Santa Cruz County CAAP

Greenhouse Gas Analysis, Forecast, and Targets Report

prepared by

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This document presents the data, methods, and results for the 2019 greenhouse gas (GHG) emissions inventory and forecast for the Unincorporated County of Santa Cruz (the County). Included is an analysis of findings and trends in the County's GHG emissions developed to support the County's GHG emissions reduction targets and ultimately the County's Climate Action and Adaptation Plan (CAAP).

The State of California has set statewide GHG emissions reduction goals to mitigate negative climate change impacts and transition the state to a low-carbon economy. In particular, the State has established goals to reduce statewide GHG emissions to 1990 levels by 2020, as established by Assembly Bill (AB) 32, and 40 percent below 1990 levels by 2030, as established by Senate Bill (SB) 32. The 2020 goal set by AB 32 was achieved by the State in 2016.[1]

In addition, Executive Order (EO) B-55-18 established a State goal of carbon neutrality by 2045. The California Air Resources Board (CARB) is the agency responsible for addressing these goals and developing strategies to achieve the goals. Many local jurisdictions are completing their own GHG inventories, forecasts, and climate action plans to align with SB 32 and EO B-55-18.

Local governments play a fundamental role in reducing local GHG emissions and preparing for a more resilient future. Local government policies can influence high-emissions behavior and mitigate climate change effects.[2] County governments are also uniquely situated to lead or coordinate regional climate action efforts, which may not be available at the city, town, or individual level. To this end, the County has already developed a Climate Action Strategy (CAS) designed to align with AB 32 and SB 32 goals, increase resilience and climate change preparedness, maintain healthy air and water resources, enhance and protect natural and working lands, and improve community health and the local economy. The CAS quantified the County's major sources of GHG emissions produced by the community and established a GHG emissions baseline for developing a forecast of anticipated future emissions. The forecast allows the County to track GHG emissions trends and facilitates target setting for future progress tracking. However, the forthcoming CAAP will include a 2019 GHG inventory which is the County's first GHG inventory update since the CAS was developed in 2013.

The GHG inventory completed for the County includes GHG emissions from activities within the County's jurisdictional boundaries during 2019. Based on the inventory, Rincon developed a back-cast of the County's GHG emissions to 1990 as well as a forecast to 2025, 2030, 2035, 2040, and 2045. The forecast provides an up-to-date projection of how GHG emissions are expected to change for the County in the future based on changes in population and employment, as well as existing State and federal legislation aimed at reducing GHG emissions through 2045. This document also presents provisional GHG targets and a gap analysis, developed to help identify GHG emissions reduction activities that will be needed to achieve the County's GHG emissions reduction targets. Like all GHG inventories, forecasts, and targets, the analysis in this document relies on the best available data and calculation methodologies currently available.

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[1] CARB. Frequently Asked Questions – California's 2022 Climate Scoping Plan. https://ww2.arb.ca.gov/sites/default/files/2022-06/2022_Scoping_Plan_FAQ_6.21.22.pdf

[2] CARB. California's 2017 Climate Change Scoping Plan. https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/scoping_plan_2017.pdf

2 Background

Legislative Context

The State of California has developed statewide legislative goals and programs to reduce GHG emissions in California. The State, via CARB, has issued several guidance documents concerning the establishment of GHG emissions reduction targets for local climate action plans to comply with legislated GHG emissions reductions goals. In the State's first Climate Change Scoping Plan (hereafter referred to as the 2008 Scoping Plan), CARB encouraged local governments to adopt a reduction target for their own community emissions that parallels the State commitment to reduce GHG emissions.[3] In 2017, CARB published California's 2017 Climate Change Scoping Plan (hereafter referred to as the 2017 Scoping Plan Update) outlining the strategies the State will employ to reach the additional State targets set by SB 32.[4]

On May 10th, 2022, the Draft 2022 California Climate Change Scoping Plan Update was published for public comment and includes recommendations for complying with the carbon neutrality by 2045 goal established by California EO B-55-18.[5]. In addition, the Bay Area Air Quality Management District (BAAQMD) adopted new CEQA GHG thresholds that recommends meeting the carbon neutrality goal by 2045. Monterey Bay Air Quality Management District does not have their own CEQA GHG thresholds and thus Santa Cruz County follows BAAQMD thresholds. Showing progress toward the 2045 goal is considered best practice when developing a climate action plan to maintain alignment with the State and regional air districts guidance.

Legislative Targets

The State of California has adopted legislation and policies to address climate change, the most relevant of which are summarized below.

- **Executive Order S-3-05**, signed by former Governor Schwarzenegger in 2005, establishes statewide GHG emissions reduction goals to achieve long-term climate stabilization as follows: by 2020, reduce GHG emissions to 1990 levels and by 2050, reduce GHG emissions to 80 percent below 1990 levels. The 2050 goal was accelerated by the 2045 carbon neutral goal established by EO B-55-18, as discussed below.
- **Assembly Bill 32**, known as the Global Warming Solutions Act of 2006, requires California's GHG emissions be reduced to 1990 levels by the year 2020 (approximately a 15 percent reduction from 2005 to 2008 levels). The 2008 Scoping Plan identifies mandatory and voluntary measures to achieve the statewide 2020 GHG emissions limit.
- **Senate Bill 32**, signed by former Governor Brown in 2016, establishes a statewide mid-term GHG emissions reduction goal of 40 percent below 1990 levels by 2030. CARB formally adopted the 2017 Scoping Plan Update in December 2017, laying the roadmap to achieve 2030 goals and

3 CARB. Climate Change Scoping Plan: A Framework for Change. Dec. 2008. ww2.arb.ca.gov/sites/default/files/classic//cc/scopingplan/document/adopted_scoping_plan.pdf

4 CARB. California's 2017 Climate Change Scoping Plan. https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/scoping_plan_2017.pdf

5 CARB. Draft 2022 Scoping Plan Update. https://ww2.arb.ca.gov/sites/default/files/2022-05/2022-draft-sp.pdf

giving guidance to achieve substantial progress toward 2050 State goals. The Draft 2022 Scoping Plan Update provides further guidance for reaching the State's SB 32 goal.

- **Executive Order B-55-18**, signed by former Governor Brown in 2018, expanded upon EO S-3-05 by creating a statewide GHG emissions goal of carbon neutrality by 2045. EO S-55-18 identifies CARB as the lead agency to develop a framework for implementation and progress tracking toward this goal in the 2022 Climate Change Scoping Plan Update.

Legislative Reduction Programs

Additional legislative programs are expected to reduce emissions in specific GHG emissions sectors throughout California, as identified in the 2017 Scoping Plan Update. Many of these programs were incorporated into the forecast analysis and are summarized in the subsections below.

Transportation Legislation

ADVANCED CLEAN CARS PROGRAM

Prior to 2012, mobile emissions regulations were implemented on a case-by-case basis for GHG and criteria pollutant emissions separately. In January 2012, CARB approved a new emissions-control program (the Advanced Clean Cars program) combining the control of smog, soot causing pollutants, and GHG emissions into a single coordinated package of requirements for passenger cars and light trucks model years 2017 through 2025. The Advanced Clean Cars program coordinates the goals of the Low Emissions Vehicles, Zero Emissions Vehicles, and Clean Fuels Outlet programs, and is more stringent than the federal Corporate Average Fuel Economy (CAFE) standards. The new standards will reduce California's GHG emissions by 34 percent in 2025. [6]

ASSEMBLY BILL 1493

Signed into law in 2002, AB 1493 (Pavley Standards) required vehicle manufacturers to reduce GHG emissions from new passenger vehicles and light trucks from 2009 through 2016. Regulations were adopted by CARB in 2004 and took effect in 2009 when the United States Environmental Protection Agency (USEPA) issued a waiver confirming California's right to implement the bill. The CARB anticipates that the Pavley I standard will reduce GHG emissions from new California passenger vehicles by about 30 percent in 2016, while simultaneously improving fuel efficiency and reducing motorists' costs.[7]

INNOVATIVE CLEAN TRANSIT (ICT)

Public transit GHG emissions will be reduced in the future through the Innovative Clean Transit (ICT) regulation, which was adopted in December 2018. It requires all public transit agencies to gradually transition to a 100-percent zero-emission bus fleet by 2040. Under ICT, large transit agencies are expected to adopt Zero-Emission Bus Rollout Plans to establish a roadmap towards zero emission public transit buses.[8]

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6 CARB. Facts About the Advanced Clean Cars Program. December 2011. http://www.arb.ca.gov/msprog/zevprog/factsheets/advanced_clean_cars_eng.pdf

7 CARB. Clean Car Standards – Pavley, Assembly Bill 1493. May 2013. http://www.arb.ca.gov/cc/ccms/ccms.htm

8 Innovative Clean Transit. Approved August 13, 2019. https://ww2.arb.ca.gov/sites/default/files/2019-10/ictfro-Clean-Final_0.pdf?utm_medium=email&utm_source=govdelivery

EXECUTIVE ORDER N-79-20

Governor Newsom recently passed EO N-79-20, which requires that all new cars and passenger trucks sold in California by 2035 be zero-emission vehicles (ZEV). While this will likely lead to an expedited timeline for adoption of ZEVs in California, EO N-79-20 as an executive order is binding only unto State agencies and would require State-wide infrastructure changes (i.e., additional ZEV chargers) that are not established in a concrete implementation plan at this time. This program was therefore conservatively excluded from the GHG forecast.

Energy Legislation

TITLE 24

Although it was not originally intended to reduce GHG emissions, California Code of Regulations Title 24, Part 6: California's Energy Efficiency Standards for Residential and Nonresidential Buildings, was adopted in 1978 in response to a legislative mandate to reduce California's energy consumption, which in turn reduces fossil fuel consumption and associated GHG emissions. The standards are updated triennially to allow consideration and possible incorporation of new energy-efficient technologies and methods. Starting in 2020, new residential developments had to include on-site solar generation and near-zero net energy use. For projects implemented after January 1, 2020, the California Energy Commission (CEC) estimates that the 2019 standards will reduce electricity consumption by 53 percent for residential buildings and 30 percent for non-residential buildings, relative to the 2016 standards. The CEC further estimates residential natural gas efficiency increases of 7 percent for residential end uses. No efficiency increases were estimated for commercial natural gas end uses, based on lack of requirements in this sector in the 2019 standards. These percentage savings relate to heating, cooling, lighting, and water heating only and do not include other appliances, outdoor lighting not attached to buildings, plug loads, or other energy uses. These reductions were incorporated into the forecast, as discussed in Section 4.2. The 2022 standards have been released but no guidance has been provided by the State on the energy reductions expected from these new standards. The 2022 standards were conservatively excluded from the GHG forecast.

The 2017 Scoping Plan Update calls for the continuation of ongoing triennial updates to Title 24 which will yield regular increases in the mandatory energy and water savings for new construction. Current Title 24 standards are incorporated into the forecast through 2045, however, future updates to Title 24 standards that may require energy efficiencies beyond current standards for residential and non-residential alterations are not taken into consideration in the GHG forecast analysis due to lack of data and certainty about the magnitude of energy savings realized with future updates.

RENEWABLES PORTFOLIO STANDARD (RPS) & SENATE BILL 100

Established in 2002 under SB 1078, enhanced in 2015 by SB 350, and accelerated in 2018 under SB 100, California's RPS is one of the most ambitious renewable energy standards in the country. The RPS program requires investor-owned utilities, publicly owned utilities, electric service providers, and community choice aggregators to increase procurement from eligible renewable energy resources to 50 percent of total procurement by 2026 and 60 percent of total procurement by 2030. The RPS program further requires these entities to increase procurement from GHG-free sources to 100 percent of total procurement by 2045. This program was incorporated into the GHG forecast by adjusting the electricity emissions factors for future years, as discussed in Section 4.4.

