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Project: **Santa Barbara Climate Action Plan Update**

Re: City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum

As part of the City of Santa Barbara Climate Action Plan (CAP) Update, Rincon Consultants, Inc. (Rincon) has prepared a (2019) community greenhouse gas (GHG) emission inventory and projected future greenhouse gas (GHG) emissions forecasts for each sector associated with land use in the City of Santa Barbara as projected by the 2023-2031 Housing Element Update. The 2019 GHG emissions inventory identifies the major sources and quantities of GHG emissions produced by communitywide activities within Santa Barbara's city limits (i.e., the Santa Barbara General Plan planning area). The GHG emissions forecasts are based on the 2019 GHG emissions inventory and utilize City of Santa Barbara specific demographics projections to estimate future GHG emissions within the City's jurisdiction. The GHG emissions forecasts were developed to better understand how Santa Barbara's GHG emissions are expected to change in the years 2025 (interim year), 2030 (initial Senate Bill 32 compliance year), 2035 (interim year), 2040 (Santa Barbara General Plan horizon year), and 2045 (initial Assembly Bill 1279 compliance year) as a result of anticipated Santa Barbara economic and population growth. The GHG emissions forecast presents three scenarios:

- Business-as-Usual Scenario (BAU) projects GHG emissions levels that scale with population, employment and transportation growth consistent with regional projections, and;
- Legislative Adjusted Scenario (Legislative Adjusted) accounts for GHG reductions expected to occur from adopted State legislation, and;
- SBCE Adjusted Scenario (SBCE Adjusted) accounts for GHG reductions expected to occur from both adopted State legislation and from the enrollment of the city residents in the Santa Barbara Clean Energy (SBCE) program that began in 2021.

The presentation of these three forecast scenarios allows for an understanding of how GHG emissions levels may evolve without further action, how State legislation will contribute to reducing future GHG emissions levels, and how SBCE has contributed to the reduction of GHG emissions locally.

This memorandum also discusses the 2030 and 2045 GHG emission reduction targets for Santa Barbara. These goals have been developed to align with those adopted by the State of California and establish the thresholds required for Santa Barbara to contribute their fair share reduction towards these state level goals.[1] The gap between the 2030 SBCE Adjusted Forecast and Santa Barbara's 2030 targets would be addressed through additional local actions to be included in the CAP Update. The following sections provide a summary of the results for the GHG emission inventories, GHG emission forecast, and GHG reduction targets to be included in the Santa Barbara CAP Update.

Inventory Background

The City of Santa Barbara has prepared previous inventories for years 2005, 2007, 2010, and 2015 following the Global Protocol for Community-scale Greenhouse Gas Emission Inventories (GPC). However, the Association of Environmental Professionals whitepaper, *Senate Bill 375 Consistency and CEQA (California Environmental Quality Act)*[2], recommends that communitywide inventories be developed following the Local Governments for Sustainability (ICLEI) *United States Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions* (Community Protocol)[3] which was adapted from the World Business Council for Sustainable Development and the World Resources Institute (WBCSD/WRI) GHG Protocol Initiative (March 2004). Following the ICLEI methodology better aligns the California statewide GHG inventory, provides the city better control over the GHG emission profile and increases the defensibility of the inventory for CEQA applications and consistency. Prior to development of the 2019 GHG inventory for the City, Rincon completed an evaluation of the City of Santa Barbara's existing 2015 GHG inventory to establish consistency and accuracy in the calculation methodologies. Findings and recommendations for updates to the City's 2015 GHG inventory are provided in the *GHG Inventory Consistency and Data Evaluation Memorandum*, prepared for the City on October 11, 2022. Based on these findings, Rincon has prepared the City's 2019 inventory using activity data provided by the City, following the Community Protocol and applied methodology verified and confirmed by the City, which will serve as the new baseline for the City. The following sections detail the methodology, data, and assumptions utilized to prepare the 2019 inventory consistent with the ICLEI Community Protocol.

[1] California's long-term GHG emission reduction goals were established by the landmark Assembly Bill 32, Senate Bill 32, and Assembly Bill 1279. Collectively, these legislative actions provide a GHG reduction trajectory of reducing Statewide GHG emissions to 1990 GHG emission levels by 2020, 40% below 1990 GHG emissions levels 2030, and carbon neutrality with an 85% minimum reduction by 2045.
[2] Senate Bill 375 Consistency and CEQA. Association of Environmental Professionals. 2012. Accessed November 2021 via online: https://www.califaep.org/climate_change.php
[3] ICLEI. July 2019. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emission.

Greenhouse Gases

The ICLEI Local Governments for Sustainability methodology suggests that inventories assess GHG emissions associated with the six internationally recognized GHGs. This inventory focuses on the three GHGs most relevant to the City's operations: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The other three gases (hydrofluorocarbons, perfluorocarbons, and sulfur hexafluorides) are emitted primarily in private sector manufacturing and electricity transmission and are therefore, omitted from this inventory. Table 1 list each gas, the primary source and the respective global warming potential (GWP). The GWP refers to the ability and degree of each gas to trap heat in the atmosphere.[4] For example, one pound of nitrous oxide gas has 265 times more heat trapping potential than one pound of carbon dioxide gas when quantified over a one-hundred-year residence time. Global warming potentials are used to equate all GHGs to CO_2 equivalent (CO_2e). Greenhouse gas emissions for the City's GHG inventory, forecast, and targets are reported in metric tons (MT) of CO_2e, per standard practice. The 2015 GHG inventory applied global warming potential (GWP) values from the International Panel on Climate Change's 5th Assessment Report (IPCC AR5).[5] To maintain consistency between previous GHG emissions inventory accounting, it is recommended that the AR5 GWP be used for the 2019 GHG emissions inventory as well. Table 1 contains the AR5 GWPs used in the GHG emissions inventories.

Table 1 Greenhouse Gases and Global Warming Potentials

Greenhouse Gas	Source of Emission	GWP (IPCC 5th AR)
Carbon Dioxide (CO_2)	Combustion	1
Methane (CH_4)	Combustion, anaerobic decomposition of organic waste (landfills, wastewater treatment plants), fuel handling	28
Nitrous Oxide (N_2O)	Combustion and wastewater treatment	265

Source: IPCC Fifth Assessment Reports

Calculating GHG Emissions

Consistent with ICLEI's Community Protocol, GHG emissions are estimated using calculation-based methodologies to derive emissions using activity data and emissions factors. To estimate emissions, the basic equation below is used:

Activity Data x Emission Factor = GHG Emissions

Activity data refers to the relevant measurement of energy use or other GHG-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles travelled. Emission factors are used to convert energy usage or other activity data into associated emissions quantities. They are usually expressed in terms of emissions per unit of activity data (e.g., lbs. CO_2/kWh).

[4] According to the United States Environmental Protection Agency, the GWP was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is a measure of how much energy the emissions of one ton of a gas will absorb over a given period of time, relative to the emissions of one ton of carbon dioxide (EPA 2017).

[5] Intergovernmental Panel on Climate Change, Fifth Assessment Report. Accessed November 2021 via online: https://www.ipcc.ch/report/ar5/syr/

GHG Emissions Sectors and Sources

ICLEI recommends that local governments examine their emissions in the context of the sector that is responsible for those emissions. Many local governments will find a sector-based analysis more directly relevant to policy making and project management, as it assists in formulating sector-specific reduction measures.

The community inventory reports emissions by the following sectors:

- Energy
- Transportation
- Water Consumption and Wastewater Treatment
- Solid Waste

The GHG emissions sectors and associated sources included in the inventories and forecasts are provided in

Table 2.

Table 2 City of Santa Barbara GHG Emissions Sectors and Sources

GHG Emissions Sector	GHG Emissions Source
Natural Gas	Residential Natural Gas Consumption
	Non-Residential Natural Gas Consumption
Electricity[1]	Residential Electricity Consumption
	Non-Residential Electricity Consumption
	Electric Vehicle Electricity Consumption
Transportation	Passenger On-Road Transportation
	Commercial On-Road Transportation
	Bus On-Road Transportation (excluding Public Transit)
	Off Road - Diesel
	Off Road - Gasoline
	Off Road - Natural Gas (LPG)
Water[2]	Indirect Electricity Consumption from Imported Water Delivery
Wastewater[3,4]	Direct Wastewater Treatment Emissions
Solid Waste	Methane Commitment of Solid Waste Generated by Community

1. Electricity Consumption includes electricity provided by SoCal Edison (SCE) and local Community Choice Aggregation (CCAs) Santa Barbara Clean Energy (SBCE).

2. For local water sources all water treatment occurs within City boundaries and as such electricity associated with providing local water is accounted for in the community's electricity. Only electricity associated with imported water is accounted for in the water sector.

3. Wastewater is treated by a wastewater treatment plant located within City boundaries and therefore electricity emissions associated with wastewater treatment and collection have been accounted for in the community's electricity and are not included in the wastewater sector.

4. Direct wastewater treatment emissions are from the following sources: digester gas from anaerobic digesters at wastewater treatment plants, nitrification of wastewater, and effluent from treatment and discharge of wastewater

City of Santa Barbara GHG Emissions 2019 Inventory

The 2019 GHG emissions inventory includes an assessment of the City of Santa Barbara's community wide GHG emissions that serves as the basis for the GHG emissions forecast. The 2019 community GHG inventory includes all emissions occurring within the City of Santa Barbara's geo-political control (i.e., sources of emissions over which the City has significant influence or jurisdictional authority).

The reporting and calculation of GHG emissions are consistent with the recommendations of ICLEI.[6] The community inventory reports GHG emissions by their source sector, which includes energy, transportation, solid waste, water, and wastewater. The calculation of GHG emissions uses the best available data and guidance of the ICLEI methodologies.

Energy

Greenhouse gas emissions included in the energy sector are generated through electricity and natural gas consumption. In 2019, the City's electricity was provided by Southern California Edison (SCE) and natural gas was provided Southern California Gas (SoCalGas). The following discussion details the methods for energy data collection and an evaluation of the completeness and accuracy of data collected.

Pursuant to the California Public Utilities Commission (CPUC) Energy Data Request Program (EDRP) established by decision 14-05-016.[7], when local governments request data from investor-owned utility providers such as SCE and SoCalGas, the data must meet aggregation rules to protect consumer privacy. This aggregation rule is commonly referred to as the *15/15 Aggregation Rule*. Public data sets must have a minimum of 100 residential customers, a minimum of 15 non-residential customers with no single non-residential customer accounting for more than 15% of the total consumption. If the rule isn't met, non-residential usage will be combined with other sectors.

Additionally, due to non-disclosure requirements of the EDRP, **this memorandum is intended to be an internal document and should not be published without redaction of activity data.** Emissions data excluding the activity data will be reported in the Climate Action Plan.

Natural Gas

Natural gas use is based on residential, commercial, and industrial building energy use. SCG provided the natural gas quantities delivered to customers in the City of Santa Barbara in 2019 through EDRP in the form of total annual therms. The data was provided by customer category (i.e., commercial, industrial, and residential). Data provided by SCG passed both the 15/20 and 5/25 aggregation rules and is aggregated annually. The inclusion of industrial natural gas in the GHG emissions inventory was deemed to be appropriate, as the two facilities in the City that are required to report under the State's Cap-and-Trade Program, Santa Barbara Cottage Hospital and University of California Santa Barbara, are not included in the SCG provided natural gas consumption data. This was determined by reviewing the State reported GHG emissions for these facilities, which determined that the total natural gas consumption for these facilities is much higher than the industrial natural gas value provided by SCG.

SCG provided the natural gas delivered to customers. However, to account for end-user leakage prior to customer consumption, the quantity of natural gas included in the inventory for consumption was

[6] ICLEI. July 2019. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emission.
[7] California Public Utilities Commission Decision 14-05-016. Accessed September 2021. https://docs.cpuc.ca.gov/publisheddocs/published/g000/m090/k845/90845985.pdf

adjusted by subtracting 0.5% of the quantity delivered.[8] The total natural gas delivered versus the natural gas consumed by customer class is shown in Table 3.

Table 3 Natural Gas Use by Source

Source[1]	Delivered[2]	Consumed[3]	Units
Residential	12,083,133	12,022,717	Therms
Commercial	7,614,588	7,576,515	Therms
Industrial	103,227	102,711	Therms

1. Data provided to the City from SCG EDRP program via Rincon's FTP portal, September 22, 2021.
2. Total natural gas quantities delivered. This quantity was used to quantify emissions from natural gas leakage.
3. Customer consumed natural gas accounting for a 0.5% end-user leakage rate occurring prior to customer consumption. This quantity was used to quantify emissions from natural gas consumption.

Emissions Calculations

GHG emissions from community natural gas consumption were calculated using the ICLEI Community Protocol Method BE.1.1. Emissions from natural gas were calculated by multiplying the activity data derived from the SCG billing history (therms of natural gas consumption in the City of Santa Barbara) by the emission factor for natural gas combustion. The emission factor for natural gas (MT CO_2e/therm) was determined based on the Environmental Protection Agency's (EPA) *Emission factors for Greenhouse Gas Inventories* document, published April 2022.[9]

In addition to direct natural gas consumption, emissions are also released from methane leakage both at the natural gas compressor stations and from leakage at the meter. Based on recent studies, there is a leakage rate of approximately 2.8% of all natural gas delivered.[10,11] Although emissions from methane leakage are outside of the City's operational control, emissions related to methane leakage are directly related to natural gas use within the community and should be included in the community emissions similar to electricity transmission and distribution loss. Methane leakage associated with natural gas delivered to the community was determined by multiplying the total community natural gas delivered in 2019 by 2.8%, the methane leakage rate. GHG emissions from community methane leakage were calculated by multiplying the quantity of natural gas leaked by the emission factor for fugitive emissions from natural gas distribution system. The fugitive emission factor for natural gas was calculated by multiplying cubic meter of natural gas per therm (2.776 cubic meter/therm)[12] by the density of natural gas (0.000712 MT/cubic meter)[13] by the percent of methane in natural gas by methane's 100-year GWP factor. Table 4 provides the activity data, emission factor, and GHG emission calculation results for community natural gas consumption and methane leakage.

