages County employees to buy homes locally to reduce commute travel distances and VMT. The program offers down payment financial assistance up to 10% of the home's purchase price at below market interest rates as long as the home is located within Napa County.	Current	No
NCTPA	On-Road Transportation	Expand and improve bicycle and pedestrian network	The Napa County Transportation and Planning Agency (NCTPA) has adopted a long-range strategic goal of having 10% of all trips made by bicycle in Napa County by 2035. Some efforts are already being made under the NCTPA Countywide Bicycle Plan.	Current	No
State/Federal	On-Road Transportation	Advancements in Fuel Efficiency and Clean Fuels	The State and Federal governments have several policies in place that address fuel efficiency and alternative fuels. These include the Advanced Clean Car rule, CAFÉ standards, Federal Pavley regulations, and Tractor-Trail Greenhouse Gas regulations.	Current	Yes
BAAQMD	Solid Waste	Reduce methane emissions from Municipal Solid Waste Landfills	In August 2011, BAAQMD entered into a memorandum of understanding with ARB to implement and enforce this regulation, including engineering review of LFG collection system design plans. Each of the 14 active landfills in the Bay Area applied for permits for alterations for their gas collection systems. These permits include conditions to test for methane from flares and energy recovery devices per the ARB landfill regulation.	Current	Yes
State	Solid Waste	Landfill Methane Control Measure	ARB approved a new regulation that reduces emissions of methane, a greenhouse gas, from municipal solid waste (MSW) landfills. The regulation, which became effective June 17, 2010, is a discrete early action greenhouse gas emission reduction measure, as described in the California Global Warming Solutions Act (“AB 32”). The regulation primarily requires owners and operators of certain uncontrolled MSW landfills to install gas collection and control systems, and requires existing and newly installed gas and control systems to operate in an optimal manner. The regulation allows local air districts to voluntarily enter into a memorandum of understanding (MOU) with ARB to implement and enforce the regulation and to assess fees to cover costs.	Current	Yes
State	Solid Waste	Statewide 75% Waste Diversion Goal	The California Department of Resources Recycling and Recovery (CalRecycle) established a target pursuant to AB 341 (Chapter 476, Statutes of 2011) to achieve a statewide waste diversion rate of 75 percent by 2020, or 2.7 pounds of waste per resident per day (lb/resident/day).	Current	Yes

Lead Agency	Sector	Measure Name	Measure Description	Current or Recommended	Included in Inventory Forecasts?
DWR	Water	Water Conservation Rebates	The California Department of Water Resources has a rebate program that provides rebates for removing turf and replacing toilets at California single-family residences to support the State's drought response. This program is financed by the Proposition 1 water bond approved by voters in 2014.	Current	No
Napa County	Water	Washer rebate	Residents in unincorporated Napa County are eligible for clothes washer rebates for up to $150 from PG&E and the County.	Current	No

Appendix C

Climate Change Vulnerability Assessment for Napa County

1 Introduction

The purpose of this vulnerability assessment is to identify the primary climate change threats facing Napa County (County) and its vulnerability to these threats.

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the World Meteorological Organization and the United Nations Environment Programme to provide the world with a scientific view on climate change and its potential effects. Global climate change has the potential to result in many adverse effects on natural resources and the human population. These include:

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

These changes over the long term have the potential for a wide variety of secondary impacts including detrimental impact on human health and safety, economic continuity, water supply, ecosystem function, and provision of basic services (CNRA 2012a:3). On a more local level, climate change is already affecting and will continue to affect the physical environment throughout California, the Bay Area, and the County. However, specific effects and impacts of climate change on the County vary because of physical, social, and economic characteristics. For this reason, it is important to identify the projected severity these impacts could have on the County and ways the County can reduce vulnerability to projected climate changes. Communities that begin to plan now will have the best options for adapting to climate change and increasing resilience (CNRA 2012a:4).

2 Climate Change Adaptation Planning Process

The California Adaptation Planning Guide (APG) provides climate adaptation planning guidance to cities, counties, and local governments. The APG, developed by the California Emergency Management Agency (CalEMA) and California Natural Resources Agency (CNRA), introduces the basis for climate change adaptation planning and details a step-by-step process for local and regional climate vulnerability assessment and adaptation strategy development (CNRA 2012a:i). As shown below in Figure 1, the planning process follows a sequence of steps:

Figure 1: The Nine Steps in Adaptation Planning Development

1. Exposure: assessing exposure to climate change impacts

2. Sensitivity: assessing community sensitivity to the exposure

3. Potential Impacts: assessing potential impacts

4. Adaptive Capacity: evaluating existing community capacity to adapt to anticipated impacts
5. Risk and Onset: evaluating risk and onset, meaning the certainty of the projections and speed at which they may occur
6. Prioritize Adaptive Needs: setting priorities for adaptation needs
7. Identify Strategies: identifying strategies to address adaptation needs
8. Evaluate and Prioritize: evaluating and setting priorities for strategies
9. Phase and Implementation: establishing a phasing and implementation plan

The first five steps of the process represent the vulnerability assessment phase, which is a method for determining the potential impacts of climate change on community assets and populations. The severity of these impacts and the community's ability to respond will determine how these impacts affect a community's health, economy, ecosystems, and socio-cultural stability. The second phase of the process is adaptation strategy development. The vulnerability assessment phase helps communities understand climate change impacts so that they can prepare effective climate adaptation strategies to increase resilience to climate change. Development of climate adaptation strategies will be included in the main body of the County's Climate Action Plan (CAP).

3 Vulnerability Assessment

A vulnerability assessment involves the first five steps in climate change adaptation planning development, and is intended to answer the following questions:

1. Exposure: What climate change effects will a community experience?
2. Sensitivity: What aspects of a community (i.e., functions, structures, and populations) will be affected?
3. Potential Impacts: How will climate change affect the points of sensitivity?
4. Adaptive Capacity: What is currently being done to address the impacts?
5. Risk and Onset: How likely are the impacts and how quickly will they occur?

Based on the work of IPCC and research conducted by the State and partner agencies and organizations, climate change is already affecting the County and will continue to further in the future. These effects are analyzed further below.

3.1 Step 1: Exposure

The first step in the vulnerability assessment is to identify what climate change effects the County will experience in the future. For purposes of this assessment, where possible, climate change effects in the County are characterized for two periods of time: midcentury (around 2050) and the end of the century (around 2100). Historical data are used to identify the degree of change by these two future periods in time.

The direct, or primary, changes analyzed for the County include average temperature, annual precipitation, and sea-level rise. Secondary impacts, which can occur because of individual or a combination of these changes, are also assessed and include extreme heat and its frequency, wildfire risk, and flooding (CNRA 2012a:16-17).

To begin identifying these impacts, the APG encourages communities to use Cal-Adapt as a means of assessing potential climate change impacts over time. Cal-Adapt is a climate change scenario planning tool developed by the California Energy Commission (CEC) and the University of California Berkeley Geospatial Innovation Facility. Cal-Adapt currently downscales global climate simulation model data to local and regional resolution under two emissions scenarios: the A-2 scenario represents a higher business-as-usual future global greenhouse has (GHG) emissions scenario, while the B-1 scenario represents a lower future GHG emissions scenario. Results from both emissions scenarios are considered in this vulnerability assessment and distinguished where possible.

While Cal-Adapt provides information on a local level, county-wide data are not readily available for all climate change effects. Most of the data presented in Cal-Adapt has been “downscaled” to grid cells that are 12 kilometer (km) by 12 km (approximately 60 square miles) in size and cannot be easily aggregated. Within the County, over a dozen grid cells are located entirely or partially within boundaries. For purposes of this vulnerability assessment, where County-wide data were not available, the same grid cell in the County was used for consistency.

Cal-Adapt data for each impact for the County are summarized in the sections below.

3.1.1 Increased Temperatures

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

Figures 1 and 2 below show the projected change in annual average temperatures across the County under the low-emissions scenario (i.e., Figure 1) and high-emissions scenario (i.e., Figure 2).

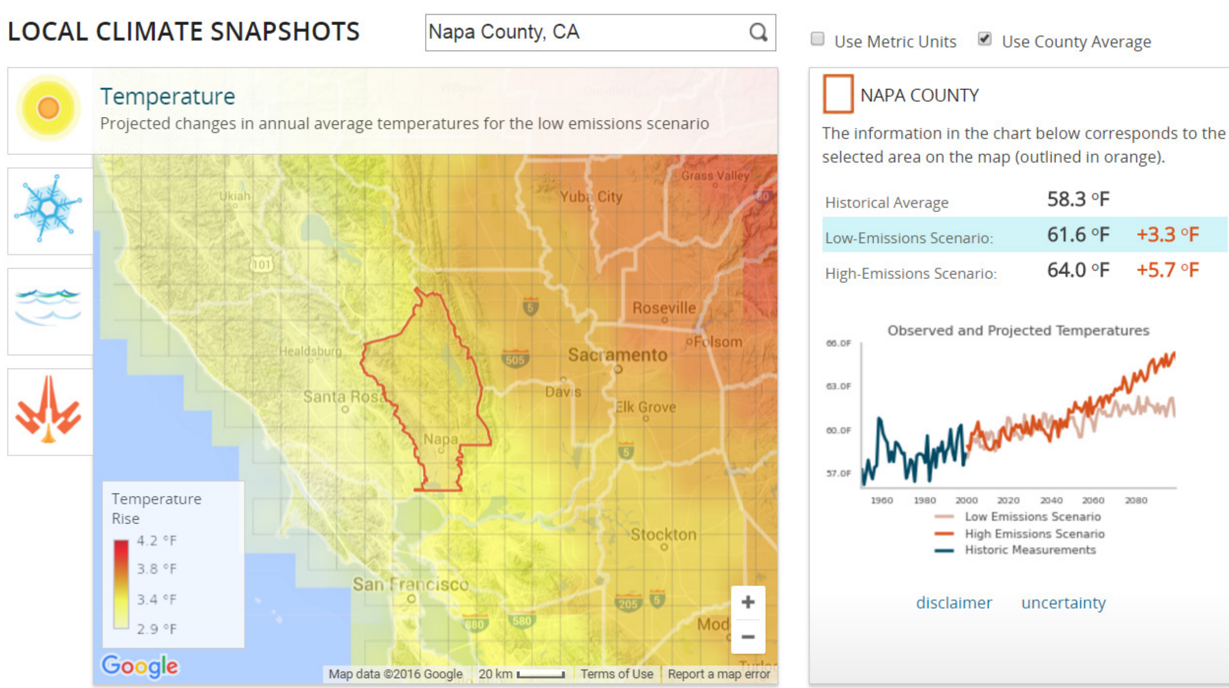


Figure 2: Projected Changes in Annual Average Temperatures for the Low-Emissions Scenario (1960-2090) (Source: CEC 2016)

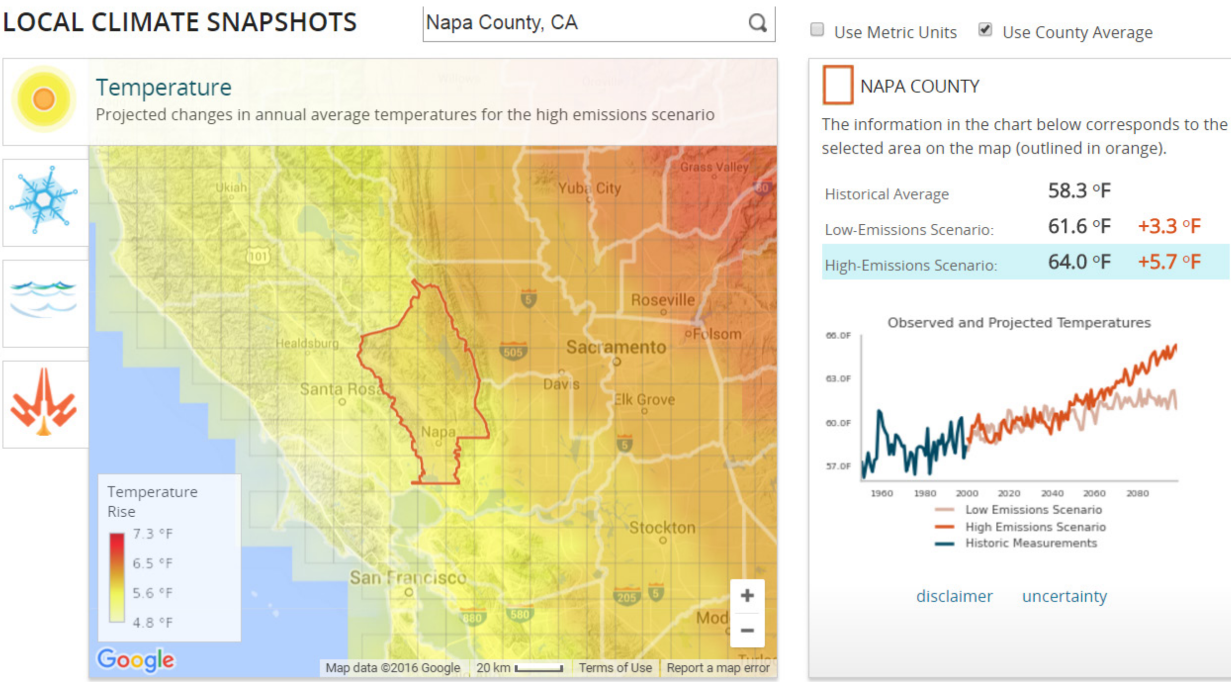


Figure 3: Projected Changes in Annual Average Temperatures for the High-Emissions Scenario (1960-2090) (Source: CEC 2016)

Figures 2 and 3 show that annual average temperatures in the County are projected to climb steadily. The County's historical average temperature, based on data from 1960-1990, is 58.3 ° F. Under the low-emissions scenario in Figure 2, annual average temperature is projected to increase to 61.6 ° F by 2090, an increase of 3.3 ° F. The annual average temperature under the high-emissions scenario in Figure 3 is projected to increase 5.7 ° F to 64.0 ° F by the end of the century.