Waste Legislation

ASSEMBLY BILL 939 & ASSEMBLY BILL 341

In 2011, AB 341 set the target of 75 percent recycling, composting, or source reduction of solid waste by 2020 calling for the California Department of Resources Recycling and Recovery (also known as CalRecycle) to take a statewide approach to decreasing California's reliance on landfills. This target was an update to the former target of 50 percent waste diversion set by AB 939.

As actions under AB 341 are not assigned to specific local jurisdictions, potential future reductions from the bill were conservatively not included in the GHG forecast analysis.

ASSEMBLY BILL 1826

In 2014, AB 1826 set regulations in places requiring California businesses to recycle all of their organic waste starting in April, 2016. The bill also required jurisdictions across the State to provide organic waste recycling programs to accommodate diverted waste from local businesses. As the County has already implemented an organics collection program, implementation of AB 1826 compliance was not part of the GHG forecast analysis.

SENATE BILL 1383

SB 1383 established a methane emission reduction target for short-lived climate pollutants in various sectors of the economy, including waste. Specifically, SB 1383 establishes targets to achieve a 50 percent reduction in the level of the statewide disposal of organic waste from the 2014 level by 2020 and a 75 percent reduction by 2025.[9] Additionally, SB 1383 requires a 20 percent reduction in "current" edible food disposal by 2025. Although SB 1383 has been signed into law, compliance with this senate bill must occur at the jurisdiction-level rather than the state-level. As such, SB 1383 is not included as part of the GHG forecast analysis.

GHG Emissions Inventory

Conducting a GHG emissions inventory serves to provide a comprehensive understanding of a jurisdiction's GHG emissions, and may be developed to serve the following purposes:

- Provide an understanding of where the highest sources of GHG emissions in the jurisdiction originate and where the greatest opportunities for emissions reduction exist.
- Enable the jurisdiction to understand the scale of GHG emissions from various sources and develop improved GHG emissions accounting and reporting principles.
- Create a GHG emissions baseline from which the jurisdiction can establish a forecast, reduction targets, and evaluate future progress.
- Help jurisdictions understand how best to meet GHG reduction legislative requirements.

GHG inventories are developed by identifying the sources and sinks (sectors) for each GHG (see *Greenhouse Gases* section below) within the geographic or system boundary of interest, establishing activity data for each sector, and applying an emissions factor to determine the carbon dioxide equivalence (CO_2e). On the level of cities or counties, there are often a large number of potential sectors contributing to the jurisdiction's GHG emissions. However, due to factors such as time, cost,

9 CalRecycle. California's Short-Lived Climate Pollutant Reduction Strategy. https://calrecycle.ca.gov/organics/slcp/

and data availability, typically only a select few sectors which are considered the major contributors to the jurisdiction's GHG inventory are considered. The GHG emissions sectors used for the County's GHG inventory are identified in Section 3.

GHG Quantification Method

GHG emissions quantification frameworks have been developed over the years in an effort to standardize GHG accounting. The International Council for Local Government Initiatives (ICLEI) protocols are designed for local-scale accounting of GHG emissions that contribute to climate change and provide authoritative guidance to account for GHG emissions accurately and consistently. The ICLEI U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions Version 1.2 (Community Protocol) serves to guide the measurement and reporting of GHG emissions in a standardized way and is used by other jurisdictions to support their own inventory, forecast, and climate action planning efforts. The Community Protocol also includes steps to evaluate the relevance, completeness, consistency, transparency, and accuracy of data used in the GHG inventory.

3 GHG Inventory Review and Reconciliation

3.1 AMBAG GHG Inventory

The County's 2019 GHG inventory was originally completed by the Association of Monterey Bay Area Governments (AMBAG) as part of a regional GHG emissions inventory in September 2021. The 2019 Inventory was further updated by AMBAG in June 2022 during the completion of the County's 2020 GHG inventory to incorporate updated modeling of estimating Transportation related emissions. The 2019 inventory was completed in accordance with the Community Protocol.[10]

GHG Emissions Boundary

The County's 2019 inventory covers the relevant emissions sources within the boundary of the unincorporated County, excluding the 4 major cities of Capitola, Santa Cruz, Scotts Valley, and Watsonville. The inventory thereby reflects emissions over which the County has direct control.

Greenhouse Gases

The ICLEI CP suggests that inventories assess GHG emissions associated with the six internationally recognized GHGs, as outlined in Table 1.[10] The 2019 inventory focuses on the three GHGs most relevant to the County's operations: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The other gases (hydrofluorocarbons, perfluorocarbons, and sulfur hexafluorides) are emitted primarily in private sector manufacturing and electricity transmission and are therefore, omitted from the inventory. This approach is consistent with typical community inventory approaches, as industrial emissions are outside of the County's jurisdictional control. Table 1 also includes the global warming potentials (GWP) for each gas. The 2019 inventory used 100-year global warming potentials (GWP) for each gas that are consistent with the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report, which were also used by the State in their latest GHG emissions inventory. The County's updated 2019 GHG inventory was prepared in conformance with the GWP used in CARBs lates statewide GHG inventory and therefore, also uses the 100-year GWP values published in the IPCC Fifth Assessment Report.[11] The GWP refers to the ability of each gas to trap heat in the atmosphere. For example, one pound of methane gas has 28 times more heat capturing potential than one pound of carbon dioxide gas. GHG emissions are reported in metric tons of CO_2 equivalent (MT CO_2e).

10 U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. https://icleiusa.org/ghg-protocols/

11 IPCC. AR5 Synthesis Report: Climate Change 2014. https://www.ipcc.ch/report/ar5/syr/

Table 1 2019 Inventory GHGs and GWPs

Greenhouse Gas	Primary Source	100-year GWP
Carbon dioxide (CO_2)	Combustion	1
Methane (CH_4)	Combustion, anaerobic decomposition of organic waste (e.g., in landfills, wastewater treatment plants)	28
Nitrous Oxide (N_2O)	Leaking refrigerants and fire suppressants	265
Hydrofluorocarbons	Leaking refrigerants and fire suppressants	4 - 12,400
Perfluorocarbons	Aluminum production, semiconductor manufacturing, HVAC equipment manufacturing	6,630 - 11,100
Sulfur Hexafluoride (SH6)	Transmission and distribution of power	23,500

Source: IPPC Fifth Assessment Report

Generally, GHG emissions were calculated by multiplying the activity data in each GHG emissions sector (e.g., transportation, energy, waste, water) by an associated emission factor. Activity data refer to the relevant measured or estimated energy usage or GHG-generating process data. Emission factors are observation-based conversion factors used to equate activity data to generated GHG emissions. The original 2019 inventory results are summarized in Table 2. In general, the 2019 inventory used up-to-date and appropriately aggregated activity data, data sources, and emission factors, and was consistent with calculation methodologies in the Community Protocol.

Table 2 Original 2019 GHG Emissions Inventory for Santa Cruz Unincorporated County (AMBAG)

GHG Emissions Sector	GHG Emissions Subsector	Activity Data	Activity Data Source	Emissions Factor	Emission Factor Source	GHG Emissions (MT CO_2e)*
Energy: GHG emissions associated with the consumption of energy for residential and commercial buildings and other facilities in the jurisdiction[1]	Residential Electricity	13,210,533 kWh	PG&E	0.00000211 MT CO_2e/kWh	PG&E	27.95
	Residential Electricity	242,512,877 kWh	3CE	0.00000543 MT CO_2e/kWh	3CE	1,317
	Nonresidential Electricity	4,523,513 kWh	PG&E	0.00000211 MT CO_2e/kWh	PG&E	9.57
	Nonresidential Electricity	257,966,446 kWh	3CE	0.00000543 MT CO_2e/kWh	3CE	1,401
	Residential Natural Gas	16,397,533 therms	PG&E	0.00531 MT CO_2e/therm	PG&E	87,213
	Nonresidential Natural Gas	8,569,089 therms	PG&E	0.00531 MT CO_2e/therm	PG&E	45,571
Transportation: GHG emissions associated with the operation of passenger, commercial, and transit within the jurisdiction	On-Road Vehicles	1,001,477,066 miles	EMFAC2021[2]	0.000442 MT CO_2e/mile	EMFAC2021	442,848
Waste: GHG emissions associated with decomposition of solid waste in a landfill generated by the jurisdiction	Waste	114,594 tons	CalRecycle[3]	N/A	ICLEI v1.2 SW.4.1,	32,786
Wastewater: GHG emissions associated with wastewater treatment processes. Electricity used for acquisition, distribution, and treatment of water is accounted for in Energy Sector activity data.	Wastewater	133,812 population served	State of California Department of Finance	N/A	ICLEI v1.2 WW.8, WW.12	2,874
TOTAL						614,048

Source: AMBAG

*Note – Totals may not match due to rounding

kWh = kilowatt hours; PG&E = Pacific Gas & Electric; MT CO_2e = metric tons of carbon dioxide equivalent; VMT = vehicle miles travelled

1. The energy sector includes energy and GHG emissions associated with water conveyance and treatment.

2. EMFAC2021 is the California Air Resources Board's (CARB) 2021 Emission FACtor (EMFAC) model, which estimates the official emissions inventories of on-road mobile sources in California, and is accessed at: https://arb.ca.gov/emfac/emissions-inventory/5e0cb7d6006cc10661f4b3ffb9c120a486d46ea6

3. The California Department of Resources, Recycling, and Recovery (CalRecycle) is a branch of the California Environmental Protection Agency which tracks a Jurisdiction's landfill tonnage per facility and characterizes California's waste streams, and is accessed at: https://www2.calrecycle.ca.gov/LGCentral/DisposalReporting/Destination/DisposalByFacility

During the review and reconciliation process, the following improvement opportunities were identified, with the methodologies used to complete these updates further discussed in the next section:

- The 2019 inventory did not include GHG emissions from natural gas methane leaks or electricity T&D losses, which are recommended sectors for inclusion according to the Community Protocol. The inventory was updated to include these sectors.
- The 2019 inventory did not use PG&E emissions factors that third-party verified sources. The inventory was updated to use a third-party verified PG&E emissions factor.
- The 2019 inventory did not include GHG emissions associated with residential propane use. The inventory was updated to include this sector in the inventory scope.
- AMBAG did not include off-road sector emissions in the 2019 inventory. Off-road sector emissions were added to the updated inventory using results from CARBs OFFROAD2021 model.
- AMBAG completed the 2019 inventory using CARB's EMFAC2021 model to estimate emission factors for the on-road transportation sector. County-wide VMT from EMFAC2021 was allocated to the unincorporated County based on the number of households in the County's jurisdiction but VMT was not further disaggregated to passenger, commercial, and bus VMT. The on-road sector was updated to separate the County's total VMT into passenger vehicle, commercial vehicle, and bus transportation.
- The 2019 inventory did not include process emissions related to solid waste landfilling, which is a recommended emissions source for inclusion according to the Community Protocol. The inventory was updated to include landfill process emissions.

The 2019 inventory assumes that all direct access energy consumption reported by PG&E is attributable to Central Coast Community Energy (3CE) and therefore, does not report on non-3CE direct access activity data. The original 2019 inventory also does not separate conveyance, treatment, and distribution electricity consumption in the water sector from energy sector emissions. With the data that is available for conducting the 2019 inventory, these assumptions are also used in the 2019 updated inventory.

3.2 Updated GHG Inventory

The updated 2019 GHG inventory leverages the latest available models and best available data in accordance with the Community Protocol. The updated inventory serves to provide a comprehensive understanding of the County's GHG emissions. The following sections contain further information on the inventory update approach, calculation methodologies, data used, and results.