[8] Fischer, ML; Chan, WR; Delp, W; Jeong, S; Rapp, V; Zhu, Z. 2018. An estimate of Natural Gas Methane Emissions from California Homes. *Environ. Sci. Technol.* 52, 17, 10205–10213 (https://doi.org/10.1021/acs.est.8b03217)
[9] Emissions Factors for Greenhouse Gas Inventories. U.S. Environmental Protection Agency. April 2022. Accessed January 2023 via online: https://www.epa.gov/system/files/documents/2022-04/ghg_emission_factors_hub.pdf
[10] Alvarez, Ramón & Zavala-Araiza, Daniel & Lyon, David & Allen, David & Barkley, Zachary & Brandt, Adam & Davis, Kenneth & Herndon, Scott & Jacob, Daniel & Karion, Anna & Kort, Eric & Lamb, Brian & Lauvaux, Thomas & Maasakkers, Joannes & Marchese, Anthony & Omara, Mark & Pacala, Stephen & Peischl, Jeff & Robinson, Allen & Hamburg, Steven. (2018). Assessment of methane emissions from the U.S. oil and gas supply chain. Science. 361. eaar7204. 10.1126/science.aar7204.
[11] Fischer, ML; Chan, WR; Delp, W; Jeong, S; Rapp, V; Zhu, Z. 2018. An estimate of Natural Gas Methane Emissions from California Homes. *Environ. Sci. Technol.* 52, 17, 10205–10213 (https://doi.org/10.1021/acs.est.8b03217)
[12] https://www.abraxasenergy.com/energy-resources/toolbox/conversion-calculators/energy/
[13] https://www.unitrove.com/engineering/tools/gas/natural-gas-density

Table 4 GHG Emissions from Natural Gas

Data	2019
Residential	
Activity Data (therms)[1]	12,022,717
Emissions factor (MT CO_2e/therm)[2]	0.00531
Residential Consumption Emissions (MT CO_2e)	63,858
Non-Residential	
Activity Data (therms)[1]	7,679,226
Emissions factor (MT CO_2e/therm)[2]	0.00531
Non-Residential Consumption Emissions (MT CO_2e)	40,788
Leakage	
Methane Leakage (% of delivered)	2.8%
Methane Leakage (therms)[3]	554,427
Emission factor (MT CO_2e /therm)[4]	0.0531
Methane Leakage Emissions (MT CO_2e)	29,422
Total Emissions	**134,068**

1. Activity data is the natural gas consumed by the customer classes as detailed above. This quantity has been adjusted to exclude natural gas leakage.

2. EPA's Emission Factors for Greenhouse Gas Inventories

3. Methane leakage is calculated from the total natural gas delivered.

4. Calculated by multiplying cubic meter of natural gas per therm (2.85) [source:https://www.abraxasenergy.com/energy-resources/toolbox/conversion-calculators/energy/] by density of natural gas (0.000712 MT/ cubic meter) [source: https://www.unitrove.com/engineering/tools/gas/natural-gas-density] by methane content of natural gas (94.9%) [source: North American Energy Standards Board]. Adjusted for GWP of CH_4.

MT = metric tons

Electricity

The City provided electricity data for the City's 2019 electricity consumption via SCE's EDRP program. The data was provided in the form of kWh consumption disaggregated by commercial and residential use then also by non-residential (commercial, industrial, and agricultural) and residential use. The data provided by SCE did not pass the 5/25 or 15/20 aggregation rule therefore the industrial and agricultural use were aggregated with commercial electricity use.[14] Because the industrial data is aggregated with commercial use, this data was included in the 2019 GHG inventory, which is also consistent with previous inventories.

Emissions Calculations

GHG emissions from community electricity consumption were calculated using the ICLEI Community Protocol Method BE.2. Emissions associated with electricity usage were separated and reported in the inventory as residential and non-residential customer classes, where non-residential includes commercial, industrial, and agricultural usage aggregated. Emissions from electricity were calculated by

[14] Residential, Commercial Consumption Data 15/20 Rule: Aggregated over a group consisting of 15 customers in a single customer class. No single customer accounts for more than 20 percent of the total energy consumption in an individual month.
Industrial Consumption Data 5/25 Rule: Aggregated over a group consisting of five customers in a single customer class. No single customer accounts for more than 25 percent of the total energy consumption in an individual month.

multiplying the activity data from SCE by the emission factor for SCE electricity for 2019. The emission factor for SCE electricity was obtained from Edison's 2020 Sustainability Report. [15]

To avoid double counting of electricity emissions associated with electric vehicles (EV) charging that is accounted for in the transportation section, consumption of electricity for EVs in 2019 was backed out of the total City of Santa Barbara electricity consumption. EMFAC2021 was utilized to estimate the electricity consumption associated with electric vehicle (EV) charging in 2019 in the City of Santa Barbara. Details regarding methodology for determining EV VMT is detailed in the Transportation Section below. Table 5 provides the activity data, emission factor, and GHG emission calculation results for community electricity.

Table 5 GHG Emissions from Electricity

Data	2019
Residential	
Activity Data (kWh)	149,661,174
Emissions factor (MT CO_2e/kWh)[1]	0.000242
Residential Electricity Emissions (MT CO_2e)	36,251
Passenger EV Charging (MT CO_2e)[2]	722
Adjusted Residential Electricity Emissions (MT CO_2e)	35,529
Non-Residential	
Activity Data (kWh)	305,112,378
Emissions factor (MT CO2e/kWh)1	0.000242
Non-Residential Electricity Emissions (MT CO2e)	73,904
Commercial and Bus EV Charging (MT CO2e)2	16
Adjusted Non-Residential Electricity Emission (MT CO2e)	73,888
Total Electricity Emissions (MT CO2e)	**110,154**
EV Charging Electricity Emissions (MT CO2e)2	**738**
Adjusted Building Electricity Emissions (MT CO2e)	**109,416**

1. SCE emission factor on Edison International 2020 Sustainability Report.

2. Electricity associated with EV charging is subtracted from total electricity usage to avoid double counting with the transportation sector. Table 7 includes details on the calculation of EV electricity.

kWh = kilowatt-hour; MT = metric tons

Electricity Transmission and Distribution Losses

In addition to energy consumption, the amount of emissions generated due to electricity transmission and distribution (T&D) losses were determined, as recommended by the ICLEI Community Protocol. T&D losses occur as electricity is transported from its generation source to its final end use destination. Transmission losses occur in the form of heat as electricity meets the small resistance in wires, and distribution losses occur when electricity is transformed from higher to lower voltage wires. Although emissions generated due to electricity T&D losses are outside of the City's operational control, emissions related to T&D losses are directly related to electricity use within the community and should be included in the community emissions.[16] GHG emissions from community T&D losses were calculated using the

[15] Edison 2020 Sustainability Report. Accessed November 2021 via online: https://www.edison.com/content/dam/eix/documents/sustainability/eix-2020-sustainability-report.pdf

[16] ICLEI 2019. U.S. Community Protocol for Account and Reporting Greenhouse Gas Emissions. Pg. 36.

ICLEI Community Protocol Method BE.4. T&D loss associated emissions were determined by multiplying the total community electricity consumption in 2019 by 4.8%, the grid loss factor for the California sub-region (CAMX) most recently determined by the United States Environmental Protection Agency (USEPA) *Emissions and Generating Resource Integrated Databases (eGRID)*.[17] Table 6 provides the activity data, emission factor, and GHG emission calculation results for community T&D losses.

Table 6 GHG Emissions from Electricity T&D Losses

Data	2019
Activity Data (kWh)	454,773,552
Grid Loss Factor[1]	4.8%
T&D Loss (kWh)	21,829,130
Emissions factor (MT CO_2e/kWh)[2]	0.000242
T&D Loss Emissions (MT CO_2e)	5,287

1. The grid loss factor for the California sub-region (CAMX) most recently determined by the USEPA eGRID for 2019
2. SCE emission factor on Edison International 2020 Sustainability Report.

kWh = kilowatt-hour; MT = metric tons,

Transportation

The transportation sector for the 2019 GHG inventory consists of GHG emissions from on-road commercial and passenger vehicle travel and off-road equipment.

On-Road

Transportation emissions associated with on-road transportation in the City of Santa Barbara in 2019 were calculated from VMT data provided by Iteris for the City of Santa Barbara Housing Element Update. Iteris utilized a travel demand model which provided total city-wide daily VMT disaggregated into passenger and commercial truck data from internal:internal (I:I), internal-external:external-internal (I:X), and external:external (X:X) trips for the baseline year of 2020 and Housing Element buildout year of 2035. The model is based on socioeconomic data consistent with the City of Santa Barbara Housing Element Update and includes the Regional Housing Needs Assessment (RHNA) allocations for 2023-2031.[18]. For the GHG inventory and forecasts, 100% of VMT associated with I:I trips and 50% of VMT associated with (I:X) trips is attributed to the community. No X:X trips are included in the analysis as these are passthrough and not associated with the City directly. Daily VMT was multiplied by an annualization factor of 347. Because the baseline year for the travel demand model was 2020, 2019 VMT data was estimated by multiplying the 2020 per capita daily VMT by the 2019 population. Further, as the data set did not include VMT from buses, VMT from buses was estimated by multiplying the passenger VMT by the EMFAC2021 proportion of bus VMT compared to passenger VMT in the County for 2019.

Emissions Calculations

GHG emissions are calculated by multiplying the VMT for each vehicle category (i.e., passenger, commercial, buses) by the respective emissions factors derived from EMFAC2021 for the County of Santa Barbara. Specifically, emissions due to passenger vehicle operation are calculated using the

[17] EPA eGRID CAMX Grid Loss Factor 2019. Accessed November 2021, via: https://www.epa.gov/egrid/download-data
[18] SBCAG. 2021. Regional Housing Needs Allocation Plan. Available: http://www.sbcag.org/uploads/2/4/5/4/24540302/item_5_attach_a_-_rhna_plan.pdf. Accessed October 12, 2021

recommended Community Protocol Method TR.1.A. Because emissions data were not provided, only VMT, ICLEI Methods TR.1.B.2 and TR.1.B.3 are used to convert provided VMT data into emissions data and calculate regional emission factors from CARB's EMFAC2021 model for passenger vehicles by dividing annual GHG emissions by the VMT. Emissions from freight and service trucks (i.e., medium and heavy-duty trucks) are calculated using Community Protocol Method TR.2.C, which is similar to calculating passenger emissions.

EMFAC2021 provides detailed data on a county-wide basis that includes annual electricity use by electric vehicles (EV) in kilowatt-hours (kWh), VMT associated with EV's, VMT associated with internal combustion engine vehicles (ICE), total VMT, and annual emissions. Vehicle classes with a gross vehicle weight rating (GVWR) less than 6,000 pounds were considered passenger vehicles, those with a GVWR greater than 6,000 pounds were considered commercial vehicles, and vehicles categorized by EMAFC2021 as buses were considered bus vehicles. Based on EMFAC2021 data, a weighted emission factor is calculated for each vehicle category using the mix of vehicle class specific to the county and by dividing the total emissions by VMT for each aggregated vehicle category defined above. EMFAC2021 characterizes the vehicle class mix for each county based on the most recent Department of Motor Vehicle (DMV) registration data as well as several other sources for the heavy-duty vehicle population such as International Registration Plan (IRP) Clearinghouse data, vehicle data from California Highway Patrol (CHP), and the National Transit Database (NTD).

EMFAC2021 data is also used to determine the percent of EV penetration in 2019 by dividing electric VMT by total VMT and to determine the energy efficiency for passenger, commercial, and bus electric vehicles by dividing total energy consumption in kWh by electric VMT for each vehicle category. Annual electric VMT is calculated by multiplying the city VMT by the EMFAC2021 EV penetration percentage. Annual electricity usage by vehicle category is determined by multiplying electric VMT by the energy efficiency (kWh/mile). Data is not available to identify the utility provider for all EV charging electricity, therefore, it is assumed that SCE is the provider and the SCE emission factor is used. Because EV's are charging both within the City of Santa Barbara as well as in the surrounding region, using SCE electricity emission rates provides a conservative estimate. The EV emission factors were applied to the annual kWh data to obtain 2019 emissions from passenger EVs, commercial EVs, and electric buses. Electricity emissions associated with EV charging are subtracted from the electricity sector to avoid double counting of emissions.

The activity data, emission factors and total GHG emissions from on-road transportation are provided in Table 7.