The County's average annual low temperature, based on historical data from 1960-1990, is 44.4 ° F. Under the low-emissions scenario, annual low temperature is projected to increase to 48.56 ° F by 2090, an increase of 4.12 ° F. The annual average low temperature under the high-emissions scenario is projected to increase to 50.66 ° F in 2090 (i.e., an increase of 6.22 ° F). Historically, annual high temperatures average 70.47 ° F. Annual average high temperature is projected to increase under the low-emissions scenario by 2.94 ° F to 73.41 ° F. Under the high-emissions scenario, annual average high temperature is projected to increase to 76.32 ° F, an increase of 5.85 ° F.

3.1.2 Increased Frequency of Extreme Heat Events and Heat Waves

Changes in precipitation patterns and increased temperatures associated with climate change will alter the distribution and character of natural vegetation and associated moisture content of plants and soils (CNRA 2012b:11). Increased temperature is also expected to lead to secondary climate change impacts including increases in the frequency, intensity, and duration of extreme events and heat waves in California. Using Cal-Adapt's Extreme Heat tool, historical data from the County was used to project the change in frequency of extreme heat days, warm nights, and heat waves (including their occurrence during the year) for the low- and high-emissions scenarios in 2050 and at the end of the century (2099).

Extreme Heat Events

Cal-Adapt defines the extreme heat day threshold for the County as 92 ° F or higher. An extreme heat day is defined as a day between April through October where the maximum temperature exceeds the historical maximum temperatures from 1961-1990. The County has a historical average of four extreme heat days a year. Figures 4 and 5 below show the number of days the County is projected to exceed the area's extreme heat day threshold for each year from 1950-2099 under both emissions scenarios.

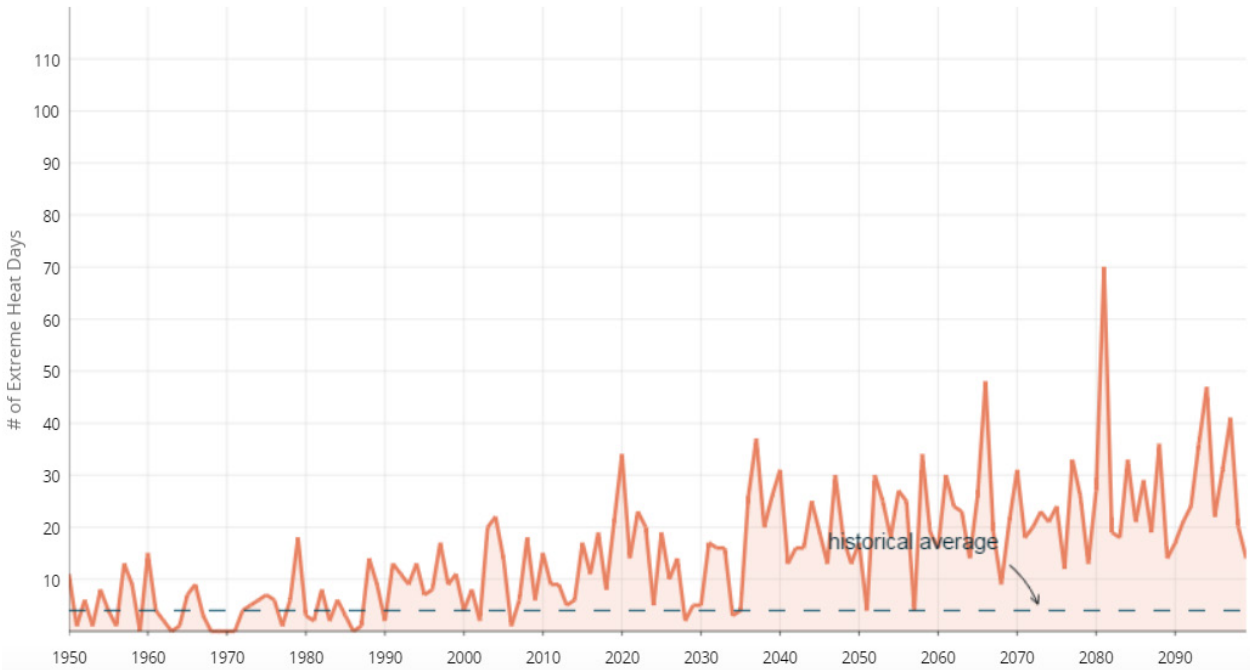


Figure 4: Number of Extreme Heat Days in Napa County Under the Low-Emissions Scenario (1950-2099) (Source: CEC 2016)

Cal-Adapt data show a range of projected increases in the number of extreme heat days by 2099, all of which are at least double the historical average in both emissions scenarios. The projected annual average number of extreme heat days is between roughly 23-26 days per year in 2050 to 54-64 days per year towards the end of the century.

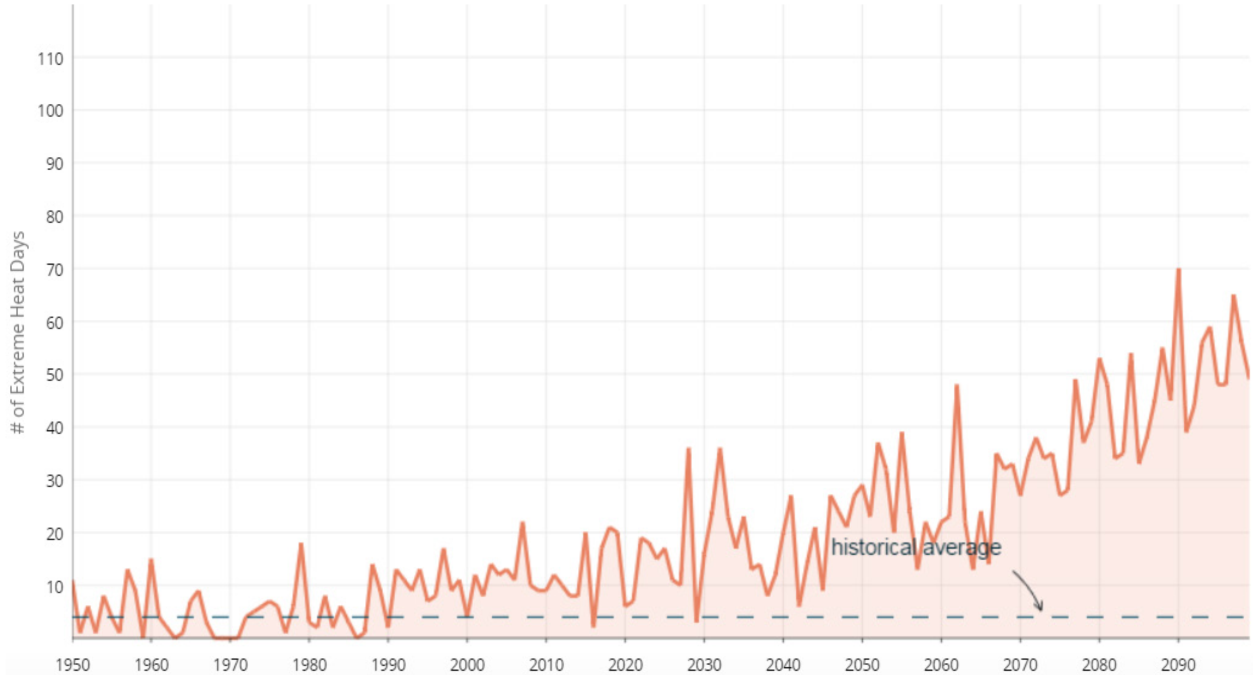


Figure 5: Number of Extreme Heat Days in Napa County Under the High-Emissions Scenario (1950-2099) (Source: CEC 2016)

In combination with extreme daytime heat, extremely warm nights are also an important factor to consider. A warm night is defined as a day between April through October where the minimum temperature exceeds the historical minimum temperatures between 1960-1990. Historically, the County has an average of four warm nights a year, with a threshold of 56 ° F. Under both the high- and low-emissions scenarios, the number of warm nights is expected to significantly increase, with an average of 17-41 warm nights in 2050 to 30-100 warm nights in 2099.

Frequency and Timing of Heat Waves

Along with individual days and nights exhibiting extreme temperature, events in which these extreme temperatures are experienced over a period of several days are known as heat waves. Cal-Adapt identifies a heat wave as an event in which the extreme heat threshold (i.e., 92 ° F in the County) is exceeded for a period of five days. Figures 6 and 7 below show the count of heat wave events in the County for each year between 1950-2099 under the low- and high-emissions scenarios. Each five-day period exceeding the extreme heat threshold is counted, so a 20-day heat wave would appear on the figures as four counted periods.

As shown in Figures 6 and 7 above, heat waves in the County are infrequent, with no more than two heat waves occurring in one year between 1950 and 2016. However, the model projects a significant rise in the frequency of heat waves under both emissions scenarios. Under the low emissions scenario, projections show an increase of heat wave events with around three at the middle of the century and up to seven in 2090. The high emissions scenario also shows an increase in heat wave events, with up to five heat wave events occurring midcentury and as high as 16 heat events at the end of the century.

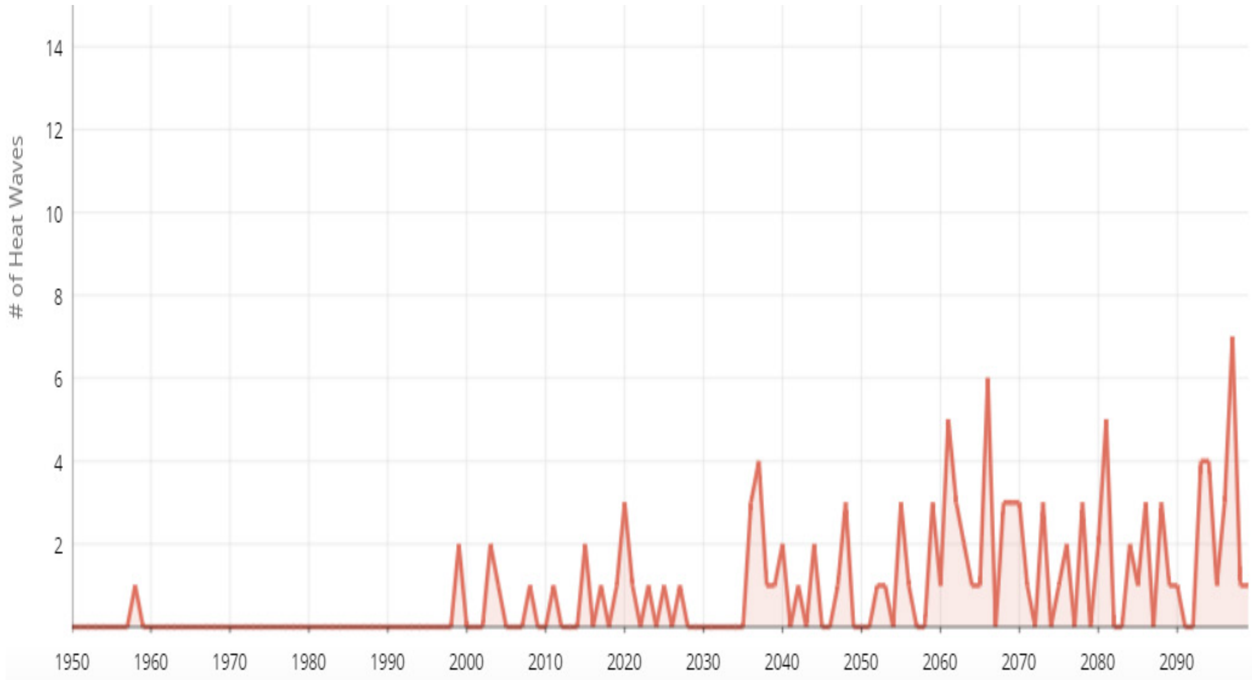


Figure 6: Number of Heat Waves in Napa County Under the Low-Emissions Scenario (1950-2099) (Source: CEC 2016)

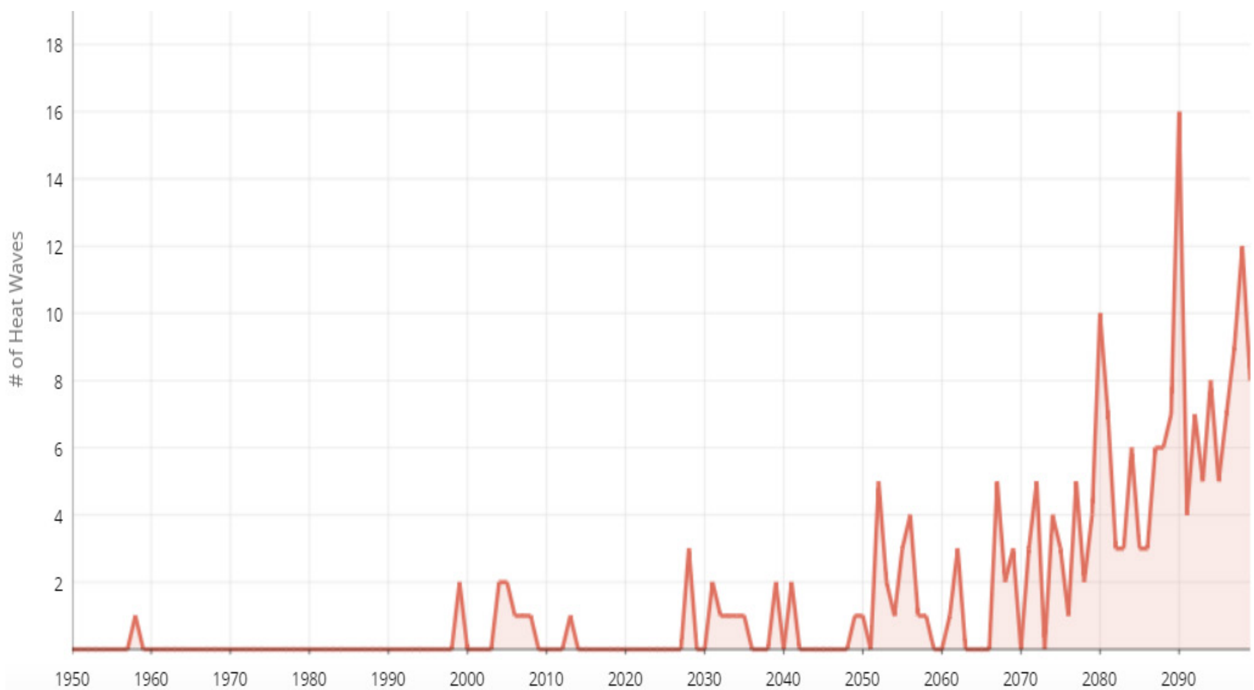


Figure 7: Number of Heat Waves in Napa County Under the High-Emissions Scenario (1950-2099) (Source: CEC 2016)

Another consideration with respect to the number of extreme heat events is the time of year when they may occur. Figures 8 and 9 below show the time of year that extreme heat conditions are projected to occur under both emissions scenarios between 1950-2099. A point on each of the figures represents each day that exceeds the extreme heat threshold for the County and what time of year, between April through October, that it occurs.