Waste

GHG emissions associated with the waste sector result from both the decomposition of waste at a landfill and from waste processing equipment. GHG emissions from waste decomposition were re-calculated using Community Protocol Method SW.4 based on CalRecycle's 2014 Waste Characterization study as provided by AMBAG for waste component percentages and U.S. Community Protocol default emissions factors. GHG emissions from waste processing equipment not included in the original 2019 Inventory were added to the Updated Inventory using Community Protocol Method SW.5 assuming Compressed Natural Gas (CNG) serves as process fuel. Activity data for community-generated waste were provided by CalRecycle's database for Jurisdiction Disposal

and Alternative Daily Coverage (ADC) Tons by Facility. The GHG emissions calculations for waste are shown in Table 3.

Table 3 2019 Waste GHG Emissions Calculations

Sector	Community Protocol Method	Activity Data Input	Activity Data (wet short ton)	GHG Emissions (MT CO_2e)
Landfill Decomposition	SW.4	Community-generated waste	114,594	31,728
Process Emissions	SW.5			1,261

Transportation: On-road

The on-road transportation sector was updated to differentiate passenger, commercial vehicle, and bus emissions leveraging the latest on-road transportation data from CARB's EMFAC2021 model. The EMFAC2021 model provides VMT data for whole counties and does not differentiate data according to unincorporated versus incorporated County activity. To estimate activity data that is under the unincorporated County's jurisdiction, VMT data was proportioned based on number of households in the unincorporated County. Household data in the 2019 Inventory was obtained from the State of California Department of Finance (DOF) demographics forecast. The inventory was updated using household data provided by AMBAG's 2022 Regional Growth Forecast.[12]

VMT data were further disaggregated to passenger, commercial, and bus VMT as well as electric VMT (EVMT) within each category. EVMT can be converted to electricity usage (in kWh) by applying an estimated energy per mile factor from EMFAC2021. Activity data were then converted to GHG emissions using emission factors from EMFAC2021. These calculations are shown in detail in Table 4 and Table 5.

To avoid double counting electricity emissions contained in the transportation sector and in the electricity sector, residential and nonresidential electricity activity data were adjusted by subtracting the electricity used for vehicle charging. These changes are discussed in the next section.

12 Association of Monterey Bay Area Governments Regional Growth Forecast (June 2022). https://www.ambag.org/sites/default/files/2022-05/PDFAAppendix%20A_2022%20RGF.pdf. Accessed July 1st, 2022

Table 4 2019 On-road VMT Calculations

Sector	EMFAC Activity Data (miles/day)	Household Allocation[1]	Annual unincorporated County VMT (miles)[1]	EMFAC EV share	Annual EVMT (miles)	EMFAC Energy per Mile (kWh/mile)	Annual EVMT (kWh)
On-road Passenger VMT	1,730,902,409	54%	940,908,487	1.59%	14,996,324	0.37	5,515,108
On-road Commercial VMT	149,241,134	54%	81,126,613	0.00%	0	N/A	0
On-road Bus VMT	8,316,038	54%	4,520,550	0.00%	0	N/A	0

Table 5 2019 On-road GHG Emissions Calculations

Sector	Activity Data	Emission Factor	GHG Emissions (MT CO_2e)
On-road Passenger VMT	940,908,487 miles	0.000376 MT CO_2e/mile	353,782
On-road Commercial VMT	81,126,613 miles	0.001155 MT CO_2e/mile	93,701
On-road Bus VMT	4,520,550 miles	0.001511 MT CO_2e/mile	6,831
On-road Passenger EVMT[1]	5,515,108 kWh	0.00000563 MT CO_2e/kWh	31.07
On-road Commercial EVMT[2]	0 kWh	0.00000550 MT CO_2e/kWh	0.00
On-road Bus EVMT[2]	0 kWh	0.00000550 MT CO_2e/kWh	0.00

1. Emissions factor for on-road passenger EV electricity use is weighted according to the portion of PG&E and 3CE electricity usage in the residential electricity sector using PG&E emissions factor of 0.0000094 MT CO_2e/kWh and 3 CE emissions factor of 0.0000054 MT CO_2e/kWh

2. Emissions factor for on-road commercial and bus EV electricity use is weighted according to the portion of PG&E and 3CE electricity usage in the non-residential electricity sector using PG&E emissions factor of 0.0000094 MT CO_2e/kWh and 3 CE emissions factor of 0.0000054 MT CO_2e/kWh

Transportation: Off-road

Off-road activity data, measured in gallons of fuel consumed by fuel type, were added to the 2019 inventory using the recently released OFFROAD2021 emissions database, per CARB recommendations. OFFROAD2021 provides fuel usage results from off-road equipment operation at the county-wide level for sectors such as lawn and garden, forestry, agricultural, portable, or recreational equipment. Fuel usage results were apportioned to the unincorporated County using demographics data obtained from the 2045 Regional Transportation Plan for Santa Cruz County (Table 6). Emission factors for diesel, gasoline, and natural gas usage in off-road vehicles were obtained from the EPA Emission Factors for Greenhouse Gas Inventories report[13]. Off-road GHG emissions calculation details are shown in Table 7.

Table 6 2019 Off-road Equipment Sector Attributions

Equipment Type	Attribution Metric	Attribution Value
Agricultural	Agriculture Jobs	41.76%
Airport	Excluded - Not Airport Land Use	0.00%
Cargo	Number of Jobs	32.32%
Commercial	Number of Jobs	32.32%
Construction	Number of Jobs	32.32%
Forestry	Assume 100% attribution	100.00%
Industrial	Number of Jobs	32.32%
Lawn	Population	49.23%
Light	Number of Jobs	32.32%
Locomotive	Excluded - Not under Jurisdictional Control	0.00%
Military	Excluded - Not under Jurisdictional Control	0.00%
Ocean	Excluded - Not under Jurisdictional Control	0.00%
Oil	Excluded - Not under Jurisdictional Control	0.00%
Pleasure	Population	49.23%
Portable	Number of Jobs	32.32%
Transportation	Number of Jobs	32.32%
Recreational	Population	49.23%

Table 7 2019 Off-road GHG Emissions Calculations

Fuel Type	Activity Data (gallons)	Emission Factor (MT CO_2e/gallon)	GHG Emissions (MT CO_2e)
Diesel	1,159,436	0.01021	11,838
Gasoline	2,106,415	0.00878	18,494
Natural Gas	212,044	0.00568	1,204

13 EPA Emission Factors for Greenhouse Gas Inventories (April 1st, 2021). https://www.epa.gov/sites/default/files/2021-04/documents/emission-factors_apr2021.pdf. Accessed July 1st, 2022

Energy: Residential and Nonresidential Electricity

As mentioned above, residential and nonresidential electricity activity data and GHG emissions were updated to accurately account for the electricity used for electric vehicle charging and to avoid double-counting. Specifically, on-road passenger EVMT electricity was subtracted from the residential electricity activity data, while commercial and bus EVMT electricity was subtracted from the nonresidential electricity activity data. These updates are shown in Table 8.

Table 8 2019 Residential and Nonresidential Electricity Adjustment

Sector	Original Activity Data (kWh)	Annual EVMT (kWh)	Adjusted Activity Data (kWh)	Emission Factor (MT CO_2e/kWh)[1]	Adjusted GHG Emissions (MT CO_2e)
Residential Electricity (PG&E & 3CE)	255,723,410	5,515,108	250,208,302	5.63448E-06	1,410
Nonresidential Electricity (PG&E & 3CE)	262,489,959	0	262,489,959	5.49909E-06	1,443

1. Emissions factors for residential and nonresidential electricity are weighted according to the portion of PG&E and 3CE electricity usage in each sector using PG&E emissions factor of 0.0000094 MT CO_2e/kWh and 3 CE emissions factor of 0.0000054 MT CO_2e/kWh

Energy: Electricity T&D Losses

Electricity T&D losses arise from electricity lost during delivery to the buildings and associated end-uses in the County. Electricity T&D losses occur in the electricity delivery system and are therefore, upstream of the delivery end-points located in Santa Cruz, but are still associated with energy usage in the County. GHG emissions from electricity T&D losses are calculated using an electricity T&D loss factor of 5.10 percent, obtained from eGRID.[14] GHG emissions from electricity T&D losses were calculated separately for each electricity stream in the energy sector (residential and nonresidential) using the associated emission factor. T&D losses associated with electric vehicles was considered negligible and therefore not included in T&D loss quantification. Electricity T&D GHG emission calculation details are shown in Table 9.

Table 9 Electricity T&D Loss GHG Emissions Calculations

Sector	Activity Data (kWh)	T&D Losses (kWh)	Emission Factor (MT CO_2e/kWh)[1]	GHG Emissions (MT CO_2e)
Residential Electricity	250,208,302	12,760,623	5.63448E-06	71.90
Nonresidential Electricity	262,489,959	13,386,988	5.49909E-06	73.62

1. Emissions factors for residential and nonresidential electricity are weighted according to the portion of PG&E and 3CE electricity usage in each sector using PG&E emissions factor of 0.0000094 MT CO_2e/kWh and 3 CE emissions factor of 0.0000054 MT CO_2e/kWh

Energy: Gas Methane Leaks

Natural gas methane leaks arise from gas lost during delivery to the buildings and associated end-uses in the County. Gas methane leaks occur in the pipeline delivery system and are therefore upstream of the delivery end-points located in Santa Cruz, but are still associated with energy usage

14 EPA Emissions & Generation Resource Integrated Database (eGRID) (May 17th, 2022). https://www.epa.gov/egrid/data-explorer. Accessed July 1st, 2022

in the County. GHG emissions from gas methane leaks are calculated using a methane leak factor of 2.3 percent.[15] GHG emissions from gas methane leaks were calculated separately for the residential and nonresidential gas streams in the energy sector, using the natural gas methane leak emission factor. Gas leakage GHG emission calculation details are shown in Table 10.

Table 10 Natural Gas Methane Leaks GHG Emissions Calculations

Natural Gas Sector	Activity Data (therms)	Methane Leaks (therms)	Emission Factor (MT CO_2e/therm)[1]	GHG Emissions (MT CO_2e)
Residential Natural Gas	16,397,533	377,143	0.053067	20,014
Nonresidential Natural Gas	8,569,089	197,089	0.053067	10,459

1. Calculated using the equation: $2.85 \frac{cubic\ meters}{therm} * 95\%\ methane\ content * 0.7 \frac{kg}{cubic\ meter} * 28 \frac{CO_2e}{CH_4} * 0.001 \frac{MT}{kg}$

Energy: Residential Propane

Propane is commonly used in residential rural communities for space heating, water heating, and cooling among other uses. For most communities, obtaining complete data on fuels like propane in the residential sector is not possible due to the nature of the distribution process, which can involve many individual private suppliers. ICLEI's BE.1.2 was used to estimate residential propane emissions as it provides clear data sources that allow statewide data to be customized on a county level and maintains consistency with the County's 2019 updated inventory. The methodology estimates propane use in Santa Cruz County by first estimating energy intensity based on the state-wide energy use per household. The state-wide energy intensity for propane is then applied to regional number of households which utilize propane. The U.S. Energy Information Administration's (EIA) State Energy Data System was used to determine state-wide total residential fuel consumption, while the total number of households using propane was determined based on the EIA's 2009 Residential Energy Consumption Survey, the most recent survey year to provide state-specific total annual consumption. A summary of state-wide data utilized and calculated energy intensity is provided in Table 11.

Table 11 Propane Data and Data Sources

Parameter	Value	Source
Total Propane Used in California's Residential Sector	25.9 trillion BTU	Table CT4. Residential Sector Energy Consumption Estimates, Selected Years, 1960-2020, California in the EIA's State Energy Data System.[16]
Total California Homes using Propane	4.4 million households	Table HC.1.11 Fuels Used and End Uses in Homes in West Region, Divisions, and States, 2009 in the EIA's Residential Energy Consumption Survey.[17]
Propane Energy Intensity	5.89 MMBtu/household	Calculated

Notes: BTU = British Thermal Units

15 Alvarez, Ramón et al. (2018). Assessment of methane emissions from the U.S. oil and gas supply chain. Science. 361. https://www.science.org/doi/abs/10.1126/science.aar7204.