Table 7 GHG Emissions from On-Road Transportation

Data	2019
Passenger Vehicle	
Daily Passenger VMT[1]	2,039,159
Total Annual Passenger VMT[3]	707,588,271
Aggregated GHG Emissions Factor (MT CO_2e/VMT)[4]	0.000362
Percent of Passenger EV Penetration (%)[5]	1.2%
Passenger EV VMT[5]	8,293,608
Passenger Fuel Efficiency (kWh/mile)[6]	0.359
Passenger EV Vehicles kWh	2,980,859
SCE Electricity GHG Emissions Factor (MT CO_2e/kWh)[7]	0.000242
Passenger EV Vehicle Emissions (MT CO_2e)	722

Data	2019
Total Passenger Vehicle Emissions (MT CO_2e)	**256,408**
Commercial Vehicle	
Daily Commercial VMT[1]	23,970
Total Annual Commercial VMT[3]	8,317,761
Aggregated GHG Emissions Factor (MT CO_2e /mile)[4]	0.001202
Percent of Commercial EV Penetration (%)[5]	0.0%
Commercial EV VMT[5]	0
Commercial Fuel Efficiency (kWh/mile)[6]	N/A
Commercial EV Vehicles kWh	0
SCE Electricity Emission Factor (MT CO_2e/kWh)[8]	0.000242
Commercial EV Vehicle Emissions (MT CO_2e)	0
Total Commercial Vehicle Emissions (MT CO_2e)	**10,000**
Busses	
Daily Bus VMT[2]	16,257
Total Annual Busses VMT[3]	5,641,017
Aggregated GHG Emissions Factor (MT CO_2e /mile)[4]	0.00135
Percent of Busses EV Penetration (%)[5]	0.65%
Busses EV VMT[5]	36,413
Buses Fuel Efficiency (kWh/mile)[6]	1.83355
Busses EV Vehicles kWh	66,766
Aggregate Electricity Emission Factor (MT CO_2e/kWh)[8]	0.000242
Busses EV Vehicle Emissions (MT CO_2e)	16
Total Busses Emissions (MT CO_2e)	**7,591**
Total On-road Emissions (MT CO_2e)	**273,999**

1. 2019 VMT data was estimated by multiplying the 2020 per capita daily VMT obtained from Iteris for the Housing Element Update by the 2019 population
2. VMT from buses was estimated by multiplying the passenger VMT by the EMFAC2021 proportion of bus VMT compared to passenger VMT in the County for 2019.
3. Weekday to annual conversion of 347 is used per CARB guidance on VMT modeling.
4. Emission factors obtained from EMFAC2021 for all vehicles where model years and speed were aggregated for each fuel type by vehicle class.
5. California Air Resource Board's EMFAC2021 model provides detailed data on electric vehicles electricity use (in annual kilowatt-hours), number of miles traveled by electric vehicles, number of miles traveled by ICE vehicles, and total number of vehicle miles traveled. Percent of EV penetration is calculated as electric VMT divided by total VMT.
6. Fuel economy for EVs obtained from EMFAC2021 by dividing annual electricity usage by total electric VMT for each vehicle category.
7. SCE emission factor on Edison International 2020 Sustainability Report.

MT CO2e = metric tons of carbon dioxide equivalent; VMT = vehicle miles traveled; EV= electric vehicle; kWh = kilowatt hour

Off-Road

Off-road transportation GHG emissions for 2019 was assessed using CARB's mobile source emissions model for off-road equipment, OFFROAD2021. This model provides annual fuel consumption from various types of off-road equipment operating in Santa Barbara County. The OFFROAD results were allocated to the City of Santa Barbara using population (i.e., recreational equipment, lawn and garden equipment) and employment (i.e., construction and mining equipment, industrial equipment, light commercial equipment, other portable equipment, and transportation refrigeration units) as compared to the county totals. Fuel consumption for agricultural equipment was attributed based on the acres of agricultural land in City limits compared with the county total. Fuel consumption from airport ground support equipment was attributed based on the City's aviation fuel sold as compared to the county total. Fuel consumption from pleasure craft were attributed based on the City's population and commercial harbor craft were attributed 100% to the City as the City of Santa Barbara Harbor is the only commercial harbor in the county. Categories that were not under the jurisdictional control of the City were excluded from the inventory including locomotive, military tactical support, ocean going vessels, and oil drilling. It is assumed that majority of military would be attributed to Vandenberg AFB outside of City limits. Additionally, oil drilling and ocean-going vessels are viewed consistently as scope 3 emissions not controllable by the city and operating outside of City limits. Table 8 details the attribution factors utilized to for the OFFROAD data.

Table 8 2019 Community Off-Road Transportation Data

Equipment	Attribution (% of City of Santa Barbara/ County)[1]	Attribution Metric
Agricultural Equipment	5%	Acres of agricultural land use
Airport Ground Support Equipment[2]	75%	Aviation fuel sold
Commercial Harbor Craft	100%	Location of harbor
Construction and Mining Equipment	34%	Jobs
Industrial Equipment	34%	Jobs
Lawn and Garden Equipment	20%	Population
Light Commercial Equipment	34%	Jobs
Other Portable Equipment	34%	Jobs
Pleasure Craft	20%	Population
Recreational Equipment	20%	Population
Transport Refrigeration Units	34%	Jobs

1. Equipment was attributed to the City based on the percent of the attribution metric associated with the City of Santa Barbara compared with the entire county.

2. The City provided fuel consumption data for the airports within the City and County boundaries.

Annual fuel consumption was multiplied by the emission factor for the corresponding off-road equipment for each fuel type using EPA's emission factors for non-road vehicles. [19] Table 9 summarizes the total annual fuel consumption and GHG emissions by fuel type. Off-road equipment powered by electricity is not included in this estimate to avoid double-counting with the electricity sector.

[19] Emissions Factors for Greenhouse Gas Inventories. U.S. Environmental Protection Agency. April 2022. Accessed January 2023 via online: https://www.epa.gov/system/files/documents/2022-04/ghg_emission_factors_hub.pdf

Table 9 GHG Emissions from Off-road Equipment

Data	2019
Diesel	
Activity Data (gallons)[1]	2,541,452
Emission Factor (MT CO_2e/gallon)[2]	0.0104
Diesel Emissions (MT CO_2e)[1]	26,534
Gasoline	
Activity Data (gallons)[1]	1,656,319
Emission Factor (MT CO_2e/gallon)[2]	0.0091
Gasoline Emissions (MT CO_2e)[1]	15,078
Natural Gas (LPG)[3]	
Activity Data (gallons)[1]	401,740
Emission Factor (MT CO_2e/gallon)[2]	0.0059
Natural Gas Emissions (MT CO_2e)	2,355
Total Emissions (MT CO_2e)	**43,967**

1. Activity data is the sum of annual fuel consumption by equipment type by fuel type. Activity data is sourced from OFFROAD2021 Database https://arb.ca.gov/emfac/emissions-inventory/811d2b1f40ed3a5737483469e61f7388769100ec
2. Emission factor is weighted based on fuel consumption by equipment type.
3. Natural Gas is not typically used in off-road equipment, LPG is used instead.

MT = metric tons

Water and Wastewater

Water sector GHG emissions include those generated from electricity used in water consumption (i.e., conveyance, treatment and delivery), electricity used to collect and treat wastewater, and fugitive emissions from centralized wastewater treatment plant (WWTP) processes and septic systems. The inclusion of these emission sources in the water sector is based on the guidance of the ICLEI Community Protocol.

Water Consumption

The City receives its water from numerous local surface and groundwater sources as well as the California State Water Project (SWP). Water supplied to the community indirectly contributes emissions through the use of energy to extract, convey, treat, and deliver water. The amount of energy required for community water usage was calculated following ICLEI Community Protocol Method WW.14 and using specific energy intensity factors for the water providers and water source when obtainable. Each energy intensity factor is associated with a specific water source and conveyance process (e.g., groundwater extraction and conveyance, water treatment, surface water conveyance, imported surface water conveyance).

Water production data was provided by the City of Santa Barbara Public Works department in the form of monthly deliveries (in acre-feet) by water source. Each source was assigned a water energy intensity value dependent on the source type (e.g., reservoir, desalination, groundwater, imported, etc.) from the City of Santa Barbara’s 2020 Enhanced Urban Water Management Plan (EUWMP). The total water volume from each type of supply (i.e. groundwater, SWP, local surface, recycled etc.) was multiplied by the energy intensity for that water supply as described above to determined energy consumption. As all water treatment, extraction, and conveyance of non-SWP water occurs within the City, the electricity associated with those activities is accounted for in Scope 2 of this inventory.[20] To avoid double counting of the electricity used to treat water, energy intensity values were applied that only account for water transport from outside City boundaries (e.g., SWP). The energy intensity value for SWP water was obtained from the City's EUWMP. The electricity consumption associated with water supplied by SWP is calculated using the eGRID 2019 emission factor for the CAMX subregion since the electricity used to import water is supplied by multiple electricity providers across the state. The total SWP demand values for the City's population, energy intensity, electricity consumption total, and emission factor used in GHG emissions calculations for imported water supplied to the community are provided in Table 10.

Table 10 GHG Emissions from Water Consumption

Data	2019
Imported Water[1]	
SWP Water Supplied to the City (AF)	440
Imported Water Energy Intensity (kWh/AF)[2]	2,520
Electricity Consumption (kWh)	1,108,800
CAMX Emission Factor (MT CO_2e/kWh)[3]	0.000206
Total Emissions (MT CO_2e)	**229**

1. Imported water includes water from SWP.
2. Energy intensity for imported water supply obtained from City of Santa Barbara 2020 Enhanced UWMP for SWP.
3. CAMX eGRID 2018 emission factor used for imported water since the electricity used to import water is supplied by multiple electricity providers across the state

AF = acre-feet, kWh = kilowatt-hour; MT = metric tons

Wastewater Generation

Communities generate wastewater that is either piped to a wastewater treatment plant (WWTP) or treated on-site via the use of a septic tank system. Wastewater treatment generates emissions via on-site process, stationary, and fugitive GHG emissions. The degradation of organic matter contained in wastewater under anaerobic (no oxygen) conditions generates methane emissions. Wastewater treatment also produces nitrous oxide as an intermediate product (ICLEI, Appendix F, Wastewater and Water Emission Activities and Sources). The electricity consumed to power these treatment devices is included in the energy sector of this inventory. On-site septic systems treat wastewater in septic tanks via physical settling and biological treatment which emits CH_4.

Wastewater GHG emissions resulting from the treatment of wastewater were calculated based on the City's data provided on water service population. The El Estero Wastewater Treatment Plan (EEWWTP) is the only WWTP located within the City and therefore, wastewater treatment assumptions are based on EEWWTP operations. A majority of the City's wastewater enters the sewer system and is treated by a WWTP. However, based on data provided by the Wastewater Treatment Manager via email there are 360 of the City's water service parcels without sewer service. These parcels receiving water but not wastewater services are assumed to be using septic systems. The total parcels without wastewater service were multiplied by the average household size, 2.353 persons per household, in the City of calculate the number of septic users in the City.[21] Based on provided information, a wastewater service population of 94,082 persons was used for wastewater calculations and an additional 847 service

[20] Per email correspondence with the City's Water Analyst, Dakota Corey, on December 14, 2021, it was determined that all water treatment occurs within the City limits. Dependent on source, the water is either treated at El Estero Wastewater Treatment Plant, Ortega Water Treatment Plant, Cater Water Treatment Plant, or the City's Charles E. Meyer Desalination Plant.

[21] Persons per parcel is based on the average number of people per household in the City of Santa Barbara in 2019 based on demographic data.

persons was used for septic related calculations. This population is larger than the City of Santa Barbara population as the EWWTP treats water for persons outside the City boundary. However, all emissions from EWWTP were included as it falls under City control.

The wastewater treatment methods for each service population detailed above were used to calculate wastewater treatment emissions using ICLEI Wastewater calculation methods (WW.1(alt), WW.2(alt), WW.6(alt), WW.7, WW.8, WW.12(alt) and WW.15). For WWTP that combust digester gas, emissions associated with anaerobic digesters were calculated based on population served and using ICLEI Community Protocol Method WW.1(alt) and WW.2(alt). Fugitive missions associated with or without the nitrification-denitrification process and effluent discharge from the plant were calculated based on population served and using ICLEI Community Protocol Method WW.7 and WW.12(alt). The emissions associated with septic system use were calculated using WW.11(alt). To avoid double-counting, energy-related emissions associated with the collection and treatment of wastewater are not included in this sector as they have been accounted for in the electricity sector as the EEWWTP that treats the City of Santa Barbara's wastewater is within City boundaries.

Table 11 provides details on the activity data used, calculation methodologies, default ICLEI values and presents total GHG emissions from wastewater in the community.