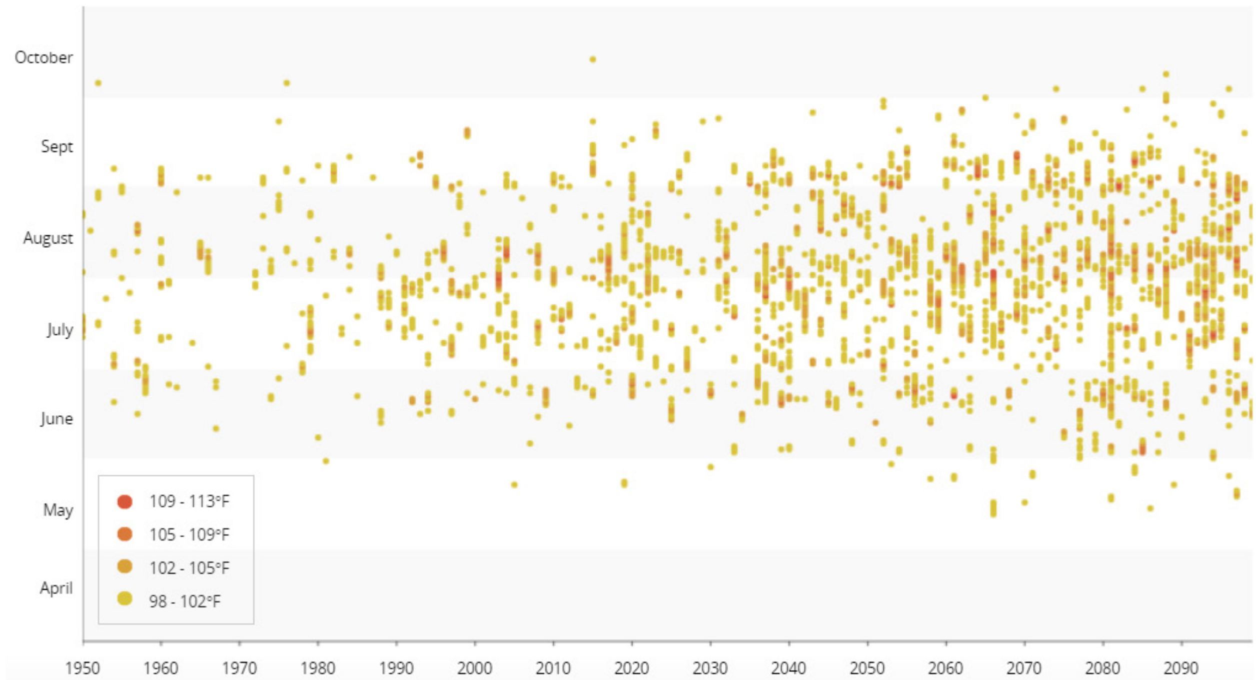


Figure 8: Timing of Extreme Heat Days by Year in Napa County Under the Low-Emissions Scenario (1950-2099) (Source: CEC 2016)

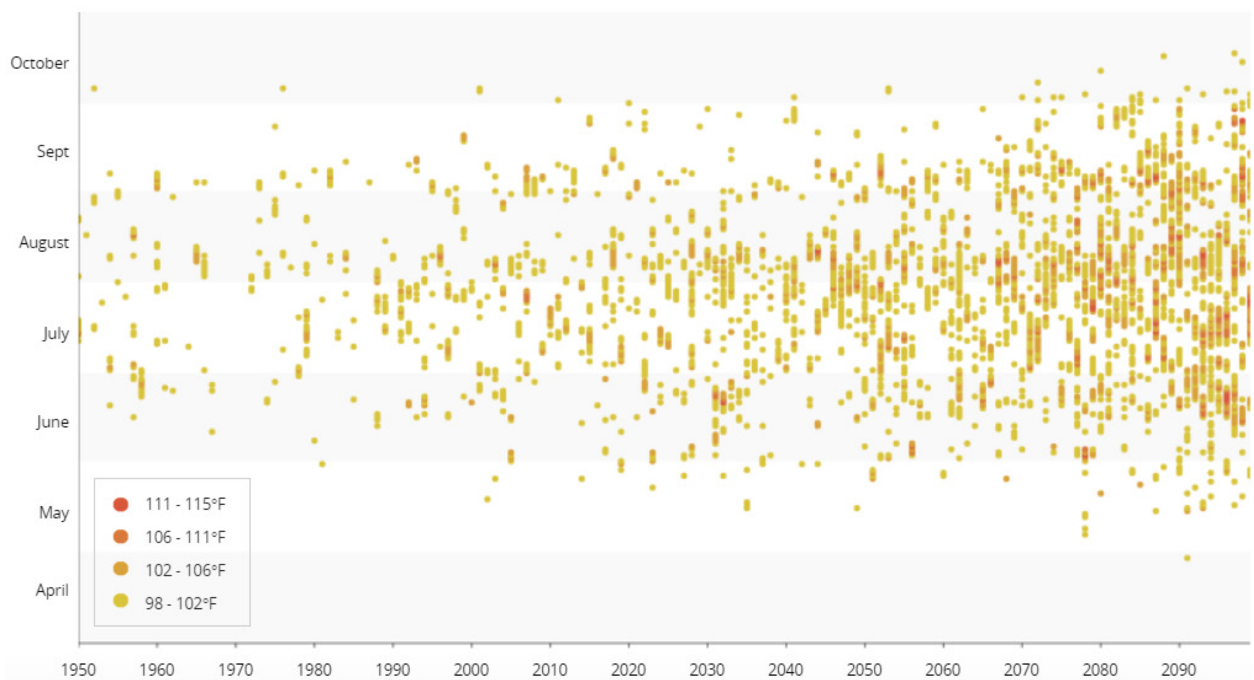


Figure 9: Timing of Extreme Heat Days by Year in Napa County Under the High-Emissions Scenario (1950-2099) (Source: CEC 2016)

As shown in Figures 8 and 9 above, the County has a history of exceeding the extreme heat threshold starting in late May/early June and ending in mid-September. As shown under both emissions scenarios, the model projects not only an increase in the frequency of exceeding the extreme heat threshold, but also their occurrence both earlier and later in the season. In Figure 9 under the high emissions scenario, longer sustained periods of exceeding the extreme heat threshold will also result in more frequent and sustained heat wave events earlier and later in the season towards the end of the century.

Changes to Precipitation Patterns

Global climate change will affect physical conditions beyond average temperatures, including changes to precipitation patterns. While projections generally show little change in total annual precipitation in California and trends are not consistent, even modest changes could have a significant effect on California ecosystems that are conditioned to historical precipitation levels (CEC 2016). Reduced precipitation could lead to higher risks of drought, while increased precipitation could cause flooding and soil erosion (CNRA 2014: 25). Changes in weather patterns resulting from increases in global average temperature could also result in a decreased volume of precipitation falling as snow in California and an overall reduction in snowpack in the Sierra Nevada. Based upon historical data and modeling, the California Department of Water Resources (DWR) projects that the Sierra snowpack will decrease by 25 to 40 percent from its historic average by 2050 (DWR 2008:4).

While the County is not located in an area where snow typically accumulates, major water districts and utilities in the County receive a significant amount of water from the State Water Project, which depends on spring and early-summer snowmelt in the Sierra Nevada for water supply. Additionally, agricultural water users in the unincorporated areas of the County are the primary user of groundwater (Napa County 2005:2). Increased average temperatures and changes in the timing and amounts of precipitation could affect local aquifer recharge for groundwater supplies, and thus the County could face increasing challenges of providing adequate water supplies because of increased uncertainty in the amount and timing of water availability to meet future demand. If demand continues to increase, water users could face shortages in normal or dry years.

Increased Wildfire Risk

Changes in precipitation patterns and increased temperatures associated with climate change will alter the distribution and character of natural vegetation and associated moisture content of plants and soils. (CNRA 2012b:11). Increased temperature and frequency of extreme heat events, along with changes in precipitation patterns, can lead to a secondary impact of climate change: an increase in the frequency and intensity of wildfires (CNRA 2012a:17).

According to Napa County's Operational Area Hazard Mitigation Plan, the County has a history of wildfires. Before the 2017 wildfires, more than 200,000 acres of the County's 482,000 acres burned in the last thirty years, most of which occurred in the unincorporated areas (Napa County 2013:12). Mitigation efforts, including adoption of the 2010 Uniform Fire Code, the Firewise Program, and the Chipping Program, have helped reduce the County's wildfire risk, but it is still vulnerable and at high-risk for wildfires, as evidenced by the 2017 wildfires (Napa County 2013: 77). The 2017 California wildfire season was one of the most destructive seasons on record, occurring in a year of record-setting heat and persistent drought (CALFIRE 2017, 2018a, b, c). In October 2017, a series of wildfires broke out across Napa, Lake, Sonoma, Mendocino, Butte, and Solano Counties, burning over 245,000 acres. According to CALFIRE and various news outlets, the fires resulted in at least 44 casualties, the hospitalization of 185 people, and the destruction of an estimated 8,900 structures (CALFIRE 2017). Napa County was greatly impacted by the fires, with over 70,000 acres burned, and 1,200 structures damaged or destroyed, including more than 700 residences (Napa County 2018). Currently, the major wildland fire hazards risks for residential development are in the County's hilly areas characterized by steep slopes, poor fire suppression delivery access, inadequate water supply and highly flammable vegetation (Napa County 2013:75).

Figure 10 below depicts that fire risk relative to 2010 levels under the low-emissions scenario is 11 percent more likely to occur in 2020 than it would have in 2010, 15 percent more likely to occur in 2050, and 12 percent more likely to occur in 2085. Under the high-emissions scenario, as depicted in Figure 11 below, fire risk is 14 percent more likely to occur in 2020 than it would have in 2010, 13 percent more likely in 2050, and 22 percent more likely to occur in 2085. Given that the County is currently at risk for wildfire, these increases of between 10 and 20 percent under both emissions scenarios is significant and can cause additional threats and vulnerability.

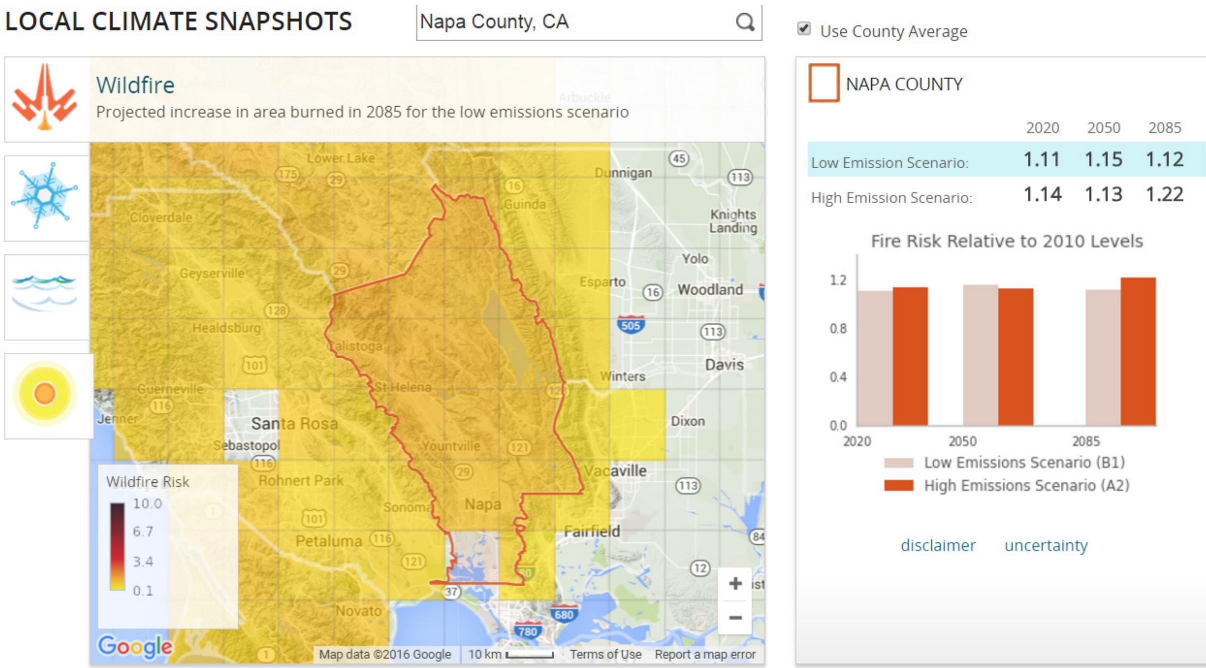


Figure 10: Projected Increase in Fire Risk Relative to 2010 Levels in Napa County for 2020, 2050, and 2085 (Source: CEC 2016)