16 EIA State Energy Data System 2020. Accessed September 2022, via: https://www.eia.gov/state/seds/seds-data-complete.php?sid=US#Consumption

17 EIA Residential Energy Consumption Survey 2009. Accessed September 2022, via: https://www.eia.gov/consumption/residential/data/2020/index.php?view=characteristics

Information regarding the number of households in Santa Cruz County utilizing propane fuel was obtained from the U.S. Census Bureau's American Community Survey,[18] which excludes households using propane solely for cooking and other end uses, though is expected to provide the most accurate approximation of regional household propane use for the County. The resulting GHG emissions from residential propane use is provided in Table 12.

Table 12 Propane Use GHG Emissions Calculations

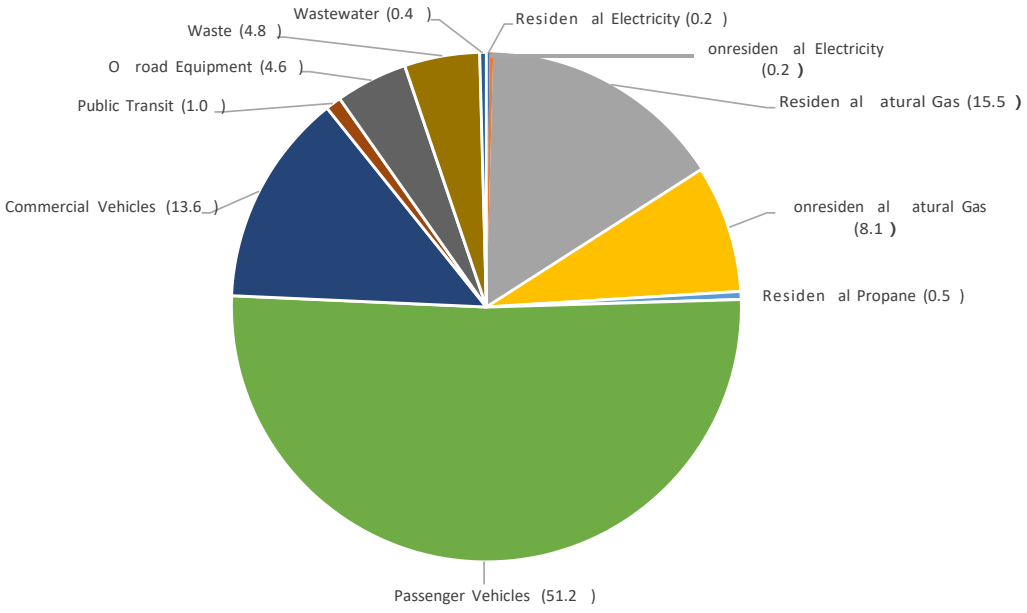
Propane Sector	Allocation Metric (MMBTU/household)	Propane Households[1]	Activity Data (MMBTU)	Emission Factor (MT CO_2e/MMBtu)[2]	GHG Emissions (MT CO_2e)
Residential Propane	5.89	9315	54,831	0.063113	3,461

1. Number of households using propane in Unincorporated Santa Cruz County provided by U.S. Census Bureau's American Community Survey.
2. Emissions Factor for propane end use provided by U.S. EPA GHG Emission Factors Hub (April 2021). Available at: https://www.epa.gov/sites/default/files/2021-04/documents/emission-factors_apr2021.pdf

3.2.1 Updated GHG Inventory Results

The results of the updated GHG inventory are summarized in Figure 1 and shown in detail in Table 13.

Figure 1 Updated Inventory GHG Emissions by Sector



18 U.S. Census Bureau American Community Survey. Accessed September 2022, via: https://data.census.gov/cedsci/table?q=House%20Heating%20Fuel&g=0500000US06087&d=ACS%201-Year%20Estimates%20Detailed%20Tables

Table 13 Updated 2019 GHG Emissions Inventory

GHG Emissions Sector	GHG Emissions Subsector	Activity Data		Emission Factor		GHG Emissions (MT CO_2e)
Energy	Residential Electricity	250,208,302	kWh	5.63448E-06	MT CO_2e/kWh	1,410
	Residential Electricity T&D	12,760,623	kWh	5.63448E-06	MT CO_2e/kWh	72
	Nonresidential Electricity	262,489,959	kWh	5.49909E-06	MT CO_2e/kWh	1,443
	Nonresidential Electricity T&D	13,386,988	kWh	5.49909E-06	MT CO_2e/kWh	74
	Residential Natural Gas	16,397,533	therms	0.00531051	MT CO_2e/therm	87,079
	Residential Natural Gas Leaks	377,143	therms	0.053067	MT CO_2e/therm	20,014
	Nonresidential Natural Gas	8,569,089	therms	0.00531051	MT CO_2e/therm	45,506
	Nonresidential Natural Gas Leaks	197,089	therms	0.053067	MT CO_2e/therm	10,459
	Residential Propane	54,831	MMBtu	0.063113	MT CO2e/MMBtu	3,461
Transportation	Passenger VMT	940,908,487	miles	0.000376	MT CO_2e/mile	353,782
	Commercial VMT	81,126,613	miles	0.001155	MT CO_2e/mile	93,701
	Bus VMT	4,520,550	miles	0.001511	MT CO_2e/mile	6,831
	Passenger EVMT	5,515,108	kWh	5.63448E-06	MT CO_2e/kWh	31
	Commercial EVMT	0	kWh	5.49909E-06	MT CO_2e/kWh	0
	Bus EVMT	0	kWh	5.49909E-06	MT CO_2e/kWh	0
	Off-road Diesel	1,052,796	gallons	0.01021	MT CO_2e/gallon	11,838
	Off-road Gasoline	1,929,915	gallons	0.00878	MT CO_2e/gallon	18,494
	Off-road Natural Gas	212,044	gallons	0.00568	MT CO_2e/gallon	1,204
Waste	Landfill CH_4	114,594	tons	N/A	N/A	31,728
	Process Emissions			N/A	N/A	1,261
Wastewater	Denitrification Process N_2O	133,812	population served	N/A	N/A	142
	Effluent Discharge Fugitive N_2O	3,596	kg N/day	N/A	N/A	2,732
Total						**691,262**

The updated inventory provides the County with baseline GHG emissions estimates that follow the Community Protocol and include, as mentioned previously, the following modifications for improved GHG accounting:

- Addition of GHG emissions from the natural gas methane leaks and electricity T&D loss sectors which were excluded from the 2019 Inventory.
- Adjustment of PG&E emissions factor using third-party verified sources which did not match the original 2019 Inventory emissions factor used for PG&E electricity.

- Addition of off-road sector GHG emissions using CARB's updated OFFROAD2021 model.
- Disaggregation of CARB's EMFAC2021 model for on-road transportation VMT into passenger, commercial, and bus vehicles which were aggregated in the 2019 Inventory.
- Addition of landfill process emissions for solid waste sector GHG emissions which were excluded in the 2019 Inventory.

The updated inventory resulted in a 11.58 percent increase in GHG emissions attributed to the County in 2019, primarily due to the addition of off-road transportation, waste process emissions, electricity T&D loss, and natural gas methane leakage sectors to the inventory. The changes from the original 2019 inventory and the updated inventory are shown in detail in Table 14

Table 14 Original 2019 Inventory versus Updated Inventory

GHG Emissions Sector	GHG Emissions Subsector	GHG Emissions (MT CO_2e)		Percent Change (%)	Summary of Reason for Change
		Updated Inventory	Original Inventory		
Energy	Residential Electricity	1,482	1,345	+10.15%	Adjusted to exclude energy usage from passenger EV charging, include GHG emissions from T&D losses, and update PG&E emissions factor
	Nonresidential Electricity	1,517	1,411	+7.54%	Adjusted to include GHG emissions T&D losses and updated PG&E emissions factor
	Residential Natural Gas	107,093	87,213	+22.80%	Adjusted to include GHG emissions from methane leaks
	Nonresidential Natural Gas	55,965	45,571	+22.81%	Adjusted to include GHG emissions from methane leaks
	Residential Propane	3,461	N/A	N/A	Sector originally excluded from inventory and updated to be included.
Transportation	Passenger Vehicles	353,813	442,848	+2.60%	Adjusted to disaggregate VMT data between passenger, commercial, and public transit vehicles, and include GHG emissions from passenger EV charging.
	Commercial Vehicles	93,701			
	Public Transit	6,831			
	Off-road Equipment	31,537	N/A	N/A	Sector originally excluded from inventory and updated to be included.
Waste	Waste	32,989	32,786	+0.62%	Adjusted to include landfill process emissions.
Water and Wastewater	Wastewater	2,874	2,874	0%	No adjustments made.
Total		**691,262**	**614,048**	**12.57%**	**N/A**

4 GHG Forecast

The County's 2019 inventory establishes a baseline reference point. However, annual GHG emissions change over time and GHG emissions forecasts provide a way to estimate future emission levels based on population and job growth. Forecasts also account for State legislative actions that are anticipated to reduce GHG emissions. Calculating the difference between the forecasted GHG emissions and the reduction target determines the gap to be closed through local policies. This section includes an estimate of the future emissions for the County in the years 2025, 2030, 2035, 2040, and 2045 in a *business-as-usual scenario* (BAU) forecast and an *adjusted scenario* (adjusted) forecast, which are defined as follows:

- B*usiness-as-usual scenario*- Provides a forecast of how future GHG emissions would change as population, housing, and job growth occurs and if current activities continued as they did in 2019 absent of any policies or legislation that would reduce local emissions. The BAU forecast is based on growth trends projected in population, housing, employment, and transportation activity over time, consistent with regional projections.
- *Adjusted scenario*- Provides a forecast of how currently adopted legislation would reduce GHG emissions from the *business-as-usual scenario*. The *adjusted scenario* represents the State's contribution to reducing local GHG emissions to meet State goals without any additional contribution from local policies or actions.

4.1 Business-as-usual Forecast

Future GHG emissions for the BAU forecast were calculated using projected unincorporated County-specific demographic data referenced in Santa Cruz County's 2045 Regional Transportation Plan[19] and AMBAG's Regional Housing Needs Allocation Plan (RHNA) 2023-2031[20]. On-road transportation and off-road equipment GHG emissions were also projected using modeled activity data for the forecast years.[21] The demographic metrics used to project activity data and associated growth factors for each forecasted GHG emission source are provided in Table 15 for each for the GHG emission sources in the updated inventory. Detailed calculations for the BAU forecast are included in Attachment A.