Table 11 GHG Emissions for Wastewater

Data	2019
Stationary Emissions from Combustion of Digester Gas[1] (WW. 1 alt and WW.2 alt)	
Activity Data (population served by WWTP with Stationary Emissions)[2]	94,082
Digestor Gas Production [Digester Gas] (scf/day)	1
CH_4 fraction of Digestor Gas [fCH_4]	0.65
BTU Content of Digestor Gas [BTU_{CH4}] (BTU/scf)	1,028
Emission Factor [EF_{CH4}] (kg CH_4/Btu)	0.0032
Emission Factor [EF_{N2O}] (kg N_2O/BTU)	0.00063
Stationary Emissions (MT CO_2e)	**5.89**
N_2O Process Emissions with or without Nitrification[3] (WW. 7)	
Activity Data (population served by WWTP with nitrification)[2]	94,082
Factor for Nitrogen Loading	1
Emission factor for WWTP *with* nitrification/denitrification [EF nit/denit] (g N2O/person/year)	7
N_2O Process Emissions (MT CO_2e)	**174.52**
Fugitive Emissions from Septic Systems[5] (WW 11.alt)	
Activity Data (population served by septic system)[2]	847
BOD_5 (kg BOD_5/person/day)	0.09
Maximum CH4 producing capacity for domestic wastewater [Bo] (kg CH_4/kg BOD_5)	0.6
CH4 correction factor for septic systems [MCF]	0.22
Septic Emissions (MT CO_2e)	**973.94**
Fugitive N_2O Emissions from Effluent Discharge[4] (WW. 12 alt)	
Activity Data (population served by WWTP with nitrification)[2]	94,082
Total N Load (kg N/person/day)	0.026
N uptake -anaerobic (kg N/kg BOD_5)	0.005
BOD_5 (kg BOD_5/person/day)	0.09

Data	2019
Effluent emission factor for ocean discharge [EF Effluent] (kg N2O-N/kg sewage-N discharge)	0.0025
Fraction of nitrogen removed from WWTP **with** nitrification/denitrification [F*plant nit/denit]*	0.7
Effluent N_2O Emissions (MT CO_2e)	**274.21**
Total Emissions (MT CO_2e)	**1,429**

1. Emissions from combustion of digester gas calculated following ICLEI Community Protocol Method WW.1(alt) and WW.2(alt) using the following equation: (Population X Digester Gas X f_{CH4} X BTU_{CH4} X 10^{-6} X EF_{CH4} X 365.25 X 10^{-3} X GWP_{CH4}) + (Population X Digester Gas X f_{CH4} X BTU_{CH4} X 10^{-6} X EF_{N2O} X 365.25 X 10^{-3} X GWP_{N2O})

2. Based on information available for service by WWTP minus septic system users.

3. N2O emissions from WWTP with or without nitrification/denitrification were calculated following ICLEI Community Protocol Method WW.7 and WW.8 using the following equation: (Population X $F_{ind-com}$ X EF nit/denit X 10^{-6} X GWP_{N2O}) + (Population X $F_{ind-com}$ X EF **no** nit/denit X 10^{-6} X GWP_{N2O})

4. Fugitive N2O emissions from effluent discharge were calculated following ICLEI Community Protocol Method WW.12(alt) using the following equation: (Population X $F_{ind-com}$ X (Total N load – N uptake X BOD_5 load) X EF effluent X 44/28 X (1 – F*plant nit/denite)* X 365.25 X 10^{-3} X GWP_{N2O}) + (Population X $F_{ind-com}$ X (Total N load – N uptake X BOD_5 load) X EF effluent X 44/28 X (1 - F*plant)* X 365.25 X 10^{-3} X GWP_{N2O})

5. Septic system emissions were calculated following ICLEI Community Protocol Method WW.11(alt) using the following equation: (Population X BOD_5 load X Bo X MCFs X 365.25 10^{-3} X GWP_{CH4})

6. Emissions for N2O Emissions from effluent conversion were calculated following ICLEI Community Protocol Method WW.12 (alt)

WWTP = wastewater treatment plant; MT = metric tons

Wastewater treatment technology specifications can vary widely between jurisdictions, as a result of process specifics, influent characteristics, and the age of infrastructure. As noted in the ICLEI Community Protocols, the wastewater emissions calculation methodologies used here were designed as a generalized top-down approach for jurisdictions where detailed information was not available; they are a simplified approach that sacrifice accuracy. These methods have a range of accuracy for CH_4 emissions of +37% to -47% and +76% to -93% for N_2O, compared to direct source measurements.[22] While there is significant uncertainty in the fugitive and process emissions associated with wastewater treatment, providing estimates of their emissions provides a general understanding of the magnitude of this emission source in comparison to others.

Solid Waste

GHG emissions result from solid waste management and decay of organic material in solid waste. ICLEI Community Protocol provides multiple accounting methods to address both emissions arising from solid waste generated by a community (regardless of where it is disposed of) as well as emissions arising from solid waste disposed of inside a community's boundaries (regardless of where it was generated). GHG emissions from the decomposition of organic material in this sector are broken down into two parts:

- Methane emissions from solid waste generated by the community in the year of the inventory, using ICLEI Community Protocol Method SW.4.
- Methane emissions from existing solid waste-in-place at landfills located within the community limits (waste-in-place), using ICLEI Community Protocol Method SW.1.

It is important to note that calculating emissions using both of the above described methodologies can lead to double counting of emissions if a communities waste is sent to a waste disposal facility inside of a community boundary. To be compliant with the ICELI Community Protocol, communities are required to estimate emissions generated from the waste generated by the entire community, regardless of

[22] ICLEI 2019. U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions. Appendix F – Wastewater and Water Emission Activities and Sources.

whether or not the receiving landfill is located inside or outside of the community boundary. Waste-in-place emissions from an in-boundary facility, however, is optional to include in a community inventory and is more commonly included in a municipal or local government inventory. To avoid double counting of community-generated waste emissions, solid waste decay methane emissions were estimated using only ICLEI Community Protocol Method SW.4 to calculate the methane generation from solid waste generated by the City population in 2019.

The City of Santa Barbara provided annual tons of disposed waste by category (landfilled, recycled, mulched green waste, and food scraps composted) which accounts for all wasted generated within the City. Emission factors were derived based on the CalRecycle 2014 waste characterization study and CARB waste specific emission factors. Table 12 provides details on the activity data used, calculation methodologies, emission factors, and presents total GHG emissions from solid waste generated by the community.

Table 12 GHG Emissions from Waste

Data	2019
Landfill Emissions	
Activity Data (short tons)[1]	163,287
Emission Factor (MT CO_2e/short ton)	0.0515
Oxidation rate	0.1
LG collection rate	0.75
Landfill Emissions (MT CO_2e)[3]	**52,977**

1. Activity data includes landfilled waste provided by City of Santa Barbara
2. Emission factor is weighted based on the waste stream characterization and the CARB emission factors for each waste type.
3. Calculated using ICLEI method SW.4 and default values for oxidation rate, LFG capture rate, and mixed waste emission factor.

LFG = landfill gas; MT = metric tons

2019 GHG Emissions Inventory Summary

In 2019, the City of Santa Barbara emitted approximately 622,110 MT CO_2e. As shown in Figure 1, the transportation sector was the largest source of emissions, generating approximately 776,168 MT CO_2e, or 51% of total 2019 GHG emissions. Electricity and natural gas consumption within the residential and non-residential sectors were the second largest source of 2019 emissions, generating 248,771 MT CO_2e, or 40% of the total. Waste generation, including waste decay resulted in 9% of the City’s emissions, while water use and wastewater generation resulted in the remaining 1%. A detailed summary of the updated 2019 GHG emissions inventory is provided in Table 13. The 2019 GHG emissions inventory was utilized for forecasting future emissions.

Figure 1 2019 Community-wide GHG Emissions by Sector (MT CO_2e)

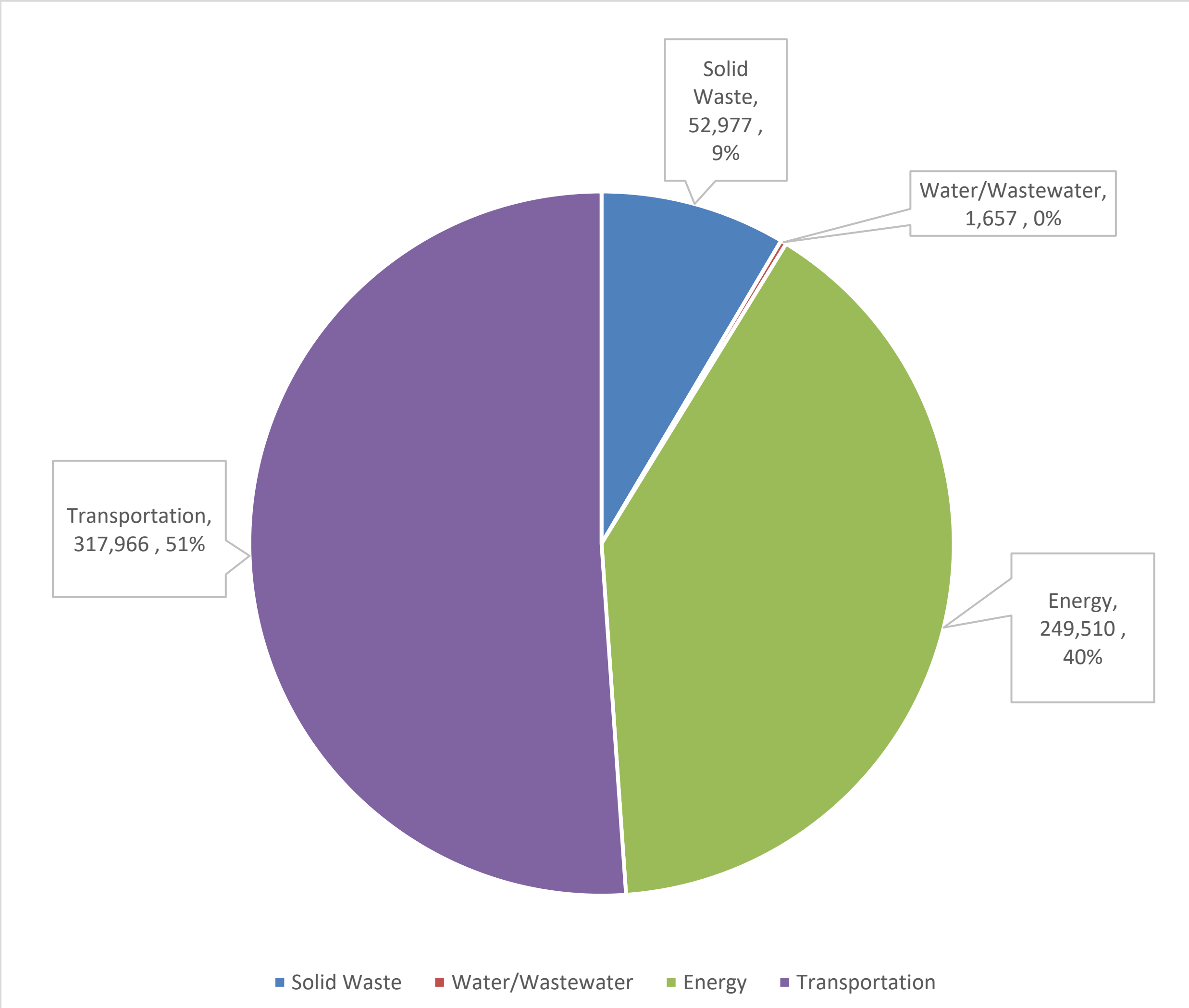


Table 13 Santa Barbara 2019 GHG Emissions Inventory Summary

GHG Emissions Sector/Source	Emissions ($MT\ CO_2e$)	Activity Data	Activity Data Units
Natural Gas			
Residential Natural Gas	63,858	12,022,717	Therms
Non-Residential Natural Gas	40,788	7,679,226	Therms
Natural Gas Leakage	29,422	554,427	Therms
Electricity[1]			
Residential Electricity (EV adjusted)	35,529	146,680,315	kWh
Non-Residential Electricity (EV adjusted)	73,888	305,045,612	kWh
Electric Vehicles	738	2,980,859	kWh
Transportation			
Passenger On-Road Transportation	256,408	707,588,271	VMT
Commercial On-Road Transportation	10,000	8,317,761	VMT
Bus On-Road Transportation	7,591	5,641,017	VMT
Off Road - Diesel	26,534	2,541,452	Gallons
Off Road - Gasoline	15,078	1,656,319	Gallons
Off Road - Natural Gas (LPG)	2,355	401,740	Gallons
Water			
Indirect Electricity from Imported Water Delivery	229	440	AF
Wastewater			
Wastewater Treatment, Process, and Fugitive	1,429	94,082/847	WWTP Population/ Septic Population
Solid Waste			
Solid Waste Generated/Disposal	52,977	163,287	Tons Landfilled
Total Emissions	**622,110**	**N/A**	**$MT\ CO_2e$**

1. As described in the above sections, the electricity emissions for electricity for EV charging is subtracted from the total electricity emissions to avoid double counting. Electricity emissions presented in this table have been adjusted accordingly.

City of Santa Barbara GHG Emissions Forecasts

The GHG emissions forecasts are based on the 2019 GHG emissions inventory and utilize City of Santa Barbara specific demographics projections to estimate future GHG emissions in the City. The forecasts were developed to better understand how population and job growth in the City of Santa Barbara could affect future GHG emissions in the years 2025, 2030, 2035, 2040, and 2045. The GHG emissions forecast presents three scenarios:

- *Business-as-Usual Scenario (BAU)* projects GHG emissions levels hat scale with population, employment, and transportation growth consistent with regional projections absent of any policies or legislation that would reduce local emissions, and;
- *Legislative Adjusted Scenario (Legislative Adjusted)* accounts for GHG reductions expected to occur from adopted State legislation absent additional contribution from local policies or actions, and;
- *SBCE Adjusted Scenario (City Adjusted)* accounts for GHG reductions expected to occur both from adopted State legislation and from the obtainment of carbon free electricity for city residents through SBCE that began in 2021.