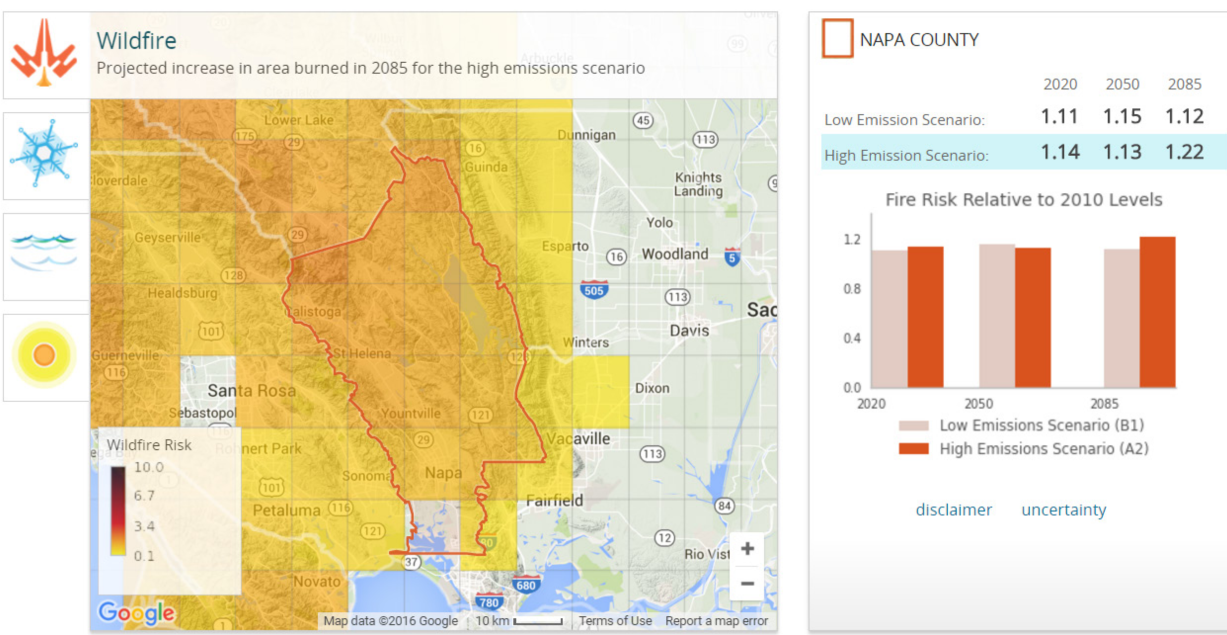


Figure 11: Projected Increase in Fire Risk Relative to 2010 Levels in Napa County for 2020, 2050, and 2085 (Source: CEC 2016)

Increased Likelihood of Flooding

Climate change is likely to lead to changes in frequency, intensity, and duration of extreme events, such as heavy precipitation and rainfall intensity. These projected changes could lead to increased flood magnitude and frequency and could place more pressure on the County, destroying land, buildings, roads, and crops (IPCC 2001:14).

According to Napa County's Operational Area Hazard Mitigation Plan, the County is considerably vulnerable to flooding. Flooding has caused the most disaster declarations and the most damage and loss of life historically in the County, with floods usually occurring during the season of highest precipitation or during heavy rainfalls after prolonged dry periods (Napa County 2013:11). The County is dry during the late spring, summer, and early fall and receives most of its rain during the winter months. A majority of the land adjacent to the Napa River is subject to flooding that has a one percent probability of occurring in any given year, or a 100-year flood event (Napa County 2013:58). While it is uncertain exactly how and to what extent climate change will affect flooding events in the County, it is reasonable to assume that any increase in flooding could have serious ramifications as the area is already considerably vulnerable. Additional information on increased risk of flooding, which could be exacerbated by sea-level rise in the southern portion of the County, is included below.

Sea-Level Rise

Another outcome of global climate change is sea-level rise. The average global sea level rose approximately seven inches during the last century. If sea-level changes along the California coast continue to reflect global trends, sea level along the State's coastline in 2050 could be 10-18 inches (0.25-0.45 meters [m]) higher than in 2000, and 31-55 inches higher (0.78-1.4 m) than 2000 levels by the end of this century (CNRA 2012b:9).

According to the CEC's 2012 report, *The Impacts of Sea-Level Rise on the San Francisco Bay*, currently 140,000 people, or 2 percent of the region's population, live in areas currently at risk of being inundated in a 100-year flood event. A 1.0 m rise in sea level will put an additional 80,000 people at risk, increasing the total number of people at risk to 220,000. With a 1.4 m rise in sea- levels, the number of people at risk of a 100-year flood event would increase to 270,000, an additional 130,000 people.

The southwestern portion of the County includes the mouth of the Napa River, which forms a tidal estuary that drains into San Pablo Bay. Less than one percent of the County's population is considered at risk and vulnerable to sea-level rise (CEC 2012:14 and Census 2014). Some critical infrastructure (i.e., roads, hospitals, schools, emergency facilities, and properties) are at risk in the County, including American Canyon Power Plant and the Napa Sanitation District Water Treatment Plant are vulnerable to a 100-year flood event with a 1.4 m sea-level rise (CEC 2012:23).

Using data developed for the Our Coast, Our Future effort, led by the United States Geological Survey (USGS), the Cal-Adapt tool depicts sea-level rise projections and existing storm-related flooding events using the Coastal Storm Modeling System (CoSMoS). CoSMos depicts coastal flooding projections for the San Francisco Bay Area due to the combination of sea-level rise and storm events, while also accounting for physical protective structures (e.g. levees), waves, tides, surge, steric effects, and fluvial discharge erosion, and other hydrodynamical factors.

Figure 12 shows land in the County that is both currently and projected to be vulnerable to flooding because of a 100-year flood event, a 1.5 m in sea-level rise, and other hydrodynamical factors. Because the CoSMos model accounts for physical structures, such as levees that protect against a 100-year flood event, only approximately 36 acres in the County are currently at risk for flooding. Taking a 1.5 m rise in sea level into account, along with other storm factors, the tool projects an additional 13,000 acres would be inundated by a 100-year flood event. Most of the area that is at risk is currently undeveloped or used for agricultural purposes. Specific areas along the Napa River include Buchli, Cuttings Wharf, Thompson, and Imola, along with areas further north along the Napa River, including some industrial uses, wineries, and parts of Downtown Napa (i.e., up to 3rd Street and portions east of State-Route 29). Additional portions of Thompson, Middleton, and American Canyon also have some flood-prone low-lying areas that would become more vulnerable to flooding because of sea-level rise. While the Napa County Airport itself is not at immediate risk for inundation, adjacent areas to the west are at increased risk of flooding due to sea-level rise.

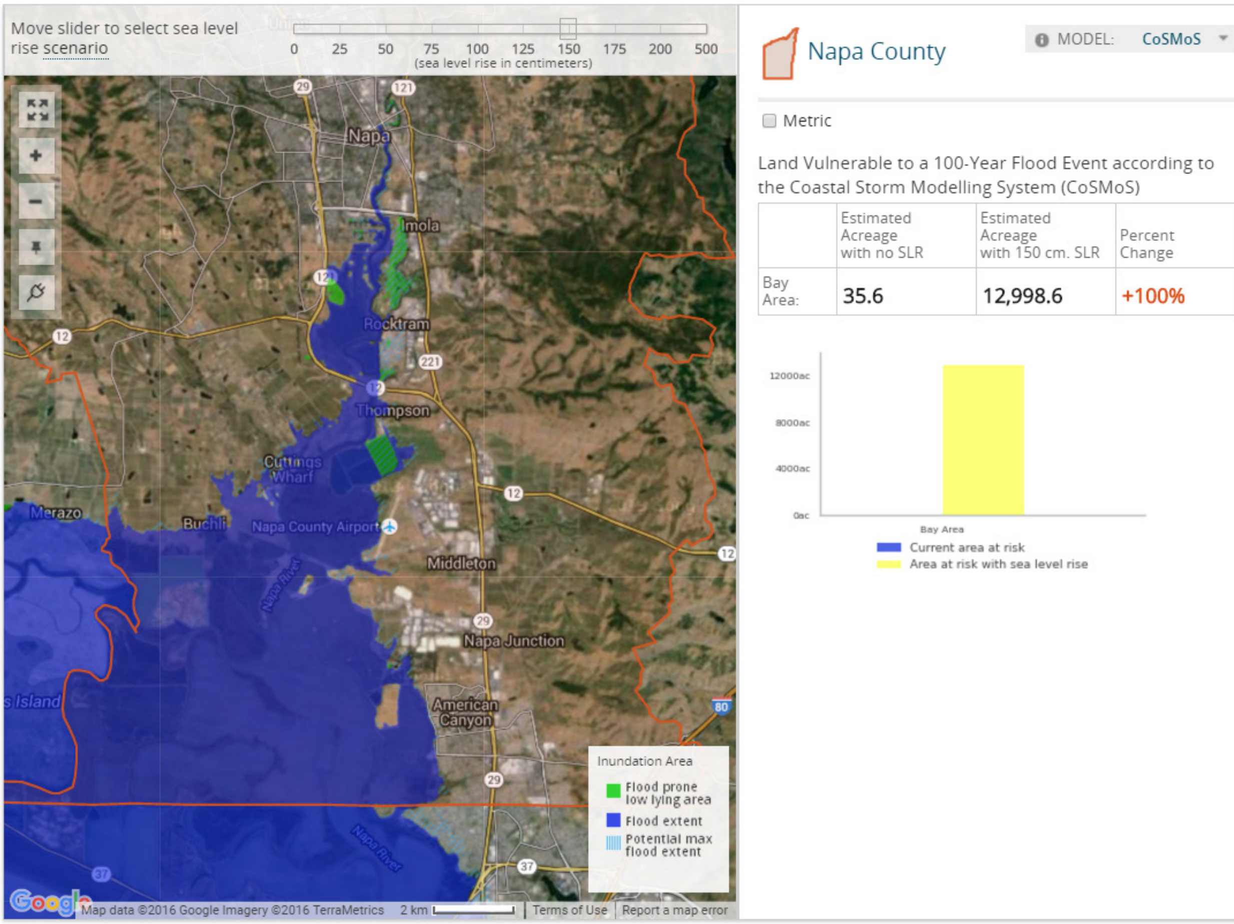


Figure 12: Sea-Level Rise, Current and Projected Areas Threatened (Source: CEC 2016)

The Adapting to Rising Tides (ART) subregional project, developed and sponsored by the San Francisco Bay Conservation and Development Commission (BCDC), studied five potential climate impact scenarios associated with sea-level rise and storm event scenarios in Alameda County (BCDC 2016a). While the subregional project looked at Alameda County specifically, potential consequences of sea-level rise and storm events identified in the project could also apply to other Bay Area counties like the County. Potential climate impacts identified include:

- more frequent flooding events due to rising Bay water levels;
- more extensive and longer duration flooding;
- permanent inundation in areas due to higher Bay water levels and shifts in the tidal range;
- increased shoreline erosion and increased potential for levy over-topping; and
- elevated groundwater and salinity intrusion (BCDC 2016b).

3.2 Steps 2 and 3: Sensitivity and Potential Impacts

The next two steps in the vulnerability assessment are closely related and are thus discussed together. The second step in the vulnerability assessment involves using a systematic evaluation to identify structures, functions, and populations that may be affected in the County by projected exposures to climate change impacts. Using the APG's recommended sensitivity checklist, this assessment focuses specifically on resources in the County potentially affected by climate change that were identified in the Exposure section of this Chapter.

The sensitivity checklist is organized into three main categories; Functions, Structures, and Populations. The categories are described in more detail below:

- **Functions**: Includes facilities that are essential to the health and welfare of the whole population and are especially important following climate-influenced hazard events. These facilities include hospitals, medical facilities, police and fire stations, emergency operations centers, evacuation shelters, and schools. Transportation systems, such as airways (e.g., airports and highways), bridges, tunnels, railways (e.g., tracks, tunnels, bridges, and rail yards), and waterways (e.g., canals, seaports, harbors, and piers) are also important to consider. Finally, lifeline utility systems such as potable water, wastewater, fuel, natural gas, electric power, and communications must also be identified.

- **Structures**: Includes the structures of essential facilities noted above. It also includes high potential loss facilities, where damage would have large environmental, economic, or public safety consequences (e.g., nuclear power plants, dams, and military installations). This category also includes hazardous material facilities that house industrial/hazardous materials.

- **Populations**: Includes a community's vulnerable populations, such as non-English-speaking people or elderly people who may require special response assistance or special medical care after a climate-influenced disaster.

Sensitivity checklists for each of the identified climate change exposures in the County are provided below, in conjunction with Step 3 of the vulnerability assessment. The third step in the assessment includes evaluating how these impacts will occur and how severe they may be. Given that climate change exposures at the local scale are inherently uncertain, the APG recommends that communities conduct a qualitative assessment that describes the potential impacts based on the exposure (CNRA 2012a:23). This assessment is not meant to be exhaustive and prescriptive, but is rather intended to provide a high-level view of potential impacts that could occur because of identified climate change exposures. Further evaluation and research would be needed to more clearly identify points of sensitivity and potential impacts, including specific facilities, structures, and areas of concern.

3.2.1 Increased Temperature and Frequency of Extreme Heat Events and Heat Waves

Based on the low- and high-emissions scenarios, annual average temperatures in the County are projected to rise three to six degrees Fahrenheit by 2090. Increased temperature can lead to secondary climate change impacts including increases in the frequency, intensity, and duration of extreme events and heat waves in the County. Points of sensitivity are identified below in Figure 13.

Higher frequency of these extreme heat conditions can cause serious public health impacts, increasing the risk of conditions directly related to heat such as heat stroke and dehydration (CNRA 2012a:3). Furthermore, public and private resources could be severely strained as the number of extreme heat occurrences increase. Older adults, particularly seniors, are more likely to experience respiratory and/or cardiovascular health complications than younger individuals. Approximately 17 percent of the County's population are elderly, which are more likely to live alone with limited mobility, all of which can exacerbate the risk of extreme heat (Census 2014).