19 2045 Regional Transportation Plan for Santa Cruz County (June 2022). https://sccrtc.org/wp-content/uploads/2022/06/Final%202045%20RTP.pdf. Accessed July 1st, 2022

20 Draft 6th Cycle Regional Housing Needs Allocation Plan 2023-2031 (April 2022). https://www.ambag.org/sites/default/files/2022-04/PDFAAMBAG%20RHNP%202023-2031_Draft_rev.pdf. Accessed July 1st, 2022

21 California Air Resources Board (CARB). Modeling Tools On-road and Off-road. 2022. https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools. Accessed April 1, 2022

Table 15 GHG Emission Sources and Growth Factors for BAU Scenario Forecast

GHG Emissions Source	Demographic Projection Metric	Growth Factor	Value
Energy			
Residential Electricity	Households	Electricity Consumption (kWh) per Household	4,344.27
Non-residential Electricity	Employment	Electricity Consumption (kWh) per Job	5,882.13
Residential Natural Gas	Households	Natural Gas Consumption (therms) per Household	284.70
Non-residential Natural Gas	Employment	Natural Gas Consumption (therms) per Job	192.02
Electricity Transmission and Distribution Losses (T&D Losses)	N/A	T&D Losses Factor (1.28%) applied to total Electricity Consumption	N/A
Natural Gas Leakage	N/A	Leakage Factor (2.3%) applied to total Natural Gas Consumption	N/A
Residential Propane[1]	Households	Propane consumption (MMBtu) per household	0.95
Transportation			
On-Road Passenger	Households	Annual Vehicle Miles Travelled per Household	16,336.63
On-Road Commercial	Employment	Annual Vehicle Miles Travelled per Job	1,817.96
On-Road Bus	Households	Annual Vehicle Miles Travelled per Household	78.49
Off-Road Equipment	N/A	MT CO_2e as obtained from CARB's OFFROAD2021 off-road transportation emissions model	N/A
Wastewater			
Wastewater Process and Fugitive Emissions	Service Population	Wastewater Process and Fugitive Emissions (MT CO_2e) per Serviced Person	0.1849
Solid Waste			
Solid Waste Disposal	Service Population	Solid Waste Disposed (tons) per Serviced Person	0.0161

Notes: MT CO_2e = Metric tons of carbon dioxide equivalent; kWh = kilowatt-hour; VMT = vehicle miles traveled; N/A = Not Applicable; Serviced Population = the combined total number of employees and residents in the County

1. Growth indicator for propane is based on total number of households in the Unincorporated county to account for increased use due to population growth and increased housing.

The BAU forecast relies on demographics projections from the Association of Bay Area Governments

estimates of population, employment, and households using the most recent 2022 Regional Growth Forecast projections which was utilized in the County's 2045 Regional Transportation Plan demographics forecasts. On-road transportation VMT projections are based on housing and employment growth, which provides a more regionally applicable BAU forecast compared to relying on EMFAC2021 model data alone. A summary of the demographics and projection metrics for each forecast year in the BAU forecast are provided in Table 16.

Table 16 BAU Forecast Demographic and Projection Metrics by Forecast Year

Demographics/ Sector	Data Source	2025	2030	2035	2040	2045
Population	AMBAG 2022 Regional Growth Forecast	134,675	135,027	135,304	135,625	135,953
Employment	AMBAG 2022 Regional Growth Forecast	45,748	46,588	47,366	48,202	49,071
Households[1]	AMBAG 2022 Regional Growth Forecast/RHNA	59,966	63,233	64,153	64,331	64,440
Service Population[2]	Calculated	180,423	181,615	182,670	183,827	185,024
Off-road Diesel (gallons)	EMFAC2021	1,183,776	1,197,400	1,216,026	1,237,317	1,260,490
Off-road Gasoline (gallons)	EMFAC2021	2,237,966	2,338,840	2,444,272	2,551,522	2,681,154
Off-road Natural Gas (gallons)	EMFAC2021	213,117	211,931	212,612	212,035	212,035

1. Household projections are determined using AMBAG 2045 Regional Growth Forecast housing projections combined with a linear interpolation of RHNA housing numbers in which additional housing needs begin in 2023 and reach additional housing numbers by 2031
2. Service population: the sum of the population and employees in the County, based on AMBAG 2045 Regional Growth Forecast.

The BAU forecast was calculated using the growth factors in Table 15, the demographic and projection metrics in Table 16, and the update inventory emission factors. In the BAU forecast, GHG emissions are expected to increase through 2045. A summary of the BAU forecast results by GHG emission sector is provided in Table 17.

Table 17 BAU Forecast Results Summary by Emission Sector

GHG Emissions Sector	2025	2030	2035	2040	2045
Energy	175,575	183,013	185,805	187,228	188,560
Transportation	504,492	527,732	536,248	540,274	544,156
Waste	33,360	33,580	33,775	33,989	34,210
Wastewater	2,907	2,926	2,943	2,961	2,981
Total	**716,334**	**747,251**	**758,771**	**764,453**	**769,907**

4.2 Adjusted Forecast

Several federal and State regulations have been enacted that would reduce the County's GHG emissions in 2025, 2030, 2035, 2040, and 2045. The impact of these regulations was quantified and incorporated into the adjusted forecast to project future emissions growth once established State regulations have been implemented. The State legislation included in the adjusted forecast result in GHG emission reductions related to transportation, building efficiency and renewable electricity. A brief description of each regulation and the methodology used to calculate associated reductions is provided in the following sections. For a description of why certain regulations were excluded, see Section 2

Transportation Legislation

Major regulations incorporated into CARB's 2021 transportation model (EMFAC2021) include Advanced Clean Car Standards (LEV III, ZEV program, etc.), Senate Bill 1, the Innovative Clean Transit regulation, and Phase 2 Federal GHG Standards.

Reductions in GHG emissions from the above referenced standards were calculated using CARB's EMFAC2021 model for Santa Cruz County. The EMFAC2021 model integrates the estimated reductions into the mobile source emissions portion of the model.[22] The degree to which GHG emissions from on-road transportation will be reduced can be quantified as the difference between transportation emissions calculated using the 2019 provided emission factors and calculated using the reduced emission factors for the target years.

Title 24

Title 24 regulations were incorporated into Santa Cruz County's forecast by applying the estimated 53% electricity consumption and 7% natural gas consumption reductions in residential buildings for each inventory forecast year. The adjusted forecast assumes a similar 7% efficiency increase for residential propane use. For the purpose of creating a conservative estimation of GHG emissions reductions, the 30 percent efficiency increase for non-residential buildings was reduced in the County's adjusted forecast. Non-residential electricity encompasses both commercial and industrial electricity usage, the latter of which Title 24 does not provide efficiency increase estimations for. Development of new industries typically relies on existing buildings and acquisition of used manufacturing equipment that is built to last for long periods of time to reduce cost. Due to this dynamic, the opportunity for GHG reductions in the industrial sector as a result of technological efficiency improvements is anticipated to be small or slower compared to other sectors. To account for this and provide a conservative estimation of GHG emissions in the County, an efficiency increase of zero percent was applied to the County's non-residential electricity adjusted forecast.

Renewables Portfolio Standard & SB 100

PG&E and 3CE currently provide electricity in Santa Cruz County and are subject to RPS requirements. Furthermore, 3CE plans to provide 60 percent renewable energy by 2025 and be 100

22 Additional details are provided in CARB's EMFAC2021 Technical Documentation, March 2021. (https://ww2.arb.ca.gov/sites/default/files/2021-03/emfac2021_volume_3_technical_document.pdf). Note that the Low Carbon Fuel Standard (LCFS) regulation is excluded from EMFAC2021 because most of the emissions benefits due to the LCFS come from the production cycle (upstream emissions) of the fuel rather than the combustion cycle (tailpipe). As a result, LCFS is assumed to not have a significant impact on CO_2 emissions from EMFAC's tailpipe emission estimates.

percent renewable by 2030.[23] PG&E and 3CE emission factors that included compliance with RPS were used to project emissions through 2045, assuming 3CE is able to meet its 2025 renewable energy target.[24] As shown in Table 18, the RPS and SB 100 requirements to reduce overall carbon intensity would reduce the County's emissions.

Table 18 Santa Cruz County Forecasted RPS and Electricity Emission Factors

Metric	2025	2030	2035	2040	2045
PG&E Renewables Mix	47.29%	60%	73.33%	86.67%	100.00%
PG&E Emission Factor (lbs CO_2e/MWh)	128.76	97.70	65.13	32.57	0
3CE Renewables Mix	60%	70%	80%	90%	100%
3CE Emission Factor (lbs CO_2e/MWh)	6.93	5.20	3.47	1.73	0

Notes: lbs CO_2e = pounds of carbon dioxide equivalent; MWh = megawatt-hour

Data Source: The Climate Registry. 2019. https://www.theclimateregistry.org/our-members/cris-public-reports/. Accessed July 1st, 2022.

Data Source: 3CE emissions factor used for forecast estimation provided by 3CE to AMBAG for Santa Cruz County's original 2019 GHG Inventory. Emissions factor was provided to Rincon via email on June 2nd, 2022

4.2.1 Legislative GHG Emission Reduction Contribution

Based on the above-described legislation and emission reduction potential for each, the County can expect significant help from these State regulations in meeting State GHG emission reduction goals. These GHG emissions reductions primarily contribute to the energy sector and transportation sectors. In the energy sector, Title 24 reductions were accounted for first, followed by California RPS reductions associated with PG&E and 3CE developments towards renewable electricity. The legislative emissions reductions for Title 24 and California RPS are known to be additive and were calculated separately to avoid double counting. As 3CE currently provides 94.83% and 98.28% of residential and commercial electricity respectively, the forecast was developed assuming this proportion between providers remains unchanged. Weighted emissions factors were developed based on these proportions for the County's residential and commercial sectors, and thereby reflected the California RPS reductions for both PG&E and 3CE. A summary of the reductions from the BAU forecast that can be expected under the adjusted forecast are provided in Table 19.

23 3CE renewable energy targets. https://3cenergy.org/understanding-clean-energy/. Accessed July 1st, 2022.

24 3CE provides two electricity options in Santa Cruz: 3Cchoice and 3Cprime portfolios. The 3Cchoice portfolio contains 31 percent renewables while the 3Cprime portfolio contains 100 percent renewables. However, considering the data provided for Santa Cruz County's updated 2019 GHG Inventory, the weighted emissions factor provided by 3CE was used for determining the County's GHG forecast.

Table 19 Summary of Legislative GHG Emissions Reductions

Legislation	2025	2030	2035	2040	2045
California RPS	293	1,047	1,889	2,773	3,676
Title 24	351	834	971	997	1,013
Transportation Legislation (Pavley, Innovative Clean Transit, etc.)	51,031	95,974	133,480	159,159	175,169
Total	**51,675**	**97,854**	**136,340**	**162,928**	**179,858**

Notes: All values are presented in metric tons of carbon dioxide equivalent (MT CO_2e)

4.2.2 Adjusted Forecast Results

In the adjusted forecast, the electricity sector experiences a strong downward trend, approaching zero in 2045 due to stringent RPS requirements from SB 100. Natural gas emissions are expected to continue on an upward trajectory until 2045 due to housing and employment growth projections. This trend is partially offset due to the increasingly stringent efficiency requirements for new construction from Title 24 for residential construction. Transportation emissions are expected to decrease through 2045 due to existing fuel efficiency requirements, fleet turnover rates, and increasing vehicle electrification driven by the electric vehicle market. As most current regulations expire in 2025 or 2030, emissions standards will experience diminishing returns while VMT continues to increase, leading to lower rates of emissions reduction in the transportation sector. A detailed summary of the projected GHG emissions under the adjusted forecast by sector and year through 2045 can be found in Table 20.

Table 20 Adjusted Forecast Results

GHG Emissions Source	2019	2025	2030	2035	2040	2045
Residential Electricity	1,482	1,608	1,245	836	418	0
Non-residential Electricity	1,517	1,159	887	601	306	0
Residential Natural Gas	107,093	111,192	116,842	118,434	118,741	118,930
Non-residential Natural Gas	55,965	57,374	58,427	59,403	60,451	61,541
Residential Propane	3,461	3,593	3,776	3,827	3,837	3,843
Energy Sector Total	**169,518**	**174,925**	**181,177**	**183,101**	**183,754**	**184,314**
On-road Passenger Vehicles	353,813	321,432	304,864	288,315	277,508	271,605
On-road Commercial Vehicles	93,701	92,735	86,745	74,863	64,260	57,362
On-road Buses	6,831	6,354	6,140	4,351	2,812	1,962
Off-road Equipment	31,537	32,946	33,964	35,084	36,240	37,614
Transportation Sector Total	**485,881**	**453,467**	**431,714**	**402,613**	**380,820**	**368,544**
Waste	**32,989**	**33,360**	**33,580**	**33,775**	**33,989**	**34,210**
Wastewater	**2,874**	**2,907**	**2,926**	**2,943**	**2,961**	**2,981**
Total GHG Emissions	**691,262**	**664,659**	**649,397**	**622,432**	**601,524**	**590,049**

Notes: All values are presented in metric tons of carbon dioxide equivalent (MT CO_2e)

GHG reduction targets are used for climate action planning to establish measurable metrics intended to guide the community's commitment to achieve GHG emissions reductions and help gauge progress reducing emissions over time. GHG targets are developed relative to a baseline emissions level. California has established statewide GHG reduction goals for 2030 and 2045. CARB's 2017 Scoping Plan recommends that local agencies provide their fair share GHG reduction to achieve the State's goals. Thus, local agencies are recommended to establish equivalent reduction targets at the local level by establishing community wide GHG reduction goals for climate action that will help California achieve its 2030 ad 2045 goals.