Business-as-usual (BAU) GHG Emissions Forecast

A Business-as-Usual (BAU) GHG emissions forecast uses demographic projections and modeled on- and off-road transportation emissions to estimate future GHG emissions without the influence of adopted GHG reduction legislation or policies. The BAU forecast is based on projected growth trends in population, and employment over time, consistent with local and regional projections. The BAU forecast does not account for GHG emissions reductions associated with local GHG reduction measures or legislative actions. BAU forecasts were estimated for 2025, 2030, 2035, 2040, and 2045. The BAU GHG emissions projections were calculated based on the guidance of the Association of Environmental Professionals 2012 whitepaper Forecasting Communitywide GHG Emissions and Setting Reduction Targets. To develop a GHG emissions forecast, the appropriate "growth metrics" (e.g., population, housing, and employment projections) are multiplied by BAU "growth indicators", which represent a baseline metric developed from the baseline GHG emissions inventory. This allows for projections of activity data that can be converted into GHG emissions estimates using specific GHG emissions factors, which is assumed to be the same in the future as in the 2019 GHG emissions inventory. The result is a BAU forecast in which GHG emissions change with time in relation to demographics, with the assumption that GHG emissions rates and activity data will continue in the future as they did in 2018, the year of the most recent GHG emissions inventory. This methodology is used for all GHG emissions sectors and sources included in the 2019 GHG emissions inventory, with the exception of on-road and off-road transportation emissions. To forecast off-road emissions, the OFFROAD 2021 model was used to project fuel use since no significant GHG emission reduction legislation is included in the model. The following provides an overview of the growth metrics, growth indicators, and GHG emissions factors used to project GHG emissions for the BAU forecast calculations.

Growth Metrics

GHG emissions are largely driven by consumption of fuel and energy, and generation of solid waste and wastewater by residents, households, and employees in a jurisdiction. As such, as population and employment grow over time, it is expected that without changes to behaviors, policies, or technologies, GHG emissions will also grow. In a BAU forecast, this growth is assumed to be the primary metric for determining changes in future GHG emissions. For the City of Santa Barbara planning area, the growth and demographic projections used as the growth metrics for the BAU GHG emissions forecast were drawn from the Santa Barbara Housing Element Update currently being drafted. Demographic projections were approved by the City for use in forecasting. Table 14 provides an overview of the growth metrics used to project GHG emissions for the BAU forecast calculations.

Table 14 Growth Metrics for City of Santa Barbara BAU GHG Emissions Forecast

Demographic	2019	2025	2030	2035	2040	2045
Population	87,670	92,561	96,637	100,713	102,023	102,431
Jobs	76,772	79,058	80,963	82,867	85,154	87,333
Housing	37,263	39,445	41,263	43,082	43,278	43,476
Service Population	164,442	171,619	177,600	183,581	187,177	189,764

Notes: Service Population = Population + Employment

Growth Indicators

Growth indicators were developed from the baseline 2019 GHG emissions inventory by dividing the activity data for each emissions source by the appropriate metric for the year 2019. The appropriate metric used for each growth indicator is developed based on the relevance of the GHG emissions source. For example, residential energy consumption would be expected to grow with the number of new households, commercial energy consumption would be expected to grow with the number of new jobs, and total solid waste generation would be expected to grow with both residents and employment (service population). Table 15 provides the metrics that were associated with each GHG emissions sector to develop growth indicators and project GHG emissions from each GHG emissions source in the respective sectors.

Table 15 Growth Metrics and Associated GHG Emissions Sectors

GHG Emissions Sector	GHG Emission Source	Associated Growth Metric	Growth Metric Data Source
Natural Gas	Residential GHG Emissions Sources	Households	Housing Element Update
	Non-Residential GHG Emissions Sources	Employment	
Electricity	Residential GHG Emissions Sources	Households	Housing Element Update
	Non-Residential GHG Emissions Sources	Employment	
Transportation	All GHG Emission Sources	Service Population	Housing Element Update
Water	All GHG Emissions Sources	Service Population	Housing Element Update
Wastewater	All GHG Emissions Sources	Population	Housing Element Update
Solid Waste	All GHG Emissions Sources	Service Population	Housing Element Update

The growth indicators for Santa Barbara are provided in Table 16 for each GHG emissions source excluding on-road VMT and off-road fuel consumption, which were modeled separately. The growth indicators are described in more detail below.

Table 16 Growth Indicators for BAU GHG Emissions Forecast

GHG Emissions Source	Growth Indicator	Units
Natural Gas		
Residential Natural Gas	322.65	Therms/Household
Nonresidential Natural Gas	100.03	Therms/Employment
Natural Gas Leakage	3.37	Therms/Service Population
Electricity		
Residential Electricity	4,016.38	kWh/Household
Non-Residential Electricity	3,974.24	kWh/Employment
Transportation		
Passenger On-Road	NA	Iteris Model
Commercial On-Road	NA	Iteris Model
Bus On-Road	NA	Iteris Model
Off Road - Diesel	NA	OFFROAD2021 Model
Off Road - Gasoline	NA	OFFROAD2021 Model
Off Road - Natural Gas (LPG)	NA	OFFROAD2021 Model
Water		
Indirect Electricity from Imported Water Delivery	0.00268	AF/Service Population
Wastewater		
Direct Emissions	0.009	MT CO2e/Service Population
Solid Waste		
Solid Waste Generation	0.99	Tons of Waste/Service Population

Notes: NA = not applicable; MT CO_2e = metric ton carbon dioxide equivalent; kWh = kilowatt-hour; MG = million gallons

On-Road Activity Data

Activity data for on-road GHG emissions forecast was modeled separately from the above growth metrics and growth indicators, using the SBCAG travel demand model utilized by Iteris. The model used a baseline year of 2020 and a build out year of 2035, as such VMT for years beyond 2035 were estimated based on the SCAG Regional Growth Forecast 2050. VMT data was allocated based on whether the entirety of a trip took place within the City of Santa Barbara jurisdictional area, started or ended within the City boundary, or started and ended outside of the City boundary. 100 percent of daily trips completely within the jurisdiction, 50 percent of partially-within trips, and 0 percent of outside trips were allocated to the City of Santa Barbara. See the above section *On-Road* for the detailed VMT methodology. Daily VMT data was annualized using the annualization factor of 347, described in the EMFAC2021 documentation. EV penetration percent was obtained from EMFAC2021 and applied to the total City VMT to determine VMT associated with EVs. For the BAU forecast, EV penetration, electricity emission factors, and mobile emission factors by vehicle category remain the same as in 2019. The results for passenger, commercial, and bus VMT and electricity usage for EVs are summarized in Table 17.

Table 17 City of Santa Barbara BAU GHG Emissions Forecast On-Road VMT

Growth Metric	2019	2025	2030	2035	2040	2045
Passenger VMT[1]	707,588,271	777,649,770	841,131,670	904,613,570	968,095,471	1,031,577,371
Commercial VMT[1]	8,317,761	8,596,077	8,797,048	8,998,020	9,198,992	9,399,964
Bus VMT[1]	5,641,017	5,447,950	5,458,892	5,448,533	5,351,029	5,213,838
Passenger EF ($MTCO_2e$/mile)[2]	0.000362	0.000362	0.000362	0.000362	0.000362	0.000362
Commercial EF ($MTCO_2e$/mile)[2]	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120
Bus EF ($MTCO_2e$/mile)[2]	0.00135	0.00135	0.00135	0.00135	0.00135	0.00135
% Passenger EV Penetration[2]	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
% Commercial EV Penetration[2]	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Bus EV Penetration[2]	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Passenger EV VMT	8,293,608	9,114,795	9,858,864	10,602,932	11,347,000	12,091,068
Commercial EV VMT	0	0	0	0	0	0
Bus EV Penetration	36,413	35,167	35,238	35,171	34,542	33,656
Passenger Fuel Efficiency (kWh/mile)[2]	0.359	0.359	0.359	0.359	0.359	0.359
Commercial Fuel Efficiency (kWh/mile)[2]	NA	NA	NA	NA	NA	NA
Bus Fuel Efficiency (kWh/mile)[2]	1.834	1.834	1.834	1.834	1.834	1.834
Passenger kWh	2,980,859	3,276,007	3,543,437	3,810,867	4,078,298	4,345,728
Commercial kWh	0	0	0	0	0	0
Bus kWh	66,766	64,481	64,611	64,488	63,334	61,710

1. Provided by Iteris travel demand model based on Santa Barbara Housing Element Update
2. Derived from EMFAC2021 for Santa Barbara County. Vehicle categories include the following vehicle types: Passenger (LDA, LDT1, LDT2, MCY, MDV, MH); Commercial (LHDT1, LHDT2, MHDT, HHDT); Buses (OBUS, SBUS, UBUS).

Off-Road Activity Data

Activity data for off-road GHG emissions forecast was modeled separately from the above growth metrics and growth indicators, using the outputs from the CARB web based OFFROAD2021 model. The OFFROAD2021 database was queried for Santa Barbara County for the forecast years to obtain fuel consumption for gasoline, diesel, and natural gas. The inclusion of specific equipment sectors from the database query was determined based on their relevance to activities occurring within the City of Santa Barbara. As with the inventory, the following equipment sectors were included:

- Agricultural
- Airport Ground Support
- Commercial Harbor Craft
- Construction and Mining
- Industrial
- Lawn and Garden

- Light Commercial
- Pleasure Craft
- Portable Equipment
- Transportation Refrigeration Unit
- Recreational Equipment

The results of the OFFROAD2021 database query were summarized for all equipment sectors in Santa Barbara County. The City of Santa Barbara was allocated a percentage of county fuel consumption for each sector relative to the City's proportion of jobs or population in the county. The results are summarized in Table 18. Off-road equipment powered by electricity is not included in this estimate to avoid double-counting with the electricity sector.

Table 18 City of Santa Barbara BAU GHG Emissions Forecast Off-Road Fuel Consumption

Off-road Fuel Category	2025	2030	2035	2040	2045
Diesel	2,642,471	2,707,729	2,798,265	2,894,249	2,997,421
Gasoline	1,785,982	1,866,281	1,946,720	2,026,576	2,107,581
Natural Gas	403,763	399,675	400,051	397,989	397,989

Notes: All values are of the unit gallons of fuel

Data Source: California Air Resources Board. 2021. OFFROAD2021 v1.0.2 Emissions Inventory. Available: https://arb.ca.gov/emfac/emissions-inventory/b3e3139ff7a2304c48acb2a0684ab41b38c5c26e. Accessed March 25, 2022.

Emissions Factors

The BAU GHG emissions forecast is representative of a scenario where community activities are generally similar to that of the baseline 2019 GHG emissions inventory. As such, BAU activity data growth is multiplied by the emissions factors used to calculate GHG emissions from the 2019 GHG emissions inventory to generate an estimate of future GHG emissions without influence from GHG reduction policies at the State or local level. The BAU GHG emissions factors for the relevant GHG emissions sources and sectors are provided in

Table 19, reported in MT CO_2e.

Table 19 BAU GHG Emissions Factors

GHG Emissions Source	GHG Emissions Factor	Units
Energy		
Natural Gas	0.00531	MT CO_2e/Therm
Natural Gas Leakage	0.05307	MT CO_2e/Therm
SCE Electricity and T&D	0.00024	MT CO_2e/kWh
Transportation		
Passenger On-Road[1]	0.00036	MT CO_2e/VMT
Commercial On-Road[1]	0.00120	MT CO_2e/VMT
Bus On-Road[1]	0.00135	MT CO_2e/VMT
Off Road - Diesel	0.0104	MT CO_2e/Gallons
Off Road - Gasoline	0.0091	MT CO_2e/Gallons
Off Road - Natural Gas (LPG)	0.0059	MT CO_2e/Gallons

GHG Emissions Source	GHG Emissions Factor	Units
Water		
Imported Water	0.00021	MT CO_2e/kWh
Wastewater		
Wastewater Treatment[2]	0.009	MT CO_2e/Service Population
Solid Waste		
Solid Waste Generation	0.324	MT CO_2e/Tons Landfilled

1. On-road passenger, commercial, and bus VMT in the 2019 inventory does not differentiate EV vs internal combustion engine vehicles, as such the emission factor is for all VMT. Electricity associated with EV charging is captured in the building energy sector.

2. It is assumed that the WWTP and septic system distribution in the population will remain consistent over time and that treatment conditions will not change.

BAU GHG Emissions Forecast Results

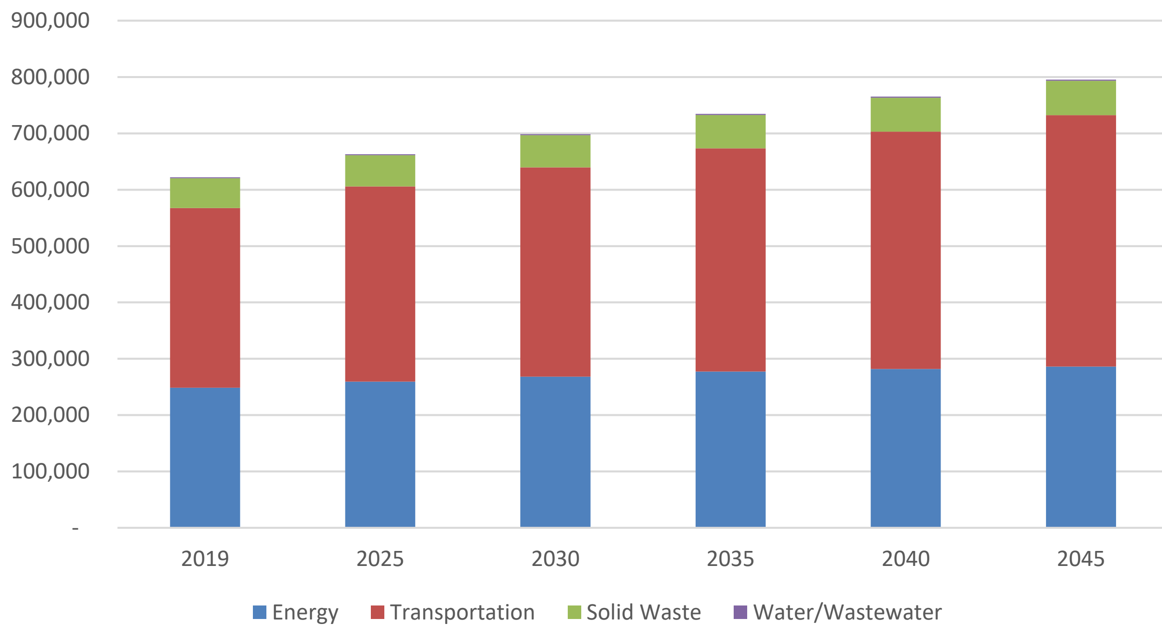
The following provides a summary of the results of the BAU GHG emissions forecast for each source in the City of Santa Barbara. The results have been reported in MT CO_2e. The BAU forecast projects a increase in GHG emissions above the baseline 2019 GHG emissions inventory from all sectors due to projected population growth. Table 20 and Figure 2 provide a summary of the Santa Barbara BAU GHG emissions forecast.