Increases in temperature, along with the frequency of extreme heat events and heat waves, can also affect the agriculture industry, which is a large driver of the County's economy. The significant, overall outcome of warming is the likely reduction in yield of some of California's most valuable specialty crops (CNRA 2014: 21). More specifically, climate change could have serious effects to the wine industry in Napa County, which produces an average of 90 percent of American wine (Mayton 2015). The County currently has 400 wineries, producing more than 9.2 million cases of wines totaling over $1 billion dollars in sales. The wine industry in Napa accounts for $10.1 billion of $51.8 billion economic impact from winemaking and related industries in California (Napa County 2013:28). Increases in temperature and moisture could impact the growing of wine grapes, by causing late or irregular blooming and affecting yields (Lee et al. 2013:1). Limited livestock operations could also be subject to heat stress, which can result in reduced livestock pregnancy rates, longer time needed to meet market weight, and reduced milk production (CNRA: 2014:24). The County's large Hispanic agricultural worker base could also be affected by heat stress, which could reduce productivity, and may lead to illness, disability, or death in extreme exposures (CNRA 2014:24).

Higher temperatures could also threaten the County's energy system, by increasing consumer energy demand and affecting the facilities themselves. Energy usage tends to spike during extreme events and heat waves, which can create stress on the energy grid. Increased consumer demand can force utilities to ramp up the supply of energy, which can sometimes require the use of older and dirtier fossil fuel. Higher temperatures can also physically alter the thermal performance of power plants (e.g., American Canyon Power Plant), substations, and transmissions lines. (CEC 2012:14).

Functions

- [ ] Government continuity
- [ ] Water/sewer/solid waste
- [x] Energy delivery
- [x] Emergency Services
- [x] Public safety
- [x] Public health
- [x] Emotional and mental health
- [ ] Business continuity
- [ ] Housing Access
- [ ] Employment and job access
- [ ] Food security
- [ ] Mobility/Transportation/access
- [x] Quality of life
- [x] Social services
- [x] Ecological function
- [x] Tourism
- [ ] Recreation
- [x] Agriculture, forest, and fishery productivity
- [ ] Industrial operations

Structures

- [ ] Residential
- [ ] Commercial
- [ ] Industrial
- [ ] Government
- [ ] Institution (schools, churches, hospitals, prisons, etc.)
- [ ] Parks and open space
- [ ] Recreational facilities
- [ ] Transportation facilities and Infrastructure
- [ ] Marine facilities
- [ ] Communication infrastructure
- [ ] Dikes and levees
- [ ] Water treatment plant and delivery infrastructure
- [ ] Wastewater treatment plant and collection infrastructure

Populations

- [x] Seniors
- [x] Children
- [x] Individuals with disabilities
- [x] Individuals with compromised immune systems
- [x] Individuals who are chronically ill
- [x] Individuals without access lifelines (e.g. car or transit, telephones)
- [x] Non-white communities
- [x] Low-income, unemployed, or underemployed communities
- [x] Individuals with limited English skills
- [ ] Renters
- [ ] Students
- [ ] Seasonal residents
- [x] Individuals uncertain about available resources because of citizenship status

Figure 13: Napa County's Sensitivity to Increased Temperatures and Extreme Heat

3.2.2 Changes to Precipitation Patterns

Increased average temperatures and a hastening of snowmelt in distant watersheds, along with local and regional changes in precipitation and timing of runoff in local watersheds, could affect both surface and groundwater supplies in the County. As a result, the County could struggle in the future in providing adequate water supplies to its residents. Water users could face shortages in normal or dry years, if demand continues to increase. The points of sensitivity identified because of changes in precipitation patterns are shown below in Figure 14.

Functions

- [ ] Government continuity
- [x] Water/sewer/solid waste
- [ ] Energy delivery
- [ ] Emergency Services
- [x] Public safety
- [x] Public health
- [x] Emotional and mental health
- [ ] Business continuity
- [ ] Housing Access
- [ ] Employment and job access
- [ ] Food security
- [ ] Mobility/Transportation/access
- [x] Quality of life
- [ ] Social services
- [x] Ecological function
- [x] Tourism
- [x] Recreation
- [x] Agriculture, forest, and fishery productivity
- [ ] Industrial operations

Structures

- [x] Residential
- [x] Commercial
- [x] Industrial
- [x] Government
- [x] Institution (schools, churches, hospitals, prisons, etc.)
- [x] Parks and open space
- [x] Recreational facilities
- [x] Transportation facilities and Infrastructure
- [ ] Marine facilities
- [ ] Communication infrastructure
- [ ] Dikes and levees
- [ ] Water treatment plant and delivery infrastructure
- [ ] Wastewater treatment plant and collection infrastructure

Populations

- [ ] Seniors
- [ ] Children
- [ ] Individuals with disabilities
- [ ] Individuals with compromised immune systems
- [ ] Individuals who are chronically ill
- [ ] Individuals without access lifelines (e.g. car or transit, telephones)
- [ ] Non-white communities
- [x] Low-income, unemployed, or underemployed communities
- [ ] Individuals with limited English skills
- [ ] Renters
- [ ] Students
- [ ] Seasonal residents
- [ ] Individuals uncertain about available resources because of citizenship status

Figure 14: Napa County's Sensitivity to Changes in Precipitation

With intensified use of groundwater, many of California's groundwater basins are already in overdraft, with groundwater being used faster than it is being replenished and groundwater levels declining. Overdraft can also lead to land subsidence, which is the gradual settling or sudden sinking of the earth's surface. The effects of subsidence could impact houses and other structures such as transportation infrastructure, water well casing failures, and changes to the elevation and gradient of stream channels, drains, and other water transport structures (CNRA 2014:235).

In terms of agriculture, changes in timing and amounts of precipitation could affect local aquifer recharge for groundwater supplies in the future, which could in turn affect water supplies for agricultural uses. Conversely, as the weather gets warmer with climate change, agricultural demand for water could intensify because in extreme heat conditions water evaporates faster and plants need more water to move through their circulatory systems to stay cool (CNRA 2014:21). More specifically, attempts to maintain wine grape productivity and quality in the face of warming may be associated with increased water use for irrigation and to cool grapes through misting or sprinkling (Lee et al. 2013).

3.2.3 Increased Wildfire Risk

The County is already considered to be an area that is at high-risk for wildfires (Napa County 2013:77). Increased temperatures and changes in precipitation patterns associated with climate change are expected to increase the risk of wildfire in the County by approximately 10 to 20 percent by the end of the century. This increase could cause additional threats to the County and has the potential to affect emergency services, roads, water supplies to residents, housing access, and quality of life. The points of sensitivity identified for this exposure to increased wildfire risk is shown below in Figure 15.

Functions

- [x] Government continuity
- [x] Water/sewer/solid waste
- [x] Energy delivery
- [x] Emergency Services
- [x] Public safety
- [x] Public health
- [x] Emotional and mental health
- [x] Business continuity
- [x] Housing Access
- [x] Employment and job access
- [ ] Food security
- [x] Mobility/Transportation/access
- [x] Quality of life
- [x] Social services
- [x] Ecological function
- [x] Tourism
- [ ] Recreation
- [x] Agriculture, forest, and fishery productivity
- [ ] Industrial operations

Structures

- [x] Residential
- [x] Commercial
- [x] Industrial
- [x] Government
- [x] Institution (schools, churches, hospitals, prisons, etc.)
- [x] Parks and open space
- [x] Recreational facilities
- [x] Transportation facilities and Infrastructure
- [ ] Marine facilities
- [x] Communication infrastructure
- [ ] Dikes and levees
- [x] Water treatment plant and delivery infrastructure
- [x] Wastewater treatment plant and collection infrastructure

Populations

- [x] Seniors
- [x] Children
- [x] Individuals with disabilities
- [x] Individuals with compromised immune systems
- [x] Individuals who are chronically ill
- [x] Individuals without access lifelines (e.g. car or transit, telephones)
- [x] Non-white communities
- [x] Low-income, unemployed, or underemployed communities
- [x] Individuals with limited English skills
- [ ] Renters
- [ ] Students
- [x] Seasonal residents
- [x] Individuals uncertain about available resources because of citizenship status

Figure 15: Napa County's Sensitivity to Wildfire Exposure

A changing climate is expected to subject forests to increased stress because of drought, disease, invasive species, and insect pests. These stressors are likely to make forests more vulnerable to catastrophic fire (Westerling 2008:231). While periodic fires are natural processes and an important ecological function, catastrophic fire events that cannot be contained or managed, can cause serious threats to homes and infrastructure, especially for properties located at the wildland-urban interface (i.e., where residential development mingles with wildland areas) (California Dept. of Forestry and Fire Protection 2009). Ecological functions are further impacted as the risk of fire increases. When it does rain in burned areas, more soil washes off the hills and into roads, ditches, and streams.

Wildfire also threatens energy generation and transmission infrastructure, resulting in damages to facilities (e.g., hydroelectric generation facilities in remote locations), increased maintenance costs, and reduced transmission line efficiency (CEC 2012:15).

The wine industry and the thousands of acres of vines could also be affected by wildfire. For vineyards that are near fires, the smoke could potentially cause problems, particularly for red grapes, where the skin is still used to in the winemaking process. That smoke could potentially infuse with the skin and create abnormal flavors (Mayton 2015). Wildfire could also negatively impact those who pick the grapes, because of the potential degradation of transportation infrastructure. Because many agricultural workers cannot afford to live in the County (due to high housing costs and the lack of affordable housing), their access and mobility could be impaired.

3.2.4 Increased Likelihood of Flooding

The County is considerably vulnerable to flooding, which has caused the most disaster declarations and the most damage and loss of life historically in the County (Napa County 2013:11). While it is uncertain exactly how climate change will affect flooding events in the County and to what extent, it is reasonable to assume that any increase in flooding could have serious ramifications as the area is already considerably vulnerable. Points of sensitivity are identified below in Figure 16.

Functions

- [x] Government continuity
- [x] Water/sewer/solid waste
- [x] Energy delivery
- [x] Emergency Services
- [x] Public safety
- [x] Public health
- [x] Emotional and mental health
- [x] Business continuity
- [x] Housing Access
- [x] Employment and job access
- [ ] Food security
- [x] Mobility/Transportation/access
- [x] Quality of life
- [x] Social services
- [x] Ecological function
- [x] Tourism
- [ ] Recreation
- [x] Agriculture, forest, and fishery productivity
- [x] Industrial operations

Structures

- [x] Residential
- [x] Commercial
- [x] Industrial
- [x] Government
- [x] Institution (schools, churches, hospitals, prisons, etc.)
- [x] Parks and open space
- [x] Recreational facilities
- [x] Transportation facilities and Infrastructure
- [ ] Marine facilities
- [x] Communication infrastructure
- [x] Dikes and levees
- [x] Water treatment plant and delivery infrastructure
- [x] Wastewater treatment plant and collection infrastructure

Populations

- [x] Seniors
- [x] Children
- [x] Individuals with disabilities
- [x] Individuals with compromised immune systems
- [x] Individuals who are chronically ill
- [x] Individuals without access lifelines (e.g. car or transit, telephones)
- [x] Non-white communities
- [x] Low-income, unemployed, or underemployed communities
- [x] Individuals with limited English skills
- [ ] Renters
- [ ] Students
- [x] Seasonal residents
- [x] Individuals uncertain about available resources because of citizenship status

Figure 16: Napa County's Sensitivity to an Increased Likelihood of Flooding

One of the projected impacts of climate change is the increased likelihood of extreme floods capable of destroying streamside land, buildings, roads, and crops. Climate change will not only stress human communities and infrastructure, but will also threaten the biodiversity that occurs along the streams and creeks in the County. Flooding could also lead to the destruction of agriculture, erosion of topsoil, and deposits of debris and sediment on crop lands. It could also release sewage and hazardous or toxic materials as wastewater treatment plans are inundated, storage tanks are damaged, and pipelines severed. Floods also cause economic losses through closure of businesses and government facilities; disrupt communications; disrupt the provision of utilities such as water and sewer; result in excessive expenditures for emergency response; and generally, disrupt the normal function of a community. (Napa County 2013:58)

3.2.5 Sea-Level Rise

The County is not very vulnerable to sea-level rise, with less than one percent of the County's total population considered at risk (CEC 2012:14 and Census 2014). Considering a 100-year flood event, a 1.5 m rise in sea-level and other hydrodynamical factors, most of the land at increased risk for flooding is undeveloped. A small portion of critical infrastructure, such as roads, railways, hospitals, emergency facilities, and properties in the southwestern portion of the County and in areas along the Napa River, including parts of Downtown Napa, could become vulnerable. American Canyon Power Plant and the Napa Sanitation District Water Treatment Plant could also become vulnerable (CEC 2012:23). The points of sensitivity identified for this exposure risk is shown below in Figure 17.

Functions

- [x] Government continuity
- [x] Water/sewer/solid waste
- [x] Energy delivery
- [x] Emergency Services
- [x] Public safety
- [x] Public health
- [x] Emotional and mental health
- [ ] Business continuity
- [ ] Housing Access
- [ ] Employment and job access
- [ ] Food security
- [x] Mobility/Transportation/access
- [x] Quality of life
- [x] Social services
- [x] Ecological function
- [ ] Tourism
- [ ] Recreation
- [x] Agriculture, forest, and fishery productivity
- [ ] Industrial operations

Structures

- [x] Residential
- [x] Commercial
- [x] Industrial
- [x] Government
- [x] Institution (schools, churches, hospitals, prisons, etc.)
- [x] Parks and open space
- [ ] Recreational facilities
- [x] Transportation facilities and Infrastructure
- [ ] Marine facilities
- [x] Communication infrastructure
- [x] Dikes and levees
- [x] Water treatment plant and delivery infrastructure
- [x] Wastewater treatment plant and collection infrastructure

Populations

- [x] Seniors
- [x] Children
- [x] Individuals with disabilities
- [x] Individuals with compromised immune systems
- [x] Individuals who are chronically ill
- [x] Individuals without access lifelines (e.g. car or transit, telephones)
- [x] Non-white communities
- [x] Low-income, unemployed, or underemployed communities
- [x] Individuals with limited English skills
- [ ] Renters
- [ ] Students
- [x] Seasonal residents
- [x] Individuals uncertain about available resources because of citizenship status

Figure 17: Napa County's Sensitivity to Sea-Level Rise Exposure

As sea-levels rise, the area and the number of people at risk due to flooding will also rise. Rising sea levels can overwhelm existing protection structures, putting those County residents living in vulnerable areas at increased risk (CEC 2012:6). Factors that increase vulnerability to the adverse impacts of flood events associated with sea-level rise include access to preparedness information, transportation, healthcare, and insurance. Key demographics associated with these vulnerabilities include income, race, linguistic isolation (i.e., non-English speaking), and residential tenure (CEC 2012:8). Language ability is an important factor in assessing vulnerability as emergency response crews may be unable to communicate with non-English speakers (CEC 2012:9). The County has a large Hispanic population, many of which are low-income agricultural workers that speak primarily Spanish. The Hispanic population has increased from 23.7 percent in 2000 to 33.7 percent in 2014 (Census 2014). This population is especially vulnerable and would be impacted by a flood event associated with sea-level rise.