CARB has issued several guidance documents concerning the establishment of GHG emission reduction targets for Climate Action Plans (CAP) to comply with legislated GHG emissions reductions targets and California Environmental Quality Act Guidelines (CEQA) § 15183.5(b). For example, as mentioned above, in the first California *Climate Change Scoping Plan,*[25] CARB encouraged local governments to adopt an evidence based GHG reduction target for community emissions that are based on local emissions sectors and population projections that parallel the State commitment to reduce GHG emissions. In 2016, the State adopted SB 32, mandating a reduction of GHG emissions by 40 percent below 1990 levels by 2030 and EO B-55-18 establishes a State goal of carbon neutrality by 2045. Pursuant to the Scoping Plan Update's recommendations, the community GHG reduction targets will be developed based on local levels of GHG emissions that would be proportional to the statewide goals, relative to 1990.

5.1 1990 Back-cast

The County does not have a 1990 GHG inventory from which to develop GHG reduction targets consistent with SB 32, however, 1990 GHG emissions can be estimated for the community relative to the County's updated 2019 inventory using a state-level emissions change metric.

The County's 1990 GHG emissions have been calculated using the State's 2019 GHG emissions inventory as compared to the State's GHG emissions inventory in 1990 to calculate specific percent reduction in the County between 2019 and 1990. This approach assumes that the County's community GHG emissions have generally tracked with the State's GHG emissions. The calculation is developed using the published State-wide emissions results from CARB, after removing emissions from sectors not included in the County's inventory (i.e., agricultural, industrial, and high GWP sectors). The 1990 back-cast for the County is shown in Table 21.

25 2008 Climate Change Scoping Plan https://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf

Table 21 1990 Back-cast

1990 Back-cast Calculations	
2019 Statewide GHG Emissions (MMT CO_2e)	280.19
1990 Statewide GHG Emissions (MMT CO_2e)	309.60
2019 to 1990 Statewide GHG Emissions Change (%)	10.49%
2019 Unincorporated County GHG Emissions (MT CO_2e)	691,262
1990 Unincorporated County GHG Emissions Back-cast (MT CO_2e)	763,809
1990 Unincorporated County Population	130,500
1990 Unincorporated County Per Capita GHG Emissions Back-cast (MT CO_2e/person)	5.85

6 Provisional Climate Action Targets

GHG reduction targets can be set as either an efficiency target (MT CO_2e per capita) or as a community-wide mass emissions target (total MT CO_2e). With CARB's 2017 Scoping Plan Update, the State recommends using efficiency metrics for local targets to incentivize growth in a coordinated manner and not penalize cities which are growing at significant rates.[26]

6.1 GHG Emissions Reduction Target Setting

Target setting is an iterative process which must be informed by the reductions that can realistically be achieved through the development of feasible GHG reduction measures. As such, the targets identified herein should remain provisional until the quantification and analysis of potential GHG reduction measures has been completed. The purpose of target setting is to develop the trajectory toward achieving the State's 2030 goal and prepare for the deep decarbonization needed by 2045 in a cost-effective manner by setting an incremental path toward achieving the EO B-55-18 goals. CARB guidance is for jurisdictions to first strive to exceed the SB 32 targets of reducing GHG emissions 40% below 1990 levels, while establishing a policy framework to achieve the long-term target of carbon neutrality by 2045.

According to the Association of Environmental Professionals (AEP), the feasibility of achieving substantial reductions through local action only is questionable given limitations on local municipality authority. The AEP also states that no city or county is completely autonomous in matters of energy and transportation systems; and notes that a municipality can influence certain matters; however, many decisions about the electricity and transportation systems are under the control of the State and federal government, and/or are controlled by market determinations. Achieving the established target will require major shifts in how communities within California obtain and use energy, transport themselves and goods, and how the population lives and builds. These transformations would require implementation across all levels of the economy, not just what local jurisdictions have authority over. As such, placing the burden predominantly on local jurisdictions would thus be highly disproportional, costly, and potentially subject to litigation.[27]

Furthermore, Executive Orders are binding only unto State agencies and are not binding on local governments or the private sector. Accordingly, EO S-03-05 and EO B-55-18 guide State agencies' efforts to control and regulate GHG emissions but have no direct binding effect on local governmental or private actions. However, traditionally the target setting EO's become State laws; for example, EO S-3-05 became AB 32 and EO B-30-15 became SB 32. To meet the State's 2045 goal of carbon neutrality as established in the 2017 Scoping Plan Update and the Draft 2022 Scoping Plan, CARB recommends that local agencies long-term targets align with EO B-55-18.

Establishing a minimum 2030 target of **3.51 MT CO_2e per person, or 458,285 MT CO_2e per year, for 2030** (the SB 32 target year) and a long-term target of **0 MT CO_2e per person, or carbon neutrality**, for 2045 will demonstrate the County's commitment to aligning with State goals. The 2030 target will maintain compliance with SB 32, as well as align with the EO B-55-18 emissions reduction

26 California Air Resources Board. 2017. California's Climate Change Scoping Plan, p. 99-102.

27 AEP. Beyond Newhall and 2020: A Field Guide to New CEQA Greenhouse Gas Thresholds and Climate Action Plan Targets in California. October 2016.

trajectory. However, as noted at the beginning of this memorandum, the long-term reduction targets are provisional and may need to be adjusted based on the reductions that can realistically be achieved from feasible GHG reduction measures that will be identified during the climate action and adaptation planning process. The intent of the future CAAP will be to demonstrate substantial progress toward the long-term State reduction targets. New opportunities are anticipated to emerge that could yield additional reductions beyond those identified in the County's future CAAP. Another phase of local climate action planning will be needed to continue and expand the actions in the future CAAP and to explore new strategies to meet the 2045 GHG reduction target.

With GHG emission reduction targets in place, the reduction gap that the County will be responsible for through local action can be calculated. The County's future CAAP will assess the GHG reduction gap based on the difference between the adjusted forecast, discussed previously, and the established GHG reduction targets. Table 22 provides a summary of the GHG emission reduction targets and gap in both mass emissions and per capita emissions metrics. The per capita targets are calculated by dividing forecasted GHG emissions by the expected Unincorporated County population in each target year.

Table 22 GHG Emission Reduction Targets and Gap Analysis

Emissions Forecast or Pathway	2019	2025	2030	2035	2040	2045
Mass Emissions Target Pathway Scenario						
Adjusted Forecast (MT CO_2e)	691,262	664,659	649,397	622,432	601,524	590,049
SB 32 Mass Emissions Target Pathway (MT CO_2e)[1]	691,262	564,184	458,285	305,524	152,762	0
Remaining Emissions Gap (MT CO_2e)	0	100,475	191,111	316,908	448,762	590,049
Per Capita Emissions Target Pathway Scenario						
Population	133,792	134,675	135,027	135,304	135,625	135,953
Per Capita Adjusted Forecast (MT CO_2e/person)	5.17	4.94	4.81	4.60	4.44	4.34
SB 32 Per Capita Target Pathway (MT CO_2e/person)[2]	5.17	4.26	3.51	2.34	1.17	-
Remaining Per Capita Emissions Gap (MT CO_2e/person)	(0.00)	0.67	1.30	2.26	3.26	4.34

Notes: MT CO_2e = Metric tons of carbon dioxide equivalent

Emissions have been rounded to the nearest whole number and therefore sums may not match.

1. The target pathway is calculated by reducing 1990 mass emissions by 40% in 2030 and to 0 in 2045. This provisional target pathway is consistent with both SB 32 and a trajectory set forth to achieve EO B-55-18.

2. The target pathway is calculated by reducing 1990 per capita emissions by 40% in 2030 and to 0 in 2045. This provisional target pathway is consistent with both SB 32 and a trajectory set forth to achieve EO B-55-18.

Figure 2 and Figure 3 provide a visual representation of future GHG emissions, with the impacts of State legislation and the remaining gap the County of Santa Cruz will be responsible for the meet the GHG emission reduction targets.

Figure 2 GHG Emissions Forecast and Provisional Target Pathways (Mass Emissions)

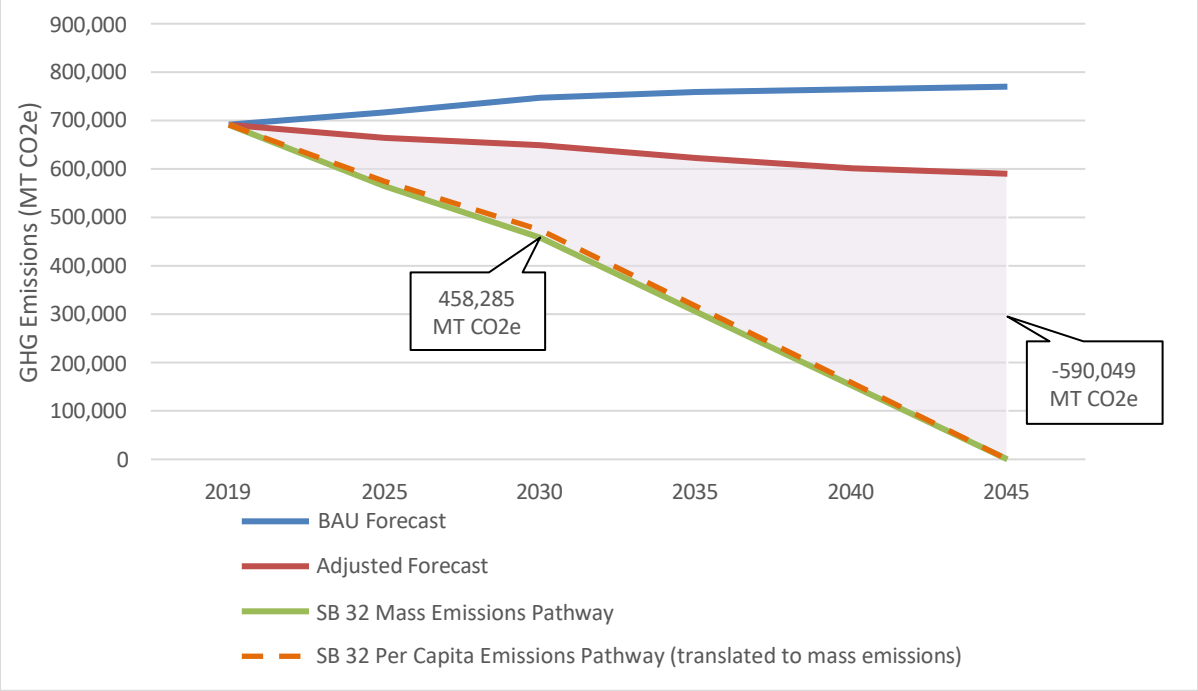
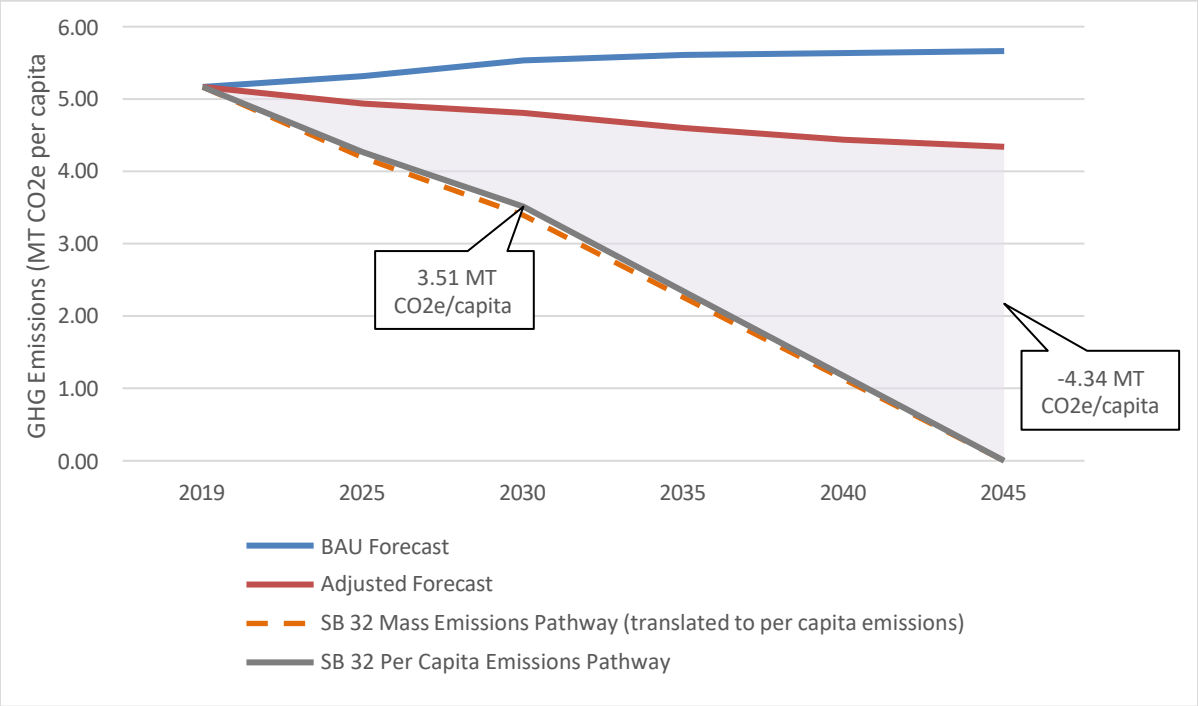