Table 20 City of Santa Barbara BAU GHG Emissions Forecast Summary

GHG Emissions Source	2019	2025	2030	2035	2040	2045
Natural Gas						
Residential Natural Gas	63,858	67,598	70,714	73,831	74,167	74,506
Non-Residential Natural Gas	40,788	42,002	43,014	44,026	45,241	46,399
Natural Gas Leakage	29,422	30,706	31,776	32,846	33,489	33,952
Electricity						
Residential Electricity	35,529	37,580	39,284	40,989	41,115	41,242
Non-Residential Electricity	73,888	76,088	77,922	79,755	81,957	84,055
Electric Vehicle Charging	738	809	874	939	1,003	1,068
T&D Electricity Losses	5,287	5,495	5,668	5,841	5,956	6,066
Transportation						
Passenger On-Road Transportation	256,408	281,796	304,800	327,804	350,808	373,811
Commercial On-Road Transportation	10,000	10,335	10,576	10,818	11,059	11,301
Bus On-Road Transportation	7,591	7,331	7,346	7,332	7,201	7,016
Off Road – Transportation and Equipment	43,967	46,225	47,616	49,294	51,009	52,815
Water						
Water Delivery	229	239	247	256	261	264
Wastewater						
Wastewater Treatment	1,429	1,491	1,543	1,595	1,626	1,649
Solid Waste						
Solid Waste Generation	52,977	55,289	57,216	59,142	60,301	61,134
Total	**622,110**	**662,984**	**698,596**	**734,467**	**765,193**	**795,278**

Notes: Values in this table may not add up to totals due to rounding. All values are of the unit metric tons of carbon dioxide equivalent (MT CO_2e)

Figure 2 City of Santa Barbara BAU GHG Emissions Forecast (MT CO_2e) through 2045



Adjusted GHG Emissions Forecasts

The Legislative Adjusted Forecast and the SBCE Adjusted Forecast accounts for GHG emissions reductions that can be reasonably expected from State legislation and regulations. The SBCE Adjusted Forecast additionally accounts for the GHG emissions reductions anticipated based on the city's residents receiving carbon-free electricity through SBCE that began serving the City of Santa Barbara in 2021. The following section describes the State legislation and regulations that are expected to reduce the City of Santa Barbara's future GHG emissions.

GHG Reduction Legislation Included in City of Santa Barbara Forecasts

Several federal and State regulations have been enacted that would reduce the City of Santa Barbara's GHG emissions in 2025, 2030, 2035, 2040, and 2045. The impact of these regulations was quantified and incorporated into an Adjusted Forecasts to provide a more accurate depiction of future GHG emissions growth and the responsibility of GHG emissions reduction for City of Santa Barbara beyond established State regulations and enrollment in SBCE. The State legislation included in the Adjusted Forecasts 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 section, as well as a description of specific legislation excluded from the analysis. The following State legislation were applied to the Adjusted Forecasts based on the unique sectors within the City of Santa Barbara:

- **2019 Title 24 Building Energy Efficiency Standards:** The California Code of Regulations Title 24, Part 6: California's Energy Efficiency Standards for Residential and Nonresidential Buildings, was first adopted in 1978 in response to a legislative mandate to reduce California's energy consumption, 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. The 2019 Title 24 Energy Efficiency Standards have come into effect, creating significantly more efficient new building stock. Starting in 2020, new residential developments must include on-site solar generation and near-zero net energy use.

- **Renewable Portfolio Standard and Senate Bill 100:** Established in 2002 under Senate Bill 1078, enhanced in 2015 by Senate Bill 350, and accelerated in 2018 under Senate Bill 100, California's Renewables Portfolio Standard (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.
- **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, and Phase 2 Federal GHG Standards. Additional reductions were calculated for the newly promulgated Innovative Clean Transit (ICT) regulations from CARB. 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.[23] 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 combining the control of smog, soot-causing pollutants, and GHG emissions into a single coordinated package of requirements for passenger cars and light trucks for 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 into a single coordinated package of requirements for model years 2017 to 2025. The new standards are anticipated to reduce GHG emissions by 34 percent in 2025.[24] Public transit GHG emissions will also 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.[25]

The following State legislation was not included in the emissions forecast calculations:

- **Assembly Bill 939 and 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 (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, AB 939 has not been included as part of the adjusted forecast and instead measures addressing compliance with AB 939 will be included in the CAP Update.

[23] CARB. Clean Car Standards – Pavley, Assembly Bill 1493. May 2013. http://www.arb.ca.gov/cc/ccms/ccms.htm
[24] CARB. Facts About the Advanced Clean Cars Program. December 2011. http://www.arb.ca.gov/msprog/zevprog/factsheets/advanced_clean_cars_eng.pdf
[25] 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

- **Senate Bill 1383:** In 2016, SB 1383 established a methane emission reduction target for short-lived climate pollutants (SLCP) in various sectors of the economy. 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 (CalRecycle 2019). Additionally, SB 1383 requires a 20 percent reduction in "current" edible food disposal by 2025. Although SB 1383 has been signed into law, compliance at the jurisdiction-level is un-proven. For example, Santa Clara County, in their SB 1383 Rulemaking Overview presentation (June 20, 2018),[26] suggest that the 75 percent reduction in organics is not likely achievable under the current structure; standardized bin colors are impractical; and the general requirement is too prescriptive. As such, SB 1383 has not been included as part of the adjusted forecast. Instead measures addressing compliance with SB 1383 will be included and quantified through GHG reduction measures in the CAP Update.

Table 21 summarizes the legislation that was applied to each sector in the adjusted forecast.

Table 21 City of Santa Barbara Legislative Adjusted GHG Emissions Forecast Sectors and Applicable Legislation

GHG Emissions Sector	GHG Emissions Source	
Natural Gas	Residential Natural Gas Consumption	Title 24 – applied to new buildings
	Non-Residential Natural Gas Consumption	Title 24 – applied to new buildings[1]
Electricity[1]	Residential Electricity Consumption	Title 24 – applied to new buildings SB 100 – all electricity use
	Non-Residential Electricity Consumption	Title 24 – applied to new buildings SB 100 – all electricity use
Transportation	Passenger On-Road Transportation	Transportation Legislation (Advanced Clean Cars Standards, Pavley Standards, Phase 2 Federal GHG Standards)
	Commercial On-Road Transportation	Transportation Legislation (Advanced Clean Cars Standards, Pavley Standards, Phase 2 Federal GHG Standards)
	Bus On-Road Transportation	Transportation Legislation (Advanced Clean Cars Standards, Pavley Standards, Phase 2 Federal GHG Standards, Innovative Clean Transit)
	Off Road - Diesel	None
	Off Road - Gasoline	None
	Off Road - Natural Gas (LPG)	None
Water	Indirect Electricity Consumption from Water Delivery	SB 100
Wastewater	Direct Wastewater Treatment Emissions	None
Solid Waste	Methane Commitment of Solid Waste Generated by Community	None

1. As detailed below, though Title 24 impacts new building it is not anticipated to have a natural gas reduction impact on non-residential buildings under the 2019 Energy Efficiency Standards.

[26] Santa Clara County. June 20, 2018. SB 1383 Rulemaking Overview. https://www.sccgov.org/sites/rwr/rwrc/Documents/SB%201383%20PowerPoint.pdf

GHG Reduction Legislation Calculations

EMFAC2021 was used to model transportation-related GHG emissions for the City of Santa Barbara forecasts. The following methodology was used to calculate energy-related GHG emissions reduction related to Title 24 and SB 100.

- **Title 24:** It is assumed that all growth in building energy consumption is from new construction. Accordingly, Title 24 GHG emissions reduction for natural gas and electricity are calculated as a percentage of the projected increase in energy consumption beyond the baseline 2019 GHG emissions inventory, under the BAU forecast. For projects implemented after January 1, 2020, the California Energy Commission (CEC) estimates that the 2019 standards will have the following energy consumption reduction impact:
    - 53 percent reduction beyond the 2019 baseline for residential electricity;
    - 30 percent reduction beyond the 2019 baseline for commercial electricity; and
    - 7 percent reduction beyond the 2019 baseline for residential natural gas.[27]
- **SB 100:** SCE and other providers such as the Community Choice Aggregation Santa Barbara Clean Energy (SBCE) that currently provide electricity in Santa Barbara are subject to SB 100 requirements. GHG emissions from electricity consumption are largely determined by the emissions factor associated with the supplied electricity. Legislative GHG emissions reductions from SB 100 are calculated as the difference between GHG emissions under the BAU forecast electricity and GHG emissions calculated using a SB 100-adjusted GHG emissions factor for a given forecast year. Adjusted GHG emission factors is calculated by scaling the current electricity GHG emissions factor with the RPS percentage for GHG-free electricity required for compliance with SB 100. Each of the electricity providers for the City of Santa Barbara has different electricity emissions factors due to different RPS percentages in their electricity delivery mix. The RPS percentages and associated GHG emissions factors used to determine the adjusted forecast electricity emissions are provided in
- Table 22. In 2021, both SBCE tiers of service already had an emission factor of 0; it was assumed that SBCE tiers would retain and emission factor of 0 through 2045. Note that while both Title 24 and SB 100 influence GHG emissions reductions in the electricity sector, double counting of these reductions is avoided by accounting for Title 24 reductions first and then accounting for reductions from SB 100.

Table 22 Electricity Provider Forecasted RPS and Electricity GHG Emissions Factors

Energy Provider	2019	2025	2030	2035	2040	2045
SCE						
Renewable Portfolio Standard Percentage	35.1%	44.1%	60.0%	90.0%	95.0%	100.0%
Adjusted Electricity Emission Factor (lbs MT CO_2e/MWh)	0.000242	0.000214	0.000153	0.000038	0.000019	-
Other Providers (SBCE)						
Adjusted Electricity Emission Factor (MT CO_2e/kWh)[1]	N/A	0.0	0.0	0.0	0.0	0.0

[1] All tiers of SBCE have a 0 MT CO2e/ kWh as shown in the power content label of SBCE therefore only one emissions factor is used throughout the forecast https://www.energy.ca.gov/filebrowser/download/4668

[27] California Energy Commission. 2018. 2019 Building Energy Efficiency Standards Frequently Asked Questions. Available: <https://www.energy.ca.gov/sites/default/files/2020-03/Title_24_2019_Building_Standards_FAQ_ada.pdf>. Accessed June 21, 2021.

The following methodology was used to calculate transportation related GHG emissions reduction related to various State legislation.

- **Transportation Legislation**: Major regulations incorporated into the CARB's 2021 transportation modeling include Advanced Clean Car Standards (LEV III, ZEV program, etc.), Innovative Clean Transit (ICT) regulation, Advanced Clean Truck (ACT) regulation, SAFE Vehicle Rules and Actions, and Federal GHG Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles. Additionally, EMFAC2021 forecasts the zero-emission vehicle market share based on consumer choice models rather than a most likely compliance scenario used in previous EMFAC versions. Passenger and commercial electric vehicle (EV) electricity consumption was calculated per forecast year based on EV penetration rates obtained from EMFAC 2021. Passenger, commercial, and bus EV emissions from electricity consumption are subtracted from residential and non-residential energy emissions, respectively, in the forecasts to avoid double counting of electricity emissions. Emissions from EV charging are a separate category in the electricity sector in the forecasts labeled as an "Electric Vehicles". The forecasted EV penetration percent and vehicle emission factors obtained from EMFAC2021 used to determine the Adjusted Forecasts on-road transportation emissions are provided in Table 23. Note that while SB 100 influences GHG emissions reduction in the on-road transportation sector from EVs, double counting of these reductions is avoided by subtracting out reductions due to SB 100 from the total transportation legislative reductions accounted for.

The forecasted annual VMT and associated GHG emissions factors used to determine the adjusted forecast on-road emissions are provided in Table 23.