Renters are also more vulnerable, as they are less likely to reinforce buildings and buy insurance because the decision to make major home improvements typically lies with the property owner. Additionally, disaster recovery services have often targeted homeowners, to the disadvantage of renters (CEC 2012:9).

3.3 Step 4: Adaptive Capacity

Once identifying the points of sensitivity and the potential impacts of exposures, the next step is to look at the County's current adaptive capacity to address climate change. Step 4 involves determining what is or can be currently done in the County to address these challenges. Review of the County's existing local policies, plans, programs, resources, or institutions provides a good snapshot of the County's ability to adapt to climate change and reduce vulnerability. Based on this information, adaptive capacity for a County can be rated high, medium, or low. High adaptive capacity indicates that sufficient measures are already in place to address projected changes, while a low rating indicates a community is unprepared (CNRA 2012a:26).

The adaptive capacity of the County to respond to projected climate change impacts is analyzed below, based on identified exposures where possible. It is important to note that this review of local climate adaptation-related work offers a high-level perspective on the issue and is not meant to be all-inclusive. As more specific facilities, structures, and areas are identified in the future, additional review of adaptive capacity may likely be needed.

On a planning level, the County addresses current and future impacts related to existing natural hazards, as evidenced by the creation of the County's Operational Area Hazard Mitigation Plan in 2013, which identifies current hazard risks and mitigation strategies for flooding, earthquakes, and fires. Furthermore, the County's 2008 General Plan includes policies aimed at reducing local contributions to global climate change and encourages sustainable building practices, efficient use of resources (i.e., water, land, and energy), sustainable vineyard practices, and ecological stewardship. It also covers vulnerable populations, including policies aimed at achieving more equitable outcomes for the growing low-income populations in the County, as well as its aging population that require better access to public services and housing.

In addition to planning efforts, climate adaptation-related work occurring in the County includes, but is not limited, to the following:

Efforts Related to Increased Temperature and Frequency of Extreme Heat Events and Heat Waves

- The Napa County Health and Human Services Agency, Public Health Division maintains an Excessive Heat Emergency Response Plan. This plan provides information and structure to the County in heat related emergencies. A part of the plan includes identifying and allocating locations of cooling centers in the event of a heat emergency. Cooling centers can include senior centers, community centers, shopping malls, churches, possible ice skating rinks, and other places that fit the appropriate criteria (Napa County 2009).

Adaptive Capacity Ranking: Medium

Napa County's Excessive Heat Emergency Response Plan is designed to address current and projected changes in increased temperature, including extreme heat events and heat waves. The plan clearly outlines procedures and steps the County can take, including which other agencies to enlist for support, to effectively help the community in the event of excessive heat emergencies. While the plan can account for projected increases in temperature, it is reactive in nature and does not include potential solutions that could be put in place before extreme heat events occur. Therefore, the adaptive capacity ranking for increased temperature is medium.

Efforts Related to Changes to Precipitation Patterns and Water Supply

- The County participates in the Home Energy Opportunity (HERO) Program, which is part of the Property Assessed Clean Energy (PACE) Program. HERO helps homeowners reduce energy bills and decrease water consumption through special financing options, while also creating jobs for registered contractors in the County (Yune 2014).

- The County has water conservation regulations for landscape design, with the intent to conserve water through promotion of the most efficient use of water in landscape design, while respecting the economic, environmental, aesthetic, and lifestyle choices of individuals and property owners (Napa County Municipal Code Title 18, Chapter 18.118)

- The County has several water conservation programs to help combat drought and other water supply issues. These include promotion of rebate programs from DWR for single-family residences to remove turf and replace toilets, as well as clothes washer rebates for residents from PG&E and the County (Napa County 2016).

- The Napa County Flood Control and Water Conservation District Office also provides free water-saving devices to those living in the County. These include faucet aerators, showerheads, and hose times (Napa County 2016).

- The County recently adopted a Sustainable Groundwater Management Plan, which continues policies that have arrested further subsidence from the Milliken, Sarco, and Tulocay (MST) basin. This has resulted in a stable aquifer for the past ten years (Napa County 2017).

Adaptive Capacity Ranking: Medium

The County has several water conservation programs, including rebates for appliances and free-water saving devices for residents, that are helping to combat drought and other water supply issues; however, the County is still currently vulnerable to water supply issues because of drought and other factors. The County will face challenges in providing sufficient water supplies in the future because of climate change effects, coupled with an increasing population (i.e., mostly in the incorporated areas) and increasing water demand. While the County has already taken steps towards achieving long-term groundwater sustainability, there is still a possibility that water supply availability may change in the future and will need to be further addressed. Therefore, the adaptive capacity ranking for changes to precipitation patterns and water supply is medium

Efforts Related to the Increased Likelihood of Flooding

- Structures to control flooding have been built throughout the populated west side of the County and are operated and maintained by several agencies. A number of levees have been built along the Napa River to protect agricultural lands and populated parts of the County and to withstand a 100-year flood event. The Napa River Flood Control Project, a major flood control project on the Napa River and its tributaries, will provide a much higher level of flood protection. (Napa County 2013:59).

Adaptive Capacity Ranking: Medium

While levees and structures have been built to protect the County from a 100-year flood event, and the Napa River Flood Control Project will provide a higher level of flood protection, the County is currently not prepared to address effects associated with future sea-level rise and other hydrodynamic factors. Climate change is projected to expose 13,000 additional acres to 100-year flood risk. While a majority of these areas are undeveloped, some developed areas are at risk and should be accounted for in future plans. Therefore, the adaptive capacity for risks associated with flooding is medium.

Efforts Related to the Increased Risk of Wildfire

- The County has adopted the 2010 Uniform Fire Code to help reduce the County's risk of wildfire (Napa County 2013:77).

- The County has provisions to help prevent the accumulation of combustible vegetation or rubbish that can be found to create fire hazards and potentially impact health, safety, and general welfare of the public. Provisions include ensuring that defensible spaces, which are adjacent to each side of a building or structure, are cleared of all brush, flammable vegetation, or combustible growth (Napa County Municipal Code Title 8, Chapter 8.36).

- The County participates in the National Fire Protection Association's (NFPA) Firewise Communities Program, which is co-sponsored by the USDA Forest Service, the US Department of the Interior, and the National Association of State Foresters. The program encourages local solutions for safety by teaching people how to adapt to living with wildfire and encourages neighbors to work together and take action to prevent losses (NFPA 2016).

- The Napa Communities Firewise Foundation, in cooperation with the Napa County Fire Department, provides a free chipping service to County residents who are working to maintain the State mandated 100-feet of defensible space around their homes and complying with the County Hazard Abatement Ordinance (Napa County 2016).

- The County has several Fire Safe Councils that are active in minimizing the potential for wildfire damage. Fire Safe Councils receive Federal grants from agencies like the U.S. Forest Service, Bureau of Land Management, and National Park Service. These funds provide Fire Safe Councils with grant money to pursue projects to reduce hazardous fuels, provide wildfire prevention education, and create risk assessments and Community Wildfire Protections Plans (California Fire Safe Council 2017).

- The County is also only one of four Counties to have road standards that meet the Board of Forestry's stringent requirements.

Adaptive Capacity Ranking: Medium

The County is an area that is currently at high-risk for wildfires. While programs and policies in place show a current capacity to address risks, the County is still vulnerable. Climate change is projected to increase this current risk by anywhere from 10 to 20 percent. The County will need to continue to adapt to this projected increase. Therefore, the adaptive capacity for risks associated with wildfire is medium.

Other Climate-Adaptation Related Efforts

- Sustainable Napa County is a nonprofit organization that brings together County business, agriculture, nonprofit, and government entities as part of a comprehensive, collaborative campaign for long term environmental, economic, and social sustainability. With support from PG&E, their mission is to help residents get informed about sustainability and to offer resources and education on a variety of issues including green business, green building, energy, water, recycle and waste, agriculture, air, and transportation (Sustainable Napa County 2016).

- The County enforces the Green Building Standards Code to establish and encourage sustainable building construction practices having a positive environmental impact (Napa County Municipal Code Title 15, Chapter 15.14).

- The County supports the Napa Green Certification program, which is a comprehensive environmental certification program for vineyards and wineries in the Napa Valley. The program aims to reduce solid waste generation, water use, and wastewater generation, promoting sustainable agricultural practices. There is currently a 40 percent participation rate amongst wineries in Napa (Napa Green 2017).

- The County recently joined Marin Clean Energy (MCE), a Community Choice Aggregation (CCA) program. A CCA allows city and county governments to aggregate or pool electricity customers to purchase and develop power, while also allowing them to administer energy programs on behalf of their residents and businesses. A CCA works in partnership with a region's existing utility, which continues to deliver power, maintain the grid, and provide consolidated billing and other customer services. MCE offers its customers three different product offerings: Light Green, Deep Green, and Local Sol. Customers in the MCE service territory are automatically enrolled in Light Green, which provides customers with 50 percent renewable energy from sources such as solar, wind, bioenergy, geothermal, and small hydroelectric power facilities (MCE 2017).

Adaptive Capacity Ranking: Medium

The County has practices and organizations in place that help address future issues of sustainability and climate adaptation. With organizations that educate the public and foster collaboration for longer term environmental sustainability, the County is finding ways to change behaviors and practices now. Furthermore, by adopting the Green Building Standards Code, the County is setting a precedent for reduced energy use, building with more sustainable materials, and employing better water conservation tactics. These efforts, however, would need to be expanded and applied on a much larger scale throughout the County to address future changes attributed to climate change. Therefore, the adaptive capacity for other climate-adaptation related efforts is medium.

In conclusion, the County is committed to continuing efforts to reduce and address existing risks and future climate change impacts on a program level. With a number of ordinances and programs that cover a range of exposures, the County is well equipped to handle current issues of extreme heat events and water supply issues but could still likely face increasing challenges as projected changes occur. Programs and adoption of the 2010 Uniform Fire Code has helped to mitigate the high risk for wildfires, but the County is still vulnerable to current and future fires. Other efforts, aimed at increasing energy efficiency, are commendable but cover only a small range of climate-related impacts. The County will also need to continue to adapt to better address impacts to sea-level rise and associated flooding. However, the long-term vision identified in the County's planning documents demonstrate that the County is forward-thinking in their policy and mitigation development towards all exposures and are positioned to maintain services in the face of climate change.

3.4 Step 5: Risk and Onset

The final step in the vulnerability assessment is to rank impacts based on the level of risk and the projected timeframe. Risk is the likelihood or probability that a certain impact will occur, which is an assessment that combines the estimated certainty of the science projecting the climate change impact and the certainty of the sector sensitivity. Certainty ratings are based on percent probability of global models created by IPCC (CNRA 2012a:29). The timeframe in which the impact is most likely to occur (based on risk) can be categorized as:

- Current: Impacts currently occurring
- Near-term: 2020-2040
- Mid-term: 2040-2070
- Long-term: 2070-2100

Risk certainty has been provided based on the certainty of exposures estimated in Step 1 in Table 1 below. Onset designations have also been assigned.

The table shows that all temperature-related impacts are the most likely near-term climate change exposure facing the County and should be addressed and prioritized in future adaptation planning efforts. While sea-level rise has a high certainty rating and is already occurring, its onset is not expected to occur until closer to the end of the century in terms of changes in areas already vulnerable to flooding or causing permanent inundation in tidally-influenced areas of the County. Addressing increases in flooding and wildfire risk have mid-term onsets and should be prioritized accordingly.

Table 1 Risk and Onset for Napa County Climate Change Impacts

Impact	Certainty Rating	Timeframe
Increased Temperature	High	Near-term
Increased Frequency in Extreme Heat Events	High	Near-term
Increased Frequency in Heat Waves	High	Near-term
Sea-Level Rise	High	Long-term
Changes to Precipitation Patterns	Medium	Near-term
Increased Wildfire Risk	Medium	Mid-term
Increased Flooding	Medium	Mid-term

4 References

BCDC. *See* San Francisco Bay Conservation & Development Commission.

California Department of Forestry and Fire Protection. 2009 (March). *Homeowners Checklist: How to Make your Home Fire Safe*. Available: http://www.fire.ca.gov/communications/downloads/fact_sheets/Checklist.pdf. Accessed April 25, 2016.

California Energy Commission. 2016a. Cal-Adapt Local Climate Snapshots for Napa County. Prepared under contract by UC Berkeley Geospatial Innovations Facility. Available http://cal-adapt.org/tools/factsheet/. Accessed April 23, 2016.

______. 2012 (July). *The Impacts of Sea-Level Rise on the San Francisco Bay*. Available: http://www.energy.ca.gov/2012publications/CEC-500-2012-014/CEC-500-2012-014.pdf. Accessed March 30, 2016.

California Fire Safe Council. 2016. California Fire Safe Council: About Us. Available: http://www.cafiresafecouncil.org/. Accessed January 20, 2017.

California Natural Resources Agency. 2014 (July). *Safeguarding California: Reducing Climate Risk. An update to the 2009 California Climate Adaptation Strategy.* Available: http://resources.ca.gov/docs/climate/Final_Safeguarding_CA_Plan_July_31_2014.pdf. Accessed April 23, 2016.

California Natural Resources Agency. 2012a (July). *California Adaptation Planning Guide: Planning for Adaptive Communities*. Available: http://resources.ca.gov/docs/climate/01APG_Planning_for_Adaptive_Communities.pdf. Accessed April 14, 2016.