Figure 3 GHG Emissions Forecast and Provisional Target Pathways (Per Capita Emissions)



6.2 Meeting the Targets

The 2025, 2030, 2035, 2040, and 2045 targets identified above will be achieved through a combination of existing State measures and the implementation of local measures that will be identified in the County's CAAP. Local measures will be identified through a comprehensive assessment of existing local and regional policies, programs, and actions and by assessing any gaps and identifying additional opportunities. Additional measures will be developed from best practices of other similar and neighboring jurisdictions, as well as those recommended by organizations and agencies, such as the California Air Pollution Control Officers Association, the Office of Planning and Research, CARB's Scoping Plan Updates, and AEP.

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Appendix A: Santa Cruz County Greenhouse Gas Analysis Report, BAU and Adjusted Forecast

Year	2019	2025	2030	2035	2040	2045
Emissions Summary (MT CO2e)						
		BAU				
Residential Electricity	1,482	1,543	1,627	1,650	1,655	1,658
Nonresidential Electricity	1,517	1,555	1,584	1,610	1,639	1,668
Residential Natural Gas	107,093	111,501	117,576	119,287	119,618	119,821
Nonresidential Natural Gas	55,965	57,374	58,427	59,403	60,451	61,541
Residential Propane	3,461	3,603	3,799	3,855	3,865	3,872
Passenger Vehicles	353,813	368,375	388,446	394,099	395,193	395,862
Commercial Vehicles	93,701	96,059	97,823	99,457	101,212	103,037
Public Transit	6,831	7,112	7,499	7,608	7,629	7,642
Off-road Equipment	31,537	32,946	33,964	35,084	36,240	37,614
Waste	32,989	33,360	33,580	33,775	33,989	34,210
Wastewater	2,874	2,907	2,926	2,943	2,961	2,981
Total	**691,262**	**716,334**	**747,251**	**758,771**	**764,453**	**769,907**
		Adjusted (State Legislation)				
Residential Electricity	1,482	1,608	1,245	836	418	-
Nonresidential Electricity	1,517	1,159	887	601	306	-
Residential Natural Gas	107,093	111,192	116,842	118,434	118,741	118,930
Nonresidential Natural Gas	55,965	57,374	58,427	59,403	60,451	61,541
Residential Propane	3,461	3,593	3,776	3,827	3,837	3,843
Passenger Vehicles	353,813	321,432	304,864	288,315	277,508	271,605
Commercial Vehicles	93,701	92,735	86,745	74,863	64,260	57,362
Public Transit	6,831	6,354	6,140	4,351	2,812	1,962
Off-road Equipment	31,537	32,946	33,964	35,084	36,240	37,614
Waste	32,989	33,360	33,580	33,775	33,989	34,210
Wastewater	2,874	2,907	2,926	2,943	2,961	2,981
Total	**691,262**	**664,659**	**649,397**	**622,432**	**601,524**	**590,049**
		Reductions from Legislation				
California RPS	-	293	1,047	1,889	2,773	3,676
Title 24	-	351	834	971	997	1,013
Transportation Legislation	-	51,031	95,974	133,480	159,159	175,169
Total	-	51,675	97,854	136,340	162,928	179,858
Demographics						
Population	133,792	134,675	135,027	135,304	135,625	135,953
Jobs	44,625	45,748	46,588	47,366	48,202	49,071
Housing	57,595	59,966	63,233	64,153	64,331	64,440
Service Population	178,417	180,423	181,615	182,670	183,827	185,024
Residential Electricity						
GI (kWh/house)	4,344	4,344	4,344	4,344	4,344	4,344
Housing	57,595	59,966	63,233	64,153	64,331	64,440
		BAU				
Electricity (kWh)	250,208,302	260,506,397	274,700,217	278,698,033	279,471,313	279,944,839

2019 PG&E/3CE EF (MT CO2e/MWh)	0.005634	0.005634	0.005634	0.005634	0.005634	0.005634
Electricity Emissions (MT CO2e)	1,410	1,468	1,548	1,570	1,575	1,577
T&D Emissions (MT CO2e)	72	75	79	80	80	80
Total Emissions (MT CO2e)	**1,482**	**1,543**	**1,627**	**1,650**	**1,655**	**1,658**
			Adjusted for California RPS and Title 24			
Title 24 Efficiency Increase		53%	53%	53%	53%	53%
Title 24 Adjusted Electricity (kWh)	250,208,302	255,048,407	261,719,502	263,598,476	263,961,917	264,184,474
California RPS PG&E/3CE EF (MT CO2e/MWh)	0.005634	0.005999	0.004526	0.003017	0.001509	-
Electricity Emissions (MT CO2e)	1,410	1,530	1,184	795	398	-
T&D Emissions (MT CO2e)	72	78	60	41	20	-
Total Emissions (MT CO2e)	**1,482**	**1,608**	**1,245**	**836**	**418**	**-**
			Reductions (MT CO2e)			
Title 24	-	32	77	89	92	93
California RPS	-	(98)	305	725	1,145	1,564
Nonresidential Electricity						
GI (kWh/job)	5,882	5,882	5,882	5,882	5,882	5,882
Jobs	44,625	45,748	46,588	47,366	48,202	49,071
			BAU			
Electricity (kWh)	262,489,959	269,095,589	274,036,576	278,612,872	283,530,331	288,641,900
2019 PG&E/3CE EF (MT CO2e/MWh)	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
Electricity Emissions (MT CO2e)	1,443	1,480	1,507	1,532	1,559	1,587
T&D Emissions (MT CO2e)	74	75	77	78	80	81
Total Emissions (MT CO2e)	**1,517**	**1,555**	**1,584**	**1,610**	**1,639**	**1,668**
			Adjusted for California RPS and Title 24			
Title 24 Efficiency Increase		0%	0%	0%	0%	0%
Title 24 Adjusted Electricity (kWh)	262,489,959	269,095,589	274,036,576	278,612,872	283,530,331	288,641,900
California RPS PG&E/3CE EF (MT CO2e/MWh)	0.005499	0.004096	0.003081	0.002054	0.001027	-
Electricity Emissions (MT CO2e)	1,443	1,102	844	572	291	-
T&D Emissions (MT CO2e)	74	56	43	29	15	-
Total Emissions (MT CO2e)	**1,517**	**1,159**	**887**	**601**	**306**	**-**
			Reductions (MT CO2e)			
Title 24	-	-	-	-	-	-
California RPS	-	397	696	1,009	1,333	1,668
Residential Natural Gas						
GI (therms/house)	285	285	285	285	285	285
Housing	57,595	59,966	63,233	64,153	64,331	64,440
			BAU			
Natural Gas (therms)	16,397,533	17,072,424	18,002,624	18,264,623	18,315,300	18,346,333
EF (MT CO2e/therm)	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Natural Gas Emissions (MTCO2e)	87,079	90,663	95,603	96,994	97,264	97,428
Natural Gas Leaks (MT CO2e)	20,014	20,838	21,973	22,293	22,355	22,392
Total Emissions (MT CO2e)	**107,093**	**111,501**	**117,576**	**119,287**	**119,618**	**119,821**
			Adjusted for Title 24			
Title 24 Efficiency Increase		7%	7%	7%	7%	7%
Title 24 Adjusted Natural Gas (therms)	16,397,533	17,025,182	17,890,267	18,133,926	18,181,056	18,209,917
EF (MT CO2e/therm)	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053

Natural Gas Emissions (MTCO2e)	87,079	90,412	95,006	96,300	96,551	96,704
Natural Gas Leaks (MT CO2e)	20,014	20,780	21,836	22,133	22,191	22,226
Total Emissions (MT CO2e)	**107,093**	**111,192**	**116,842**	**118,434**	**118,741**	**118,930**
		Reductions (MT CO2e)				
Title 24	-	309	734	854	877	891
Nonresidential Natural Gas						
GI (therm/job)	192	192	192	192	192	192
Jobs	44,625	45,748	46,588	47,366	48,202	49,071
		BAU				
Natural Gas (therms)	8,569,089	8,784,732	8,946,033	9,095,428	9,255,960	9,422,829
EF (MT CO2e/therm)	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Natural Gas Emissions (MTCO2e)	45,506	46,651	47,508	48,301	49,154	50,040
Natural Gas Leaks (MT CO2e)	10,459	10,722	10,919	11,101	11,297	11,501
Total Emissions (MT CO2e)	**55,965**	**57,374**	**58,427**	**59,403**	**60,451**	**61,541**
		Adjusted for Title 24				
Title 24 Efficiency Increase		0%	0%	0%	0%	0%
Title 24 Adjusted Natural Gas (therms)	8,569,089	8,784,732	8,946,033	9,095,428	9,255,960	9,422,829
EF (MT CO2e/therm)	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Natural Gas Emissions (MTCO2e)	45,506	46,651	47,508	48,301	49,154	50,040
Natural Gas Leaks (MT CO2e)	10,459	10,722	10,919	11,101	11,297	11,501
Total Emissions (MT CO2e)	**55,965**	**57,374**	**58,427**	**59,403**	**60,451**	**61,541**
		Reductions (MT CO2e)				
Title 24	-	-	-	-	-	-
Residential Propane						
GI (mmBtu/house)	0.95	0.95	0.95	0.95	0.95	0.95
Housing	57,595	59,966	63,233	64,153	64,331	64,440
		BAU				
Propane (mmBtu)	54,831	57,088	60,199	61,075	61,244	61,348
EF (MT CO2e/mmBtu)	0.06311	0.06311	0.06311	0.06311	0.06311	0.06311
Propane Emissions (MT CO2e)	**3,461**	**3,603**	**3,799**	**3,855**	**3,865**	**3,872**
		Adjusted for Title 24				
Title 24 Efficiency Increase		7%	7%	7%	7%	7%
Title 24 Adjusted Propane (mmBtu)	54,831	56,930	59,823	60,638	60,795	60,892
EF (MT CO2e/mmBtu)	0.06311	0.06311	0.06311	0.06311	0.06311	0.06311
Propane Emissions (MTCO2e)	**3,461**	**3,593**	**3,776**	**3,827**	**3,837**	**3,843**
		Reductions (MT CO2e)				
Title 24	-	10	24	28	28	29
On-road Passenger Vehicles						
GI (miles/house)	16,336.63	16,336.63	16,336.63	16,336.63	16,336.63	16,336.63
Houses	57,595	59,966	63,233	64,153	64,331	64,440
Passenger VMT (miles)	940,908,487	979,634,481	1,033,010,351	1,048,044,139	1,050,952,060	1,052,732,753
		BAU				
Passenger Total VMT (miles)	940,908,487	979,634,481	1,033,010,351	1,048,044,139	1,050,952,060	1,052,732,753
Passenger EV Share	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%
Passenger EPM (kWh/EV-mile)	0.368	0.368	0.368	0.368	0.368	0.368