Table 23 City of Santa Barbara Legislative Adjusted GHG Emissions Forecast On-Road VMT

Growth Metric	2019	2025	2030	2035	2040	2045
Passenger VMT[1]	707,588,271	777,649,770	841,131,670	904,613,570	968,095,471	1,031,577,371
Commercial VMT[1]	8,317,761	8,596,077	8,797,048	8,998,020	9,198,992	9,399,964
Bus VMT[1]	5,641,017	5,447,950	5,458,892	5,448,533	5,351,029	5,213,838
Passenger EF ($MTCO_2e$/mile)[2]	0.000362	0.000317	0.000285	0.000265	0.000254	0.000249
Commercial EF ($MTCO_2e$/mile)[2]	0.00120	0.00115	0.00105	0.00090	0.00077	0.00069
Bus EF ($MTCO_2e$/mile)[2]	0.00135	0.00127	0.00119	0.00099	0.00085	0.00064
% Passenger EV Penetration[2]	1.2%	4.6%	6.8%	8.4%	9.3%	9.7%
% Commercial EV Penetration[2]	0.0%	0.7%	6.6%	18.4%	29.3%	36.8%
% Bus EV Penetration[2]	0.6%	0.7%	3.6%	17.6%	28.5%	44.5%
Passenger EV VMT	8,293,608	35,583,332	57,453,262	76,306,124	89,953,915	99,821,246
Commercial EV VMT	0	57,768	577,831	1,653,897	2,696,704	3,454,567
Bus EV Penetration	36,413	37,915	194,725	960,964	1,526,862	2,320,259
Passenger Fuel Efficiency (kWh/mile)[2]	0.359	0.368	0.369	0.369	0.369	0.369
Commercial Fuel Efficiency (kWh/mile)[2]	NA	1.027	1.016	0.997	0.985	0.982
Bus Fuel Efficiency (kWh/mile)[2]	1.834	1.565	1.392	1.511	1.455	1.451
Passenger kWh	2,980,859	13,096,132	21,172,399	28,154,984	33,209,175	36,860,692

Growth Metric	2019	2025	2030	2035	2040	2045
Commercial kWh	-	59,326	586,834	1,649,743	2,655,245	3,390,716
Bus kWh	-	59,325	271,093	1,451,716	2,221,926	3,366,582

1. Provided by Iteris travel demand model based on Santa Barbara Housing Element Update

2. Derived from EMFAC2021 for Santa Barbara County and applied to City of Santa Barbara. Vehicle categories include the following vehicle types: Passenger (LDA, LDT1, LDT2, MCY, MDV, MH); Commercial (LHDT1, LHDT2, MHDT, HHDT); Buses (OBUS, SBUS, UBUS).

Legislative Adjusted GHG Emissions Forecast Results

Compliance with State legislation is expected to result in GHG emissions reduction from the BAU GHG Emissions Forecast in the transportation and energy sectors for residential and non-residential activities. Compliance with both the Pavley regulation, which requires automakers to control GHG emission from new passenger vehicles for the 2009 through 2016 model years, and the Advanced Clean Car Program, which combines the control of smog-causing (criteria) pollutants and GHG emissions into a single package of regulations, are expected to reduce GHG emissions from transportation. Emissions associated with heavy-duty trucks and transit buses are also anticipated to be reduced through the Advanced Clean Trucks Regulation and Innovative Clean Transit, respectively.

Compliance with Title 24 requirements are expected to reduce GHG emissions from reduced electricity and natural gas consumption in new buildings. Compliance with SB 100 requirements are expected to further reduce GHG emissions in the residential sector through reduced GHG emissions associated with electricity generation, as well as similar reductions in the commercial sector. SB 100 is also anticipated to reduced indirect electricity emissions associated with water and wastewater conveyance and treatment as well as transportation emissions as more vehicles shift to being electrically powered over traditional fuel powered vehicles. The expected legislative reductions from SB 100, Title 24, and the various transportation legislation are summarized in Table 24.

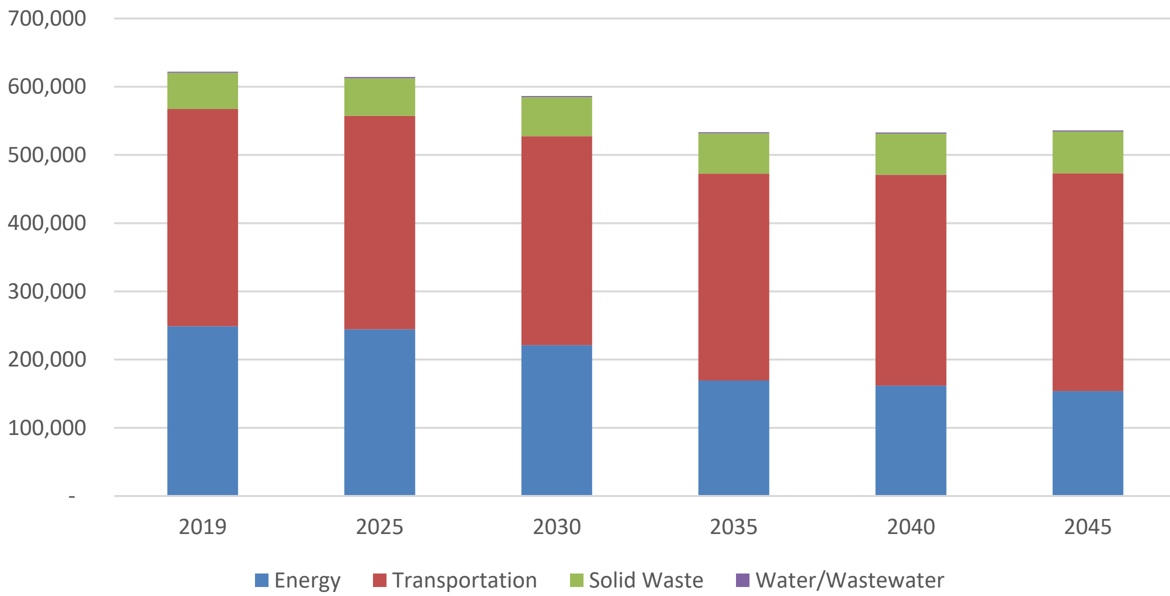
Table 24 City of Santa Barbara Legislative Adjusted GHG Emissions Forecast Detail

GHG Emissions Source	2019	2025	2030	2035	2040	2045
Natural Gas						
Residential Natural Gas	63,858	67,336	70,234	73,133	73,446	73,760
Non-Residential Natural Gas	40,788	42,002	43,014	44,026	45,241	46,399
Natural Gas Leakage	29,422	30,637	31,650	32,663	33,272	33,710
Electricity						
Residential Electricity	35,529	32,292	23,619	6,032	3,020	-
Non-Residential Electricity	73,888	66,745	48,583	12,349	6,296	-
Electric Vehicles	738	2,832	3,379	1,199	730	-
T&D Electricity Losses	5,287	5,399	4,006	1,038	533	-
Transportation						
Passenger On-Road Transportation	256,408	246,887	239,674	239,468	245,747	256,623
Commercial On-Road Transportation	9,698	9,902	9,213	8,055	7,089	6,486
Bus On-Road Transportation	7,591	6,926	6,509	5,386	4,522	3,329
Off Road – Transportation and Equipment	43,967	46,225	47,616	49,294	51,009	52,815
Water						
Imported Water Delivery	229	214	163	42	22	-
Wastewater						
Wastewater Treatment	1,429	1,491	1,543	1,595	1,626	1,649
Solid Waste						
Solid Waste Generation	52,977	55,289	57,216	59,142	60,301	61,134
Total	**622,110**	**614,180**	**586,420**	**533,421**	**532,854**	**535,905**

Notes: Values in this table may not add up to totals due to rounding. All values are of the unit metric tons of carbon dioxide equivalent (MT CO_2e)

Figure 3 presents the GHG emissions trends in terms of MT CO_2e for the Legislative Adjusted forecast. The Legislative Adjusted forecast emissions trend downward over time through 2045.

Figure 3 City of Santa Barbara Legislative Adjusted GHG Emissions Forecast (MT CO_2e) through 2045



SBCE Adjusted GHG Emissions Forecast Results

In addition to the State legislation expected to reduce GHG emissions in the City of Santa Barbara, the City also began receiving carbon-free electricity through SBCE in 2021. Both tiers offered by SBCE are carbon-free, giving an emission factor of 0 MT CO_2e/kWh.[28] Both residential and commercial customers have demonstrated an opt out rate of 5%. By receiving electricity from a carbon-free source now, the City of Santa Barbara significantly decreases their electricity emissions to near zero in the short term ahead of SB 100 requirements. The expected reductions from enrollment in SBCE in addition to the State legislation discussed previously are summarized in Table 25.

Table 25 City of Santa Barbara SBCE Adjusted GHG Emissions Forecast Detail

GHG Emissions Source	2019	2025	2030	2035	2040	2045
Natural Gas						
Residential Natural Gas	63,858	67,336	70,234	73,133	73,446	73,760
Non-Residential Natural Gas	40,788	42,002	43,014	44,026	45,241	46,399
Natural Gas Leakage	29,422	30,637	31,650	32,663	33,272	33,710
Electricity						
Residential Electricity	35,529	1,615	1,181	302	151	-
Non-Residential Electricity	73,888	3,337	2,429	617	315	-
Electric Vehicles	738	142	169	60	37	-
T&D Electricity Losses	5,287	270	200	52	27	-

[28] SBCE 2021 Power Content Label: https://www.energy.ca.gov/filebrowser/download/4668

GHG Emissions Source	2019	2025	2030	2035	2040	2045
Transportation						
Passenger On-Road Transportation	256,408	246,887	239,674	239,468	245,747	256,623
Commercial On-Road Transportation	10,000	9,902	9,213	8,055	7,089	6,486
Bus On-Road Transportation	7,591	6,926	6,509	5,386	4,522	3,329
Off Road – Transportation and Equipment	43,967	46,225	47,616	49,294	51,009	52,815
Water						
Imported Water Delivery	229	214	163	42	22	-
Wastewater						
Wastewater Treatment	1,429	1,491	1,543	1,595	1,626	1,649
Solid Waste						
Solid Waste Generation	52,977	55,289	57,216	59,142	60,301	61,134
Total	**622,110**	**512,274**	**510,812**	**513,835**	**522,803**	**535,905**

Notes: Values in this table may not add up to totals due to rounding. All values are of the unit metric tons of carbon dioxide equivalent (MT CO_2e)

Figure 4 presents the GHG emissions trends in terms of MT CO_2e for the SBCE Adjusted Forecast. Emissions drops quickly in 2025 due to the carbon free electricity received from SBCE. The impact from SBCE becomes less pronounced as time moves towards 2045 when all electricity is required to be carbon-free per SB 100. By 2045, both the SBCE Adjusted and Legislative Adjusted forecasts converge.

Figure 4 City of Santa Barbara SBCE Adjusted GHG Emissions Forecast (MT CO_2e) through 2045

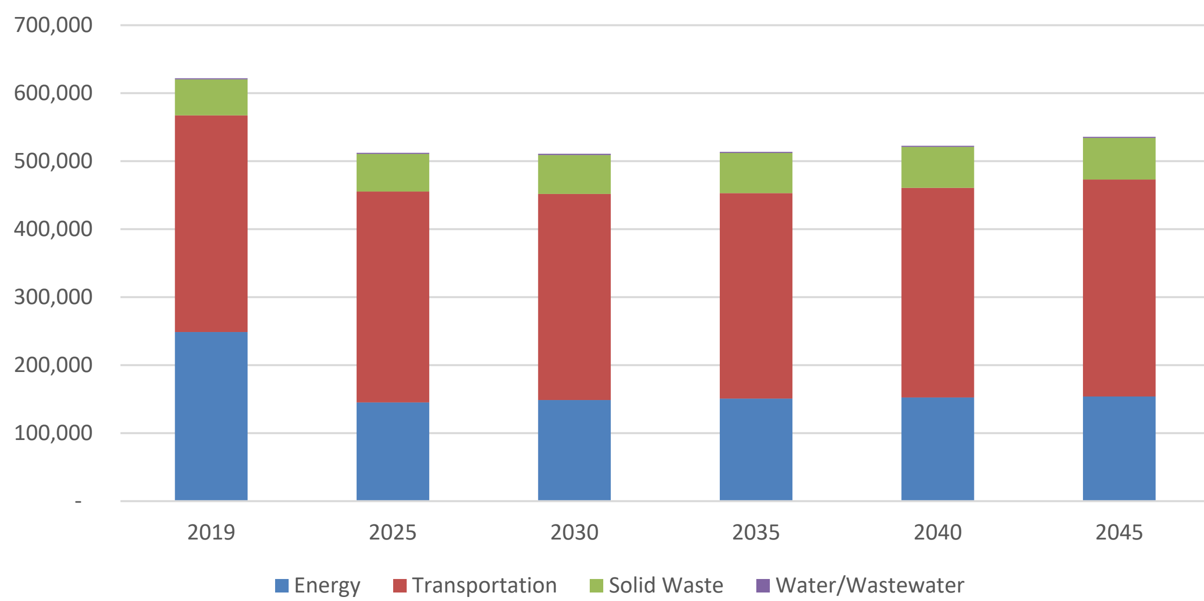


Table 26 provides the results summary of the GHG emissions forecast for the City of Santa Barbara, including the BAU Forecast, the Legislative Adjusted Forecast, the SBCE Adjusted (State Legislation and SBCE) Forecast, and the reductions expected from individual legislation and SBCE.