______. 2012b. *Our Changing Climate: Vulnerability & Adaptation to the Increasing Risks of Climate Change in California*. Available: http://www.energy.ca.gov/2012publications/CEC-500-2012-007/CEC-500-2012-007.pdf. Accessed April 21, 2016.

CEC. *See* California Energy Commission.

CNRA. *See* California Natural Resources Agency.

DWR. *See* California Department of Water Resources.

______. 2008 (October). *Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water*. Available: http://www.water.ca.gov/climatechange/docs/ ClimateChangeWhitePaper.pdf. Accessed April 24, 2016.

IPCC. *See* Intergovernmental Panel on Climate Change.

Intergovernmental Panel on Climate Change. 2014 (November). *Climate Change 2014 Synthesis Report: Approved Summary for Policymakers*. Available: http://www.ipcc.ch/. Accessed April 2016.

______.2001. Climate Change 2001 Synthesis Report: Summary for Policymakers. Available: https://www.ipcc.ch/ipccreports/tar/vol4/english/index.htm /. Accessed May 24, 2016.

Lee, Hanna et al. 2013. *Climate Change, Wine, and Conservation*. Available: http://www.pnas.org/content/110/17/6907.short. Accessed April 25, 2016.

Marin Clean Energy. 2017. MCE Clean Energy. My Community. My Choice. Available: https://www.mcecleanenergy.org/. Accessed January 20, 2017.

MCE. *See* Marin Clean Energy.

Mayton, Joseph. 2015 (August). California wildfires threaten to make local wine "unpalatable." *The Guardian*. Available: http://www.theguardian.com/us-news/2015/aug/05/california-wildfires-wine-industry. Accessed April 25, 2016.

Napa County. 2005 (November). *2050 Napa Valley Water Resource Study*. Available: http://www.napawatersheds.org/files/managed/Document/3067/2050_FactSheet.pdf. Accessed April 22, 2016.

______. 2009. *HHSA Excessive Heat Emergency Response Plan*. Available: http://www.Countyofnapa.org/publichealth/preparedness/plans/. Accessed April 22, 2016.

______.2013. *Napa County Operational Area Hazard Mitigation Plan*: 2013 Update. Available: http://www.ci.calistoga.ca.us/home/showdocument?id=17868. Accessed April 25, 2016.

______.2016. Water Conservation. Available: http://www.Countyofnapa.org/WaterConservation/. Accessed April 25, 2016.

______.2017. Flood Control and Water Resources. Available: http://www.countyofnapa.org/groundwater/. Accessed January 20, 2017.

Napa Green. 2017. *What Defines Napa Green.* Available: https://napagreen.org/. Accessed January 20, 2017.

NFPA. *See* National Fire Protection Association.

National Fire Protection Association. 2016. About Firewise. Available: http://www.firewise.org/about.aspx. Accessed April 26, 2016.

San Francisco Bay Conservation & Development Commission. 2016a. ART Findings by Issue. Available: http://www.adaptingtorisingtides.org/portfolio-type/findings-by-issue/. Accessed March 30, 2016.

______.2016b. *Adapting to Rising Tides: Climate Impact Statements*. Available: http://www.adaptingtorisingtides.org/wp-content/uploads/2016/03/ARTClimateStatements_update.pdf. Accessed April 15, 2016.

Sustainable Napa County. 2016. About Us. Available: https://www.sustainablenapaCounty.org/site/aboutus. Accessed April 25, 2016.

U.S. Census Bureau. 2014. Quick Facts: Napa County. Available: http://www.census.gov/quickfacts/table/PST045215/06055. Accessed April 2016.

Westerling, A.L. and B.P. Bryant. 2007 (October). *Climate Change and Wildfire in California*. Available: http://ulmo.ucmerced.edu/pdffiles/08CC_WesterlingBryant.pdf. Accessed April 25, 2016.

Yune, Howard. 2014 (January). Napa to join financing program for home, business, conservation fixes. N*apa Valley Register*. Available: http://napavalleyregister.com. Accessed April 25, 2016.

Appendix D

Climate Action Plan Consistency Checklist

FILE#__________

NAPA COUNTY
PLANNING, BUILDING, AND ENVIRONMENTAL SERVICES
1195 Third Street, Suite 210, Napa, California, 94559
(707) 253-4417

A Tradition of Stewardship
A Commitment to Service

Climate Action Plan Consistency Checklist

Introduction

The Napa County Climate Action Plan (CAP), adopted by the County Board of Supervisors on XXXXXXX, 2018, outlines actions that the County will undertake to achieve its proportional share of State greenhouse gas (GHG) emissions reductions. Implementation of the CAP will require that new development projects attain higher levels of energy efficiency and incorporate more sustainable design standards. To help new development applicants plan and design projects consistent with the CAP, and to assist County staff in determining the consistency of proposed projects with the CAP during development review, the County has prepared a CAP Consistency Checklist (Checklist). This Checklist, in conjunction with the CAP, provides a streamlined review process for proposed new development projects that are subject to discretionary review and trigger environmental review pursuant to the California Environmental Quality Act (CEQA).

Analysis of GHG emissions and potential climate change impacts from new development is required under CEQA. The Napa County CAP is a plan for the reduction of GHG emissions in accordance with CEQA Guidelines Section 15183.5. Pursuant to CEQA Guidelines Sections 15064(h)(3), 15130(d), and 15183(b), a project's incremental contribution to cumulative GHG emissions effect may be determined to not cumulatively be significant if it complies with the requirements of a plan for the reduction of GHG emissions. The Napa County CAP meets the criteria identified in Section 15183.5; therefore, the CAP is considered a "qualified" plan for the reduction of GHG emissions. New development projects that can demonstrate consistency with applicable GHG reduction measures in a qualified plan for the reduction of GHG emissions are eligible for CEQA streamlining, per the provisions of CEQA Guidelines Section 15183.5. Under these provisions, if a project can show consistency with applicable GHG reduction measures, the level of analysis for the project required under CEQA with respect to GHG emissions can be reduced considerably (i.e., a detailed analysis of project-level GHG emissions and potential climate change impacts is not needed).

This Checklist contains measures that are required to be implemented on a project-by-project basis to ensure that the specified emissions targets identified in the CAP are achieved. Implementation of these measures would ensure that new development is consistent with the CAP's assumptions regarding the implementation of relevant CAP strategies toward achieving the identified GHG reduction targets. Furthermore, a project's incremental contribution to cumulative GHG emissions may be determined to not be cumulatively considerable. Projects that are consistent with the CAP, as determined using this Checklist, may rely on the CAP for the cumulative impacts analysis of GHG emissions under CEQA. Projects requiring discretionary review that cannot demonstrate consistency with the CAP using this Checklist would be required to prepare a separate, more detailed project-level GHG analysis as part of the CEQA document prepared for the project.

Checklist Applicability

This Checklist only applies to certain development projects that require discretionary review and must undergo environmental review (i.e., not exempt) pursuant to CEQA. Projects that only require ministerial review (e.g., only building permits) would not be subject to the Checklist. The CAP contains other measures that, when implemented, would apply broadly to all ministerial and discretionary projects. Some of those measures (e.g., CALGreen Tier 1 standards) are included for discretionary projects in this Checklist but could also apply to all ministerial projects broadly once the County takes action to codify specific requirements or standards.

Discretionary actions that are not subject to this Checklist would include: 1) discretionary actions that are otherwise exempt from CEQA because they do not result in any physical changes to the environment; 2) permits allowing wireless communication facilities; and 3.) certain infrastructure projects such as roads, pipelines, or other public works projects that are not directly tied to specific development proposals. These classes of discretionary actions would not result in changes in land use, the intensification of existing land uses, new building construction, or substantial renovations or expansions of buildings, and thus completion of this Checklist would not be applicable. However, staff may still require certain discretionary projects to complete separate, project-specific GHG analyses and incorporate such analyses and any project-level mitigation required into CEQA documents. This could include, for example, roads, pipelines, or other public works, where construction activities or physical changes in the environment could result in increases in GHG emissions. The final determination of whether the CAP Checklist may be used, or whether a project-specific analysis is required, will be made by staff.

Checklist Procedures

General procedures for Checklist compliance and review are described below. Specific guidance is also provided under each of the questions under Steps 1 and 2 of the Checklist in subsequent pages.

- The County's Planning Division reviews development applications and will make determinations regarding environmental review requirements under CEQA. Procedures for CEQA can be found on the County's Planning Policy Documents Homepage. County staff will make the final determination as to whether environmental review is required, and if so, whether completion of the CAP Checklist is required for a proposed project or whether a separate project-level GHG analysis is required.

- The specific requirements outlined in the Checklist, along with any items the applicant agrees to in consideration of this process, shall be required as a condition of approval.

- The applicant must provide a written explanation that demonstrates how the proposed project will implement each Checklist requirement described herein to the satisfaction of the Planning Division.

- If a question in the Checklist is deemed not applicable (N/A) to a project, an explanation must be provided to the satisfaction of the Planning Division.

- Applicants may provide alternate GHG reduction measures to those included in this checklist, so long as the alternate measures are demonstrated to be equivalent or more effective than those being replaced. Applicants requesting use of alternate GHG reduction measures must submit supporting documentation along with the completed CAP Checklist, including detailed GHG reduction calculations and a written narrative, substantiating how the alternate measures would achieve equivalent or more GHG reductions.

- Development projects requiring discretionary review that cannot demonstrate consistency with the CAP using this Checklist would be required to prepare a separate, more detailed project-level GHG analysis as part of the CEQA document prepared for the project.

- The Checklist is an administrative document that may be updated periodically by County staff to incorporate new GHG reduction measures or to comply with later amendments to the CAP or local, State, or federal law. Any updates to the Checklist will be administered by the Planning Division at the staff level.

Application Information

Contact Information

Project No./Name: ______________________________

Property Address/APN: ______________________________

Applicant Name/Co.: ______________________________

Contact Phone: ______________________ Contact Email: ______________________

Was a consultant retained to complete this checklist? ☐ Yes ☐ No
If Yes, complete the following:

Consultant Name: ______________________ Contact Phone: ______________________

Company Name: ______________________ Contact Email: ______________________

Project Information

1. What is the size of the project (acres)? ______________________

2. Identify all applicable proposed land uses (indicate square footage):

- ☐ Residential (indicate # of one- and two-family units): ______________________
- ☐ Residential (indicate # of multi-family units): ______________________
- ☐ Commercial (indicate total square footage): ______________________
- ☐ Industrial (indicate total square footage): ______________________
- ☐ Winery (indicate total square footage): ______________________
- ☐ Agricultural (indicate total acreage): ______________________
- ☐ Other (describe): ______________________

4. Provide a brief description of the project proposed: ______________________

CAP Consistency Checklist Questions

Step 1: Land Use Consistency

For projects that are subject to the CAP consistency evaluation, the first step in determining consistency is to assess the project's consistency with the growth projections used in the development of the CAP. This section allows the County to determine a project's consistency with the land use assumptions used in the CAP.

Step 1: Land Use Consistency		
Checklist Item (Check the appropriate box and provide explanation and supporting documentation for your answer)	Yes	No
1. Is the proposed project consistent with the existing General Plan land use and zoning designations?	☐	☐
Applicant Detail: Please substantiate how the project satisfies question 1. ____ ____ ____ ____ ____ ____ ____		
If **"Yes,"** proceed to Step 2 (CAP Measures Consistency) of the Checklist. If **"No,"** proceed to the question 2 below.		
2. Does the project include a land use plan and/or zoning designation amendment that would result in an equivalent or less GHG-intensive project when compared to the existing designations?	☐	☐
Applicant Detail: Please substantiate how the project satisfies question 2 and provide estimated project emissions under both existing and proposed designations(s) for comparison. ____ ____ ____ ____ ____ ____ ____ ____ ____		
If "No," the project's GHG impact is potentially significant and must be analyzed in accordance with CEQA. The applicant must prepare a separate, more detailed project-level GHG analysis to demonstrate how it would offset the increase in emissions over the existing designations. The project must incorporate each of the measures identified in Step 2 to mitigate cumulative GHG emissions impacts unless the decision maker finds that a measure is infeasible in accordance with CEQA Guidelines Section 15091. Proceed and complete a separate project-specific GHG analysis and Step 2 of the Checklist.		

Step 2: CAP Measures Consistency

The second step of the CAP consistency review is to review and evaluate a project's consistency with the applicable measures of the CAP. Each checklist item is associated with a specific GHG reduction measure(s) in the Napa County CAP.