Passenger EVMT (kWh)	5,515,108	5,742,099	6,054,960	6,143,080	6,160,125	6,170,563
2019 Passenger EF (MT CO2e/mile)	0.000376	0.000376	0.000376	0.000376	0.000376	0.000376
2019 PG&E/3CE EF (MT CO2e/MWh)	0.005634	0.005634	0.005634	0.005634	0.005634	0.005634
Passenger VMT Emissions (MT CO2e)	353,782	368,343	388,412	394,065	395,158	395,828
Passenger EVMT Emissions (MT CO2e)	31.07	32.35	34.12	34.61	34.71	34.77
Total Emissions (MT CO2e)	**353,813**	**368,375**	**388,446**	**394,099**	**395,193**	**395,862**
Per capita VMT (miles/person)	*7,033*	*7,274*	*7,650*	*7,746*	*7,749*	*7,743*
Per house VMT (miles/house)	*16,337*	*16,337*	*16,337*	*16,337*	*16,337*	*16,337*
Adjusted for Transportation Legislation an d California RPS						
Passenger Total VMT (miles)	940,908,487	979,634,481	1,033,010,351	1,048,044,139	1,050,952,060	1,052,732,753
Passenger EV Share	1.59%	5.16%	7.31%	8.80%	9.60%	9.98%
Passenger EPM (kWh/EV-mile)	0.368	0.370	0.370	0.370	0.370	0.370
Passenger EVMT (kWh)	5,515,108	18,726,169	27,924,397	34,093,518	37,285,668	38,820,705
Passenger EF (MT CO2e/mile)	0.000376	0.000328	0.000295	0.000275	0.000264	0.000258
PG&E/3CE EF (MT CO2e/MWh)	0.005634	0.005999	0.004526	0.003017	0.001509	-
Passenger VMT Emissions (MT CO2e)	353,782	321,320	304,738	288,212	277,451	271,605
Passenger EVMT Emissions (MT CO2e)	31.07	112.33	126.37	102.86	56.25	-
Total Emissions (MT CO2e)	**353,813**	**321,432**	**304,864**	**288,315**	**277,508**	**271,605**
Reductions (MT CO2e)						
Transportation Legislation - Activity	-	(73)	(123)	(157)	(175)	(184)
Transportation Legistlation - Tailpipe	-	47,022	83,674	105,852	117,707	124,222
California RPS	-	(7)	31	89	154	219
On-road Commercial Vehicles						
GI (miles/job)	1,817.96	1,817.96	1,817.96	1,817.96	1,817.96	1,817.96
Jobs	44,625	45,748	46,588	47,366	48,202	49,071
Commercial VMT (miles)	81,126,613	83,168,186	84,695,275	86,109,650	87,629,468	89,209,278
BAU						
Commercial Total VMT (miles)	81,126,613	83,168,186	84,695,275	86,109,650	87,629,468	89,209,278
Commercial EV Share	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Commercial EPM (kWh/EV-mile)	-	-	-	-	-	-
Commercial EVMT (kWh)	0	0	0	0	0	0
2019 Commercial EF (MT CO2e/mile)	0.001155	0.001155	0.001155	0.001155	0.001155	0.001155
2019 PG&E/3CE EF (MT CO2e/MWh)	0.005499	0.005499	0.005499	0.005499	0.005499	0.005499
Commercial VMT Emissions (MT CO2e)	93,701	96,059	97,823	99,457	101,212	103,037
Commercial EVMT Emissions (MT CO2e)	-	-	-	-	-	-
Total Emissions (MT CO2e)	**93,701**	**96,059**	**97,823**	**99,457**	**101,212**	**103,037**
Adjusted for Transportation Legislation an d California RPS						
Commercial Total VMT (miles)	81,126,613	83,168,186	84,695,275	86,109,650	87,629,468	89,209,278
Commercial EV Share	0.00%	0.66%	6.61%	19.38%	31.49%	39.87%
Commercial EPM (kWh/EV-mile)	-	0.989	0.986	0.988	0.988	0.993
Commercial EVMT (kWh)	0	538,596	5,520,609	16,486,133	27,261,023	35,327,259
Commercial EF (MT CO2e/mile)	0.001155	0.001115	0.001024	0.000869	0.000733	0.000643
PG&E/3CE EF (MT CO2e/MWh)	0.005499	0.004096	0.003081	0.002054	0.001027	-
Commercial VMT Emissions (MT CO2e)	93,701	92,733	86,728	74,829	64,232	57,362
Commercial EVMT Emissions (MT CO2e)	-	2.206	17.009	33.863	27.998	-
Total Emissions (MT CO2e)	**93,701**	**92,735**	**86,745**	**74,863**	**64,260**	**57,362**
Reductions (MT CO2e)						

Transportation Legislation - Activity	-	(3)	(30)	(91)	(150)	(194)
Transportation Legistlation - Tailpipe	-	3,327	11,095	24,627	36,980	45,675
California RPS	-	1	13	57	122	194
On-road Buses						
GI (miles/house)	78.49	78.49	78.49	78.49	78.49	78.49
Houses	57,595	59,966	63,233	64,153	64,331	64,440
Bus VMT (miles)	4,520,550	4,706,607	4,963,049	5,035,278	5,049,249	5,057,804
			BAU			
Bus Total VMT (miles)	4,520,550	4,706,607	4,963,049	5,035,278	5,049,249	5,057,804
Bus EV Share	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Bus EPM (kWh/EV-mile)	-	-	-	-	-	-
Bus EVMT (kWh)	0	0	0	0	0	0
2019 Bus EF (MT CO2e/mile)	0.001511	0.001511	0.001511	0.001511	0.001511	0.001511
2019 PG&E/3CE EF (MT CO2e/MWh)	0.005499	0.005499	0.005499	0.005499	0.005499	0.005499
Bus VMT Emissions (MT CO2e)	6,831	7,112	7,499	7,608	7,629	7,642
Bus EVMT Emissions (MT CO2e)	-	-	-	-	-	-
Total Emissions (MT CO2e)	**6,831**	**7,112**	**7,499**	**7,608**	**7,629**	**7,642**
			Adjusted for Transportation Legislation and California RPS			
Bus Total VMT (miles)	4,520,550	4,706,607	4,963,049	5,035,278	5,049,249	5,057,804
Bus EV Share	0.00%	0.22%	4.26%	32.48%	53.61%	66.37%
Bus EPM (kWh/EV-mile)	-	1.075	1.425	1.620	1.634	1.631
Bus EVMT (kWh)	0	11,377	301,443	2,649,343	4,423,907	5,476,397
Bus EF (MT CO2e/mile)	0.001511	0.001350	0.001237	0.000863	0.000556	0.000388
PG&E/3CE EF (MT CO2e/MWh)	0.005499	0.004096	0.003081	0.002054	0.001027	-
Bus VMT Emissions (MT CO2e)	6,831	6,354	6,139	4,345	2,807	1,962
Bus EVMT Emissions (MT CO2e)	-	0.047	0.929	5.442	4.543	-
Total Emissions (MT CO2e)	**6,831**	**6,354**	**6,140**	**4,351**	**2,812**	**1,962**
			Reductions (MT CO2e)			
Transportation Legislation - Activity	-	(0)	(2)	(15)	(24)	(30)
Transportation Legistlation - Tailpipe	-	758	1,360	3,263	4,822	5,680
California RPS	-	0	1	9	20	30
Waste						
			BAU			
GI (MT CO2e/SP)	0.1849	0.1849	0.1849	0.1849	0.1849	0.1849
Service Population	178,417	180,423	181,615	182,670	183,827	185,024
Emissions (MTCO2e)	**32,989**	**33,360**	**33,580**	**33,775**	**33,989**	**34,210**
Wastewater						
			BAU			
GI (MT CO2e/SP)	0.0161	0.0161	0.0161	0.0161	0.0161	0.0161
Service Population	178,417	180,423	181,615	182,670	183,827	185,024
Emissions (MTCO2e)	**2,874**	**2,907**	**2,926**	**2,943**	**2,961**	**2,981**
Off-road Transportation						
			Diesel			
Fuel use (gallons)	1,159,436	1,183,776	1,197,400	1,216,026	1,237,317	1,260,490

EF (kg CO2e/gallon)	0.01021	0.01021	0.01021	0.01021	0.01021	0.01021
Emissions (MT CO2e)	11,838	12,086	12,225	12,416	12,633	12,870
			Gasoline			
Fuel use (gallons)	2,106,415	2,237,966	2,338,840	2,444,272	2,551,522	2,681,154
EF (kg CO2e/gallon)	0.00878	0.00878	0.00878	0.00878	0.00878	0.00878
Emissions (MT CO2e)	18,494	19,649	20,535	21,461	22,402	23,541
			Natural Gas			
Fuel use (gallons)	212,044	213,117	211,931	212,612	212,035	212,035
EF (kg CO2e/gallon)	0.00568	0.00568	0.00568	0.00568	0.00568	0.00568
Emissions (MT CO2e)	1,204	1,211	1,204	1,208	1,204	1,204
			All Fuels - Total			
Emissions (MT CO2e)	**31,537**	**32,946**	**33,964**	**35,084**	**36,240**	**37,614**

Sector Summaries

			BAU Sector Summary			
	2019	2025	2030	2035	2040	2045
Energy	169,518	175,575	183,013	185,805	187,228	188,560
Transportation	485,881	504,492	527,732	536,248	540,274	544,156
Waste	32,989	33,360	33,580	33,775	33,989	34,210
Watewater	2,874	2,907	2,926	2,943	2,961	2,981
Total	**691,262**	**716,334**	**747,251**	**758,771**	**764,453**	**769,907**

			Adjusted (State Legislation) Sector Summary			
	2019	2025	2030	2035	2040	2045
Energy	169,518	174,925	181,177	183,101	183,754	184,314
Transportation	485,881	453,467	431,714	402,613	380,820	368,544
Waste	32,989	33,360	33,580	33,775	33,989	34,210
Watewater	2,874	2,907	2,926	2,943	2,961	2,981
Total	**691,262**	**664,659**	**649,397**	**622,432**	**601,524**	**590,049**