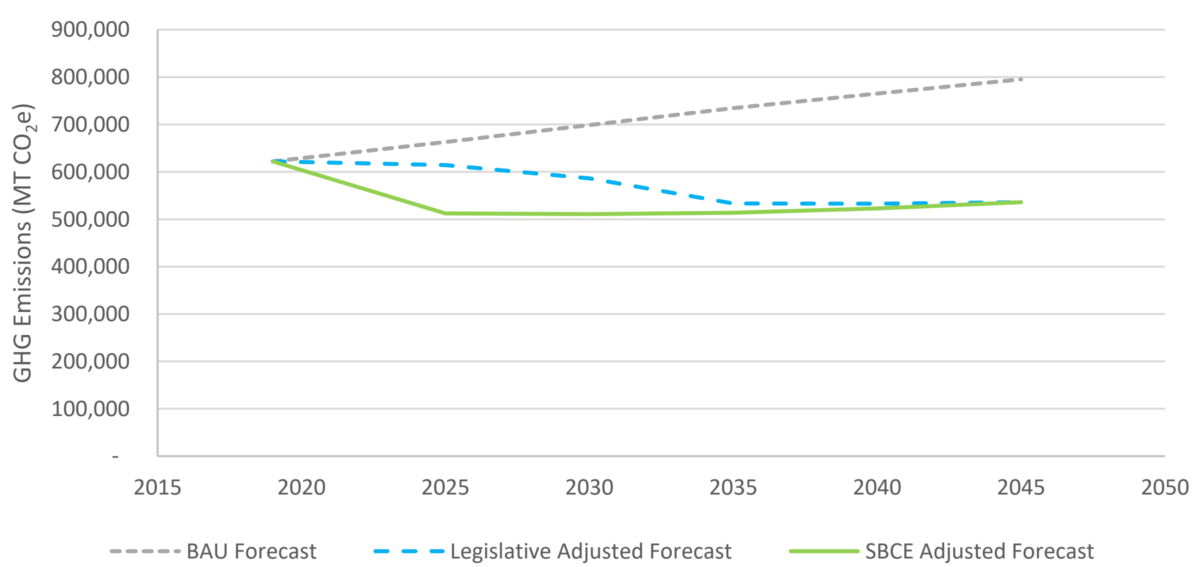
Table 26 City of Santa Barbara GHG Emissions Forecast Results Summary

	2019	2025	2030	2035	2040	2045
Business-As-Usual Forecast	622,110	662,984	698,596	734,467	765,193	795,278
SB 100 Reductions	-	-13,403	-45,567	-109,193	-122,667	-136,278
Title 24 Reductions	-	-2,047	-3,746	-5,440	-6,184	-6,902
Transportation Reductions	-	-33,354	-62,863	-86,412	-103,488	-116,193
Legislative Adjusted Forecast	622,110	614,180	586,420	533,421	532,854	535,905
SBCE Reductions	-	-101,906	-75,608	-19,586	-10,051	-
SBCE Adjusted Forecast	622,110	512,274	510,812	513,835	522,803	535,905
Percent Reduction in GHG Emissions from Legislation and SBCE	-	23%	27%	30%	32%	33%

SBCE= Santa Barbara Clean Energy

Figure 5 provides a visual representation of present and future GHG emissions, with the impacts of State legislation and SBCE.

Figure 5 GHG Emissions Forecasts



City of Santa Barbara GHG Emissions Targets

GHG reduction targets are used in CAPs to establish measurable metrics intended to guide the community's commitment to achieve GHG emissions reduction and help gauge progress with 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. The CARB 2022 Scoping Plan recommends that local agencies provide their fair share GHG reduction to achieve the States goals. Thus, local agencies are recommended to establish at a minimum, equivalent reduction targets at the local level by establishing community wide GHG reduction goals for climate action that will help California achieve its 2030 and 2045 GHG emissions goals.

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 2022 Scoping Plan Update, California recommended using efficiency metrics for local targets to incentivize growth in a coordinated manner and not penalize cities which are growing at significant rates.[29]

Back-cast to 1990 Emission Levels

State climate legislation compares emissions reduction targets to a 1990 baseline. However, the City of Santa Barbara does not have a 1990 GHG inventory, and the targets developed by the City in the 2012 CAP were instead compared to a 2005-2008 baseline following guidance in the California Air Resources Board's 2008 Climate Change Scoping Plan which estimates 1990 emissions (also the 2020 target) as 15% below "current" (2005-2008) emissions.[30] However, as previously discussed herein and in the *GHG Inventory Consistency and Data Evaluation Memorandum* the historical inventories were prepared following the GPC protocol. To better align with the state inventory, the 2019 inventory was prepared following ICLEI's Community Protocol. As the methodology used to develop the 2019 inventory and future inventories is different from the baseline inventory year previously used to set the 2020 target for the 2012 CAP, it is not appropriate to continue to use the established targets or baseline emissions. As such, the 2019 inventory has been established as the new baseline moving forward and emission levels are back-casted from this baseline to 1990 levels. It is assumed that the City's emissions for the 2019 inventory year and the State's emissions for that same year have increased or decreased approximately the same percentage relative to 1990. The percent change in the State's emissions in the 2019 inventory year compared with 1990 levels has been applied to the City's 2019 inventory to estimate the 1990 levels to be used for target setting.

Table 27 details the State's emissions in 2019 and 1990 for emission sectors relevant (i.e., electric power, transportation, commercial, residential, recycling/waste) to the City of Santa Barbara and the percent change applied to the 2019 baseline inventory to back-cast to 1990 level for the City of Santa Barbara.

[29] California Air Resources Board. 2022. California's Climate Change Scoping Plan,
[30] Governor's Office of Planning and Research (OPR). 2017. General Plan Guidelines. Ch 8 Climate Change. p. 228. https://opr.ca.gov/docs/OPR_C8_final.pdf.

Table 27 1990 GHG Emissions Back-cast

Emissions	Total
State of CA 1990 Emissions (MMT CO_2e)	313
State of CA 2019 Emissions (MMT CO_2e)	272
Percent Difference (%)	15.0%
2019 City of Santa Barbara Emissions (MT CO_2e)	622,110
1990 City of Santa Barbara Emissions (MT CO_2e)	**715,530**

City of Santa Barbara GHG Emissions Targets for 2030 and 2045

As the State is continuously setting new GHG emission targets, this allows the City to choose a variety of GHG emission targets to include in their CAP Update. These targets include:

- State-mandated target for a CEQA qualified Climate Action Plan (SB 32 Minimum Target)
  - Senate Bill (SB) 32/Senate Bill (1279) – 40% below 1990 emissions level by 2030, carbon neutrality by 2045. The State-mandated target (or SB 32 minimum) requires a clear plan to reach the 2030 target of 40% below 1990 levels, and a pathway toward carbon neutrality by 2045.
- Aspirational targets
  - Carbon-neutrality by 2035. This target represents the most ambitious target that the City has set for itself. This target also aligns with Governor Newsom's recent direction to CARB to explore feasibility of carbon neutrality by 2035.

With GHG emission reduction targets in place, the reduction gap that Santa Barbara will be responsible for through local action can be calculated. The CAP Update will assess the GHG emissions reduction gap based on the difference between the SBCE Adjusted GHG emissions forecast and the adopted Santa Barbara GHG reduction targets.

There are two methodologies for calculating the minimum GHG emissions reductions the City will have to monitor to stay on track for meeting their goals. The City could choose to adopt a mass emission or per capita target. Mass emission targets describe emissions in terms of total MT CO_2e without any adjustment for population growth. The 2017 California Climate Change Scoping Plan included guidance that details the methodology and benefits of developing per capita targets. The key benefit of a per capita target is that it normalizes emissions based on population growth, as the target does not become more difficult to reach if the City grows faster than projected. Per capita emissions targets are developed by dividing the emissions in each target year by the forecasted population. Mass and per capita emissions targets for each of the potential targets listed above (i.e., state-mandated SB 32 target and aspirational target) are summarized below in Table 28.

Table 28 Summary of City of Santa Barbara GHG Emission Reduction Targets and Gap Analysis

Metric	2019	2025	2030	2035	2040	2045
Mass Emissions Target and Gap						
Mass Emissions SBCE Adjusted Forecast	622,110	512,274	510,812	513,835	522,803	535,905
SB 32 Mass Emissions Target	622,110	516,951	429,318	286,212	143,106	-
Remaining Emissions Gap from State targets	-	(4,677)	81,495	227,623	379,697	535,905
2035 Carbon Neutrality Mass Emissions Target	622,110	388,819	194,409	-	-	-
Remaining Emissions Gap from 2035 Carbon Neutrality	-	123,455	316,403	513,835	522,803	535,905
Per Capita Emissions Target and Gap						
Population	87,670	92,561	96,637	100,713	102,023	102,431
Per Capita SBCE Adjusted Forecast	7.10	5.53	5.29	5.10	5.12	5.23
SB 32 Per Capita Emissions Target	7.10	5.97	5.04	3.36	1.68	-
Remaining Emissions Gap from State targets	-	(0.44)	0.25	1.74	3.44	5.23
2035 Carbon Neutrality Per Capita Emissions Target	7.10	4.44	2.22	-	-	-
Remaining Emissions Gap from 2035 Carbon Neutrality	-	1.10	3.07	5.10	5.12	5.23

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.

Figure 6 presents the gap the City of Santa Barbara will be responsible for to meet the State's SB 32 emissions reduction targets. Figure 7 presents the gap the City of Santa Barbara will be responsible for to meet the aspirational target of carbon neutrality by 2035. The targets are shown as mass emissions and as efficiency targets converted to mass emissions.

Figure 6 GHG Emissions Gap Analysis for SB 32 Targets

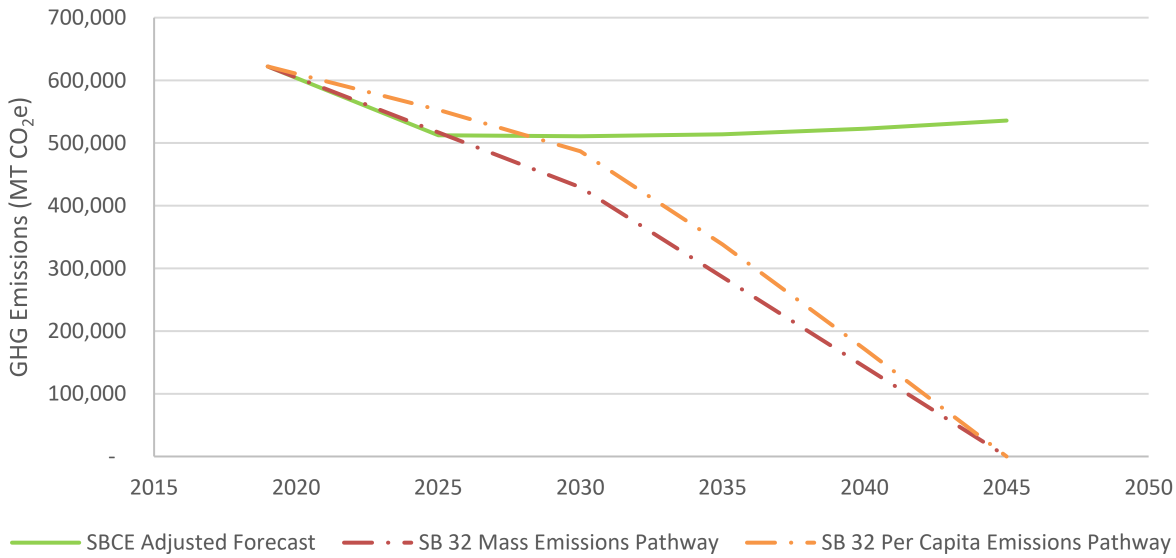
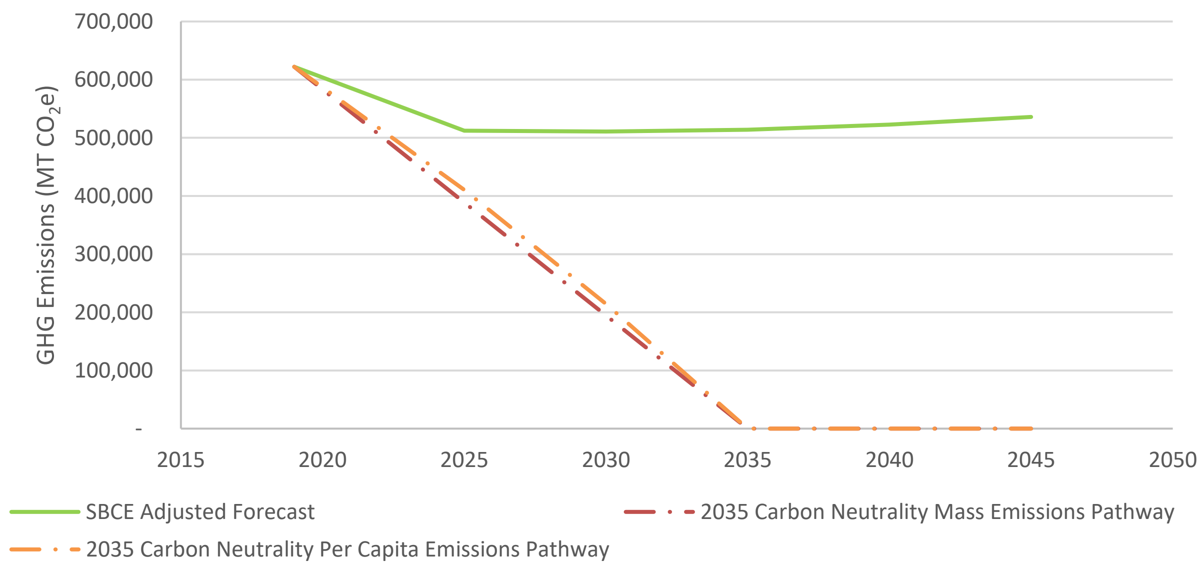


Figure 7 GHG Emissions Gap Analysis for 2035 Carbon Neutrality Targets



Plan to Meet the Targets

The 2030 and 2045 targets identified above would be achieved through a combination of existing California measures and implementation of local measures identified in the City of Santa Barbara CAP Update. 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 (CAPCOA), the Office of Planning and Research, CARB's 2022 Scoping Plan, and Association of Environmental Professionals (AEP). Measures will vetted by City staff, stakeholders, and the community and will be quantified to identify their overall contribution to meeting the City's 2030 and 2045 GHG reduction targets in the City of Santa Barbara CAP Update.