Step 2: CAP Measures Consistency				
Checklist Item (Check the appropriate box and provide explanation for your answer)	CAP Measure	Yes	No	N/A
New Vineyards on More than 5% Slopes				
1a. Electric Irrigation Pumps If installing new irrigation pumps, would the project install only electric irrigation pumps using either on-site solar photovoltaic (PV) or small wind energy generation systems and battery storage, or via connection to overhead power lines?; OR If the site contains existing diesel-powered or gasoline-powered irrigation pumps, would the project convert them to electric pumps using on-site solar PV or small wind energy generation systems with battery storage, or via connection to overhead power lines? Check "N/A" only if the project does not contain any agricultural operations.	AG-1	☐	☐	☐
1b. Applicant Detail: Please substantiate how the project satisfies questions 1a. ____________________________________ ____________________________________ ____________________________________				
2a. Agricultural Equipment Would the project, following project completion, use electric or alternatively-fueled agricultural equipment (i.e., renewable diesel, natural gas, or other low-carbon fuels) in its operations?; OR If the project cannot commit to using electric or alternatively-fueled agricultural equipment during operations, would the project use Tier 4 diesel equipment for off-road agricultural equipment? Check "N/A" only if the project does not contain any agricultural operations.	AG-2 & AG-3	☐	☐	☐
2b. Applicant Detail: Please substantiate how the project satisfies questions 2a. ____________________________________ ____________________________________ ____________________________________				
3a. Sustainable Agricultural Practices Which of the following sustainable agricultural best management practices (BMPs) will the project, following project completion, include in its operations? Check all that apply: ☐ Low carbon farming ☐ Low impact farming (e.g., minimizing tractor passes) ☐ Low- or no-till farming ☐ Cover cropping strategies ☐ Low nitrogen fertilizer usage ☐ Low water usage ☐ Composting ☐ Use of fuel efficient equipment ☐ Napa Green Land certification ☐ Other Check "N/A" only if the project does not contain any agricultural operations.	AG-6	☐	☐	☐

Step 2: CAP Measures Consistency				
Checklist Item (Check the appropriate box and provide explanation for your answer)	CAP Measure	Yes	No	N/A
3b. Applicant Detail: Please substantiate how the project satisfies questions 3a, providing details for each checked BMP. ____ ____ ____ ____ ____				
Building Energy Efficiency and Green Building				
4a. Energy Audits Existing Buildings: For projects that require substantial additions to or alterations to existing buildings, and the scope of work would affect greater than or equal to 50 percent of the lot's total building square footage, the project must complete an energy audit. Will the energy audit be performed prior to issuance of a building permit? And, will the project applicant agree, as a condition of approval, to incorporate all cost-effective energy improvements into the project design, per the recommendations of the energy audit? Check "N/A" only if the project is not an existing project addition or alteration.	BE-9	☐	☐	☐
4b. Applicant Detail: Please substantiate how the project satisfies questions 4a. ____ ____ ____ ____ ____				
5a. CALGreen Tier I Standards for Existing Nonresidential and Residential Construction: For projects that require substantial alterations or additions to existing buildings over 1,000 square feet, will the project agree, as a condition of approval, to comply with current CALGreen Tier 1 Green Building standards, as outlined in the California Green Building Standards Code; and, current Tier 1 energy efficiency standards in Title 24, Part 6 of the California Code of Regulations?	BE-1	☐	☐	☐
5b. CALGreen Tier I Standards for New Nonresidential and Residential, and ZNE Requirements: For projects that include new nonresidential or residential construction, will the project agree, as a condition of approval, to comply with current CALGreen Tier 1 Green Building standards, as outlined in the California Green Building Standards Code; and, current Tier 1 energy efficiency standards in Title 24, Part 6 of the California Code of Regulations? For projects that include new residential construction for which building permits would be issued after January 1, 2020, will the project agree, as a condition of approval, to achieve zero-net energy (ZNE) performance, in accordance with standards, specifications or guidance issued by the California Energy Commission under Title 24 of the California Code of Regulations?	BE-2	☐	☐	☐

Step 2: CAP Measures Consistency				
Checklist Item (Check the appropriate box and provide explanation for your answer)	CAP Measure	Yes	No	N/A
5c. Applicant Detail: Please substantiate how the project satisfies questions 5a and 5b. ____ ____ ____ ____ ____ ____ ____ ____				
Oak Woodland and Forest Preservation and Tree Mitigation				
6a. Oak Woodland and Coniferous Forest – Preservation and Mitigation Would the project preserve a minimum of 30 percent of existing trees on-site?; <u>AND</u> For any existing trees that cannot be preserved on-site, would they be replanted at a minimum ratio of 2:1 on-site or elsewhere?	LU-1	☐	☐	☐
6b. Applicant Detail: Please substantiate how the project satisfies questions 6a. ____ ____ ____ ____ ____				
Riparian Woodland Preservation				
7a. Riparian Woodlands Would the project avoid removal of riparian woodland habitat and result in no net losses? Check "N/A" only if the project does not contain any riparian woodland habitat.	LU-2	☐	☐	☐
7b. Applicant Detail: Please substantiate how the project satisfies questions 7a. ____ ____ ____ ____ ____				
Tree and Woody Biomass Waste Diversion				
8a. Tree and Woody Biomass Waste Diversion If the project requires existing trees and/or woody biomass to be removed, will the project applicant demonstrate in the Construction & Demolition (C&D) Waste Management Plan that at least 80 percent of the total removed weight of trees or woody biomass will be diverted for other uses or prevented from burning by implementing any of the following? ☐ Reuse of harvested wood from removed trees as lumber or furniture in on-site construction ☐ Sale of harvested wood from removed trees to local businesses ☐ Chipping non-usable wood or woody biomass for use as mulch on-site ☐ Burying non-usable woody biomass ☐ Other sustainable reuse or disposal methods Check "N/A" only if the project does not remove existing trees or woody biomass on-site.	LU-3	☐	☐	☐

Step 2: CAP Measures Consistency				
Checklist Item (Check the appropriate box and provide explanation for your answer)	CAP Measure	Yes	No	N/A
8b. Applicant Detail: Please substantiate how the project satisfies questions 8a, providing details for each checked item. ____ ____ ____ ____ ____				
Water Heating Systems				
9a. Electric or Alternatively-Fueled Water Heating Systems: <u>Residential</u>: For residential, will the project agree, as a condition of approval, to install the following types of electric or alternatively-fueled water heating systems? Please check which types of systems will be installed: ☐ Electric water heater ☐ Ground source heat pump ☐ Solar thermal water heater ☐ Heat pump water heater ☐ Other Natural gas water heating systems will only be permitted if natural gas water heaters proposed to be used are rated to achieve a minimum thermal efficiency of 95 percent. In this case, applicants must submit documentation verifying that the thermal efficiency ratings of the proposed water heaters are at least 95 percent. Check "N/A" if the project does not contain any residential buildings.	BE-4	☐	☐	☐
9b. Applicant Detail: Please substantiate how the project satisfies questions 9a. ____ ____ ____ ____ ____				
Transportation System Management				
10a. Transportation System Management (TSM) <u>Non-residential:</u> For non-residential projects in which more than 20 employees will be employed on-site, will the project agree, as a condition of approval, to comply with the County's TSM ordinance? And, will the project work with County staff to implement the proper combination of the following BMPs? At least one of the following components: ☐ Parking cash out program ☐ Parking management plan that includes charging employees market-rate for single-occupancy vehicle parking and providing reserved, discounted, or free spaces for registered carpools or vanpools ☐ Unbundled parking whereby parking spaces would be leased or sold separately from the rental or purchase fees for the development for the life of the development At least three of the following components: ☐ Convenient access to transit ☐ On-site car-sharing vehicle(s) or bike-sharing ☐ Secure bike parking ☐ Preferential parking for carpools and vanpools ☐ Pedestrian access to public sidewalks	TR-1	☐	☐	☐

Step 2: CAP Measures Consistency				
Checklist Item (Check the appropriate box and provide explanation for your answer)	CAP Measure	Yes	No	N/A
☐ Flexible or alternative work hours ☐ Parking management plan ☐ Telework program ☐ Transit, carpool, and vanpool subsidies ☐ Pre-tax deduction for transit or vanpool fares and bicycle commute costs ☐ Access to services that reduce the need to drive, such as cafes, commercial stores, banks, post offices, restaurants, gyms, or childcare, either onsite or within ¼ mile of the structure/use? Check "N/A" if the project is a residential project or if the project would not accommodate more than 20 employees.				

10b. Applicant Detail:
Please substantiate how the project satisfies questions 10a, providing details for each checked item.

____
____
____
____
____

Vehicle Miles Traveled

11a. Vehicle Miles Traveled (VMT) Per the requirements of Circulation Element Policy CIR-39, will the project reduce unmitigated VMT by at least 15 percent?	TR-15	☐	☐	☐

11b. Applicant Detail:
Please substantiate how the project satisfies questions 11a.

____
____
____
____
____

Parking

12a. Clean-Air Designated Parking Spaces Non-residential projects: For new nonresidential projects, will the project agree, as a condition of approval, to comply with clean-air designated parking spaces as stated in non-residential voluntary measure A5.106.5.11 of the California Green Building Standards Code and to provide designated parking for a combination of low-emitting, fuel-efficient, and carpool/vanpool vehicles as outlined in the table below?	BE-1, BE-2 and TR-2	☐	☐	☐

Number of Required Parking Spaces	Number of Designated Parking Spaces
0-9	0
10-25	2
25-60	4
51-75	6
76-100	9
101-150	11
151-200	18
201 and over	At least 10% of total

This question does not cover electric vehicles (EVs). See Question 14 for EV parking requirements.

Step 2: CAP Measures Consistency				
Checklist Item (Check the appropriate box and provide explanation for your answer)	CAP Measure	Yes	No	N/A
Note: Vehicles bearing Clean Air Vehicle stickers from expired HOV lane programs may be considered eligible for designated parking spaces. The required designated parking spaces are to be provided within the overall minimum parking requirement, not in addition to it. Check "N/A" only if the project is a residential project.				

12b. Applicant Detail:
Please substantiate how the project satisfies questions 12a.

____
____
____
____
____

13a. Reduced Parking Capacity Non-residential: For new nonresidential projects, will the project agree, as a condition of approval, to comply with provisions stated in non-residential voluntary measure A5.106.6.1of the California Green Building Standards Code to reduce parking capacity by employing at least one of the following strategies? 1. Use of on street parking or compact spaces, illustrated on the site plan; or, 2. Implementation and documentation of programs that encourage occupants to carpool, ride share or use alternate forms of transportation. Check "N/A" only if the project is a residential project.	BE-1, BE-2 and TR-2	☐	☐	☐

13b. Applicant Detail:
Please substantiate how the project satisfies questions 12a

____
____
____
____
____

Electric Vehicle Infrastructure				
14a. EV Charging For the following types of projects, will the project agree, as a condition of approval, to comply with applicable EV charging measures, as outlined in the California Green Building Standards Code? • One- and two-family dwellings and townhouses with attached private garages: To comply with Tier 1 residential voluntary measure A4.106.8.1 of the California Green Building Standards Code, would the required parking serving each new dwelling be "EV Ready"[1] to allow for the future installation of electric vehicle supply equipment to provide an electric vehicle charging station for use by the resident? • Multi-Family Projects of 17 or more dwelling units: To comply with Tier 1 residential voluntary measure A4.106.8.2 of the California Green Building Standards Code, would 5% of the total parking spaces required, or a minimum of one space, whichever is greater, be "EV Capable"[2] to allow for the future installation of electric vehicle supply equipment to provide electric vehicle charging stations at such time as it is needed for use by residents?	BE-1, BE-2 and TR-12	☐	☐	☐

[1] "EV Ready" means a parking space that is pre-wired with a dedicated 208/240 branch circuit installed in conduit that originates at the electrical service panel or sub-panel and 40 ampere minimum overcurrent protection device, and terminates into a cabinet, box or enclosure, in a manner approved by the building official.

[2] "EV Capable" means a parking space that has a cabinet, box or enclosure connected to a conduit linking the parking space to the electrical service panel in a manner approved by the building official. The electrical service panel shall provide sufficient capacity to simultaneously charge all electric vehicles with or without a load management system.

Step 2: CAP Measures Consistency				
Checklist Item (Check the appropriate box and provide explanation for your answer)	CAP Measure	Yes	No	N/A
• Non-residential: To comply with Tier 1 nonresidential voluntary measure A5.106.5.3 .1 of the California Green Building Standards Code, would the project provide "EV Capable" spaces, as outlined in the table below, to allow for future installation of electric vehicle supply equipment to provide stations at such time as it is needed for use by future occupants?				

Number of Required Parking Spaces	Number of Designated Parking Spaces
0-9	0
10-25	2
25-60	3
51-75	5
76-100	7
101-150	10
151-200	14
201 and over	At least 8% of total

14b. Applicant Detail:
Please substantiate how the project satisfies questions 13a.

____
____
____
____
____
____

Recycling and Composting

15a. Recycling and Composting	CAP Measure	Yes	No	N/A
Multi-Family Projects of 5 or more dwelling units: Would the project provide a readily accessible area(s) that serve all buildings on the site and is identified for the depositing, storage and collection of non-hazardous materials for recycling, including (at a minimum) paper, corrugated cardboard, glass, plastics, organic waste, and metals? Commercial and Wineries: Would the project facilitate or participate in food or winery waste composting for small and large businesses, in coordination with applicable food waste and winery waste composting programs offered by various recycling and waste disposal services within the County? Check "N/A" if the project is single-family residential, multi-family less than five units, and industrial.	SW-1	☐	☐	☐

15b. Applicant Detail:
Please substantiate how the project satisfies questions 15a.

____
____
____
____
____

Step 2: CAP Measures Consistency				
Checklist Item (Check the appropriate box and provide explanation for your answer)	CAP Measure	Yes	No	N/A
Water Efficiency and Conservation				
16a. For residential and non-residential projects, would the project comply with all applicable indoor and outdoor water efficiency and conservation measures required under CALGreen Tier 1, as outlined in the California Green Building Standards Code?	BE-1, BE-2 and WA-1	☐	☐	☐
16b. Applicant Detail: Please substantiate how the project satisfies questions 16a. __________ __________ __________ __________ __________				
17a. Water Audits Existing Commercial and Industrial: For commercial and industrial projects that require substantial addition, alteration, and expansion to existing facilities, the project must comply with a water audit. Will the water audit be performed prior to issuance of a building permit? And, will the project agree, as a condition of approval, to incorporate all cost-effective water efficiency improvements into the project design, per recommendations in the water audit?	WA-4	☐	☐	☐
17b. Applicant Detail: Please substantiate how the project satisfies questions 17a. __________ __________ __________ __________ __________				
Low-Global Warming Potential Refrigerants				
18a. Low-Global Warming Potential (GWP) Refrigerant Use Non-residential: For new nonresidential projects, will the project agree, as a condition of approval, to comply with CALGreen Tier 1 non-residential voluntary measure A5.508 as stated in the California Green Building Standards Code, which would require the installation of HVAC equipment that complies with either of the following: 1. Install HVAC, refrigeration and fire suppression equipment that do not contain HFCs or that do not contain HFCs with a global warming potential greater than 150. 2. Install HVAC and refrigeration equipment that limit the use of HFC refrigerant through the use of a secondary heat transfer fluid with a global warming potential no greater than 1. Check "N/A" if the project is residential.	BE-1, BE-2 and HG-2	☐	☐	☐
18b. Applicant Detail: Please substantiate how the project satisfies questions 18a. __________ __________ __________ __________ __________				