Climate Action Plan Update

GHG Emissions Reductions Technical Evidence

prepared by

City of Santa Barbara
Sustainability & Resilience Department
801 Garden Street, Suite 200
Santa Barbara, California 93101
Contact: Jefferson Litten, Energy & Climate Manager

prepared with the assistance of

Rincon Consultants, Inc.
319 East Carrillo Street, Suite 105
Santa Barbara, California 93103

May 6, 2024

RINCON CONSULTANTS, INC.
Environmental Scientists | Planners | Engineers
rinconconsultants.com

Table of Contents

Tables

Figures

1 Introduction

This report presents the technical quantification and evidence supporting the greenhouse gas (GHG) emissions reduction potential of the City of Santa Barbara's Climate Action Plan (CAP) Update.

Section 15183.5(b)(1) of the California Environmental Quality Act (CEQA) guidelines establishes several criteria which a CAP must meet to be considered a "qualified GHG reduction plan" and allow for programmatic CEQA streamlining of project GHG emissions. This document provides the evidence substantiating the GHG emissions reductions associated with the CAP Update measures pursuant to Subsection (D) of the statute, which states, "measures or a group of measures, including performance standards, that substantial evidence demonstrates, if implemented on a project-by-project basis, would collectively achieve the specified emissions level." Based on the substantial evidence contained in this report, the GHG emissions reductions associated with the measures in the CAP Update are sufficient to meet and exceed the City of Santa Barbara's fair share of GHG emissions consistent with the reduction target established in 2022 by Senate Bill (SB) 32 of 40% below 1990 levels by 2030 and make substantial progress towards the City's aspirational climate target of reaching carbon neutrality by 2035 (which exceeds California's carbon neutrality target established by Assembly Bill [AB] 1279).

The quantification in this report is specifically intended to illustrate a viable path to achieving the state climate action target. As required in CEQA Guidelines Section 15183.5(b)(e), mechanisms to monitor the CAP's progress toward achieving the GHG emission reductions provided in this report have been established through the CAP development process. If, based on the tracking of community GHG emissions, the City is not on track to reach the 2030 GHG reduction specified here or the City's aspirational carbon neutrality goal, the CAP as a whole or specific measures and actions will be amended and a new CAP update will be prepared that includes altered or additional measures and actions, with evidence that their implementation can achieve the City's climate action targets.

1.1 Climate Action Targets

The City of Santa Barbara's climate action target of carbon neutrality by 2035 is more aggressive than California's goals to reduce GHG emissions 40% below 1990 levels by 2030 (SB 32) and 85% below 1990 levels or net zero[1] by 2045 (AB 1279). Therefore, the City of Santa Barbara's targets align with state legislation and this document focuses on the GHG emission reductions associated with 2030 and 2035. Future CAP updates will evaluate progress made towards the 2045 time horizon.

[1] Net-zero refers to a state of carbon neutrality GHG emissions (in units of carbon dioxide equivalent, or CO2e), where a community's GHGemissions have been reduced as much as possible, and any remaining GHG emissions arising from community-level activities are offset by GHG emissions sequestration activities and technologies, such as tree planting, compost application, or industrial practices that take GHG emissions out of the atmosphere and sequester them in solid or liquid form.

1.2 Measures and Actions Organization

As part of the CAP Update process, the City of Santa Barbara has developed a comprehensive set of measures reducing community wide GHG emissions in all sectors to achieve the City's climate action targets. Each measure is supported by a set of actions that provide measurable GHG emissions reduction that is supported by substantial evidence. The City has also developed a set of measures and actions for offsetting GHG emissions through carbon sequestration. AB 1757 requires California Natural Resources Agency (CNRA) to set carbon sequestration targets by 2024 as well as methodologies to track carbon sequestration effectiveness by 2025. Consequently, carbon sequestration measures and actions have been quantified when substantial evidence is available to affirm these reductions. Measures and actions are organized according to the following hierarchy:

1. **Sectors:** Sectors define the GHG emissions category in which the GHG reductions will take place and include Building Energy, Transportation, Solid Waste, Water, and Wastewater and Carbon Sequestration.
2. **Measures:** Measures are developed under each sector pursuant to the GHG Inventory and Forecast and in line with the Community Protocol and the California Air Resources Board (CARB) 2022 Climate Change Scoping Plan:
   - Building Energy
   - Transportation
   - Solid Waste, Water, and Wastewater
   - Carbon Sequestration

   Additional measures developed for the City of Santa Barbara Climate Action Plan that are not quantified in emissions reductions include:

   - Municipal Measures (are a part of each sector)[2]
   - Community Climate Potential
   - Administrative and Implementation

   These measures are not quantified in this report because reductions would either be minor or could cause double counting of other measures and actions.

   Measures and actions can be either quantitative or supportive, defined as follows:

   - **Quantitative:** Quantitative measures and actions result in quantifiable GHG emissions reductions when implemented. GHG emissions reductions from these measures and actions are supported by case studies, scientific articles, calculations, or other third-party substantial evidence. Quantitative measures/actions can be summed to quantify how the City of Santa Barbara will meet its 2030 climate action target and demonstrate progress towards the 2045 target. GHG emissions reductions were calculated using published evidence provided through adequately controlled investigations, studies, and articles carried out by qualified experts that establish the effectiveness for the reduction measures and actions. The estimates and underlying calculations provided in this report provide the

[2] Note that the City's municipal measures as established in the CAP Update are not quantified within this document. The City's operations as demonstrations of climate action leadership, they contribute only minorly to community-level GHG emissions reductions and are a subset of the community GHG emissions. For this reason, the GHG emissions reductions expected from municipal measures were conservatively excluded from the analysis in this document and were not quantified as part of the CAP Update preparation process.

substantial evidence and a transparent approach to achieving the City's GHG emissions reduction targets.

- **Supportive:** Supportive measures and actions may also be quantifiable and have substantial evidence to support their overall contribution to GHG reduction. However, due to one of several factors – including a low GHG reduction benefit, indirect GHG reduction benefit, or potential for double-counting– they have not been quantified and do not contribute directly to the expected GHG reduction target and consistency with the state goals. Despite not being quantified, supportive measures/actions are nevertheless critical to the overall success of the CAP and provide support so that the quantitative measures and actions will be successfully implemented.

3. **GHG Reduction Metrics:** Identify specific goals (i.e., activity data targets by 2030 and 2035) to address GHG emissions in each sector. Each quantifiable measure has at least one metric to track implementation and GHG emissions reductions. Each sector may have one or more measures with associated metrics. For example, three measures and metrics may be established under the Transportation sector to address active transportation, public transportation, and single-passenger vehicles subsectors.
4. **Actions:** Actions identify the programs, policies, funding pathways, and other specific commitments that the City of Santa Barbara will implement. Each measure contains a suite of actions, which together have been designed to accomplish the measure goal and metrics.
    - **Key Strategic Themes:** The actions supporting each measure have been designed around a set of key strategic themes. Each theme emphasizes specific criteria that have been proven to play an essential role in the implementation of the measure. Because community-focused climate action often requires community-level behavioral changes and buy-in to be implementable and successful, the City must design a suite of actions that support these changes by emphasizing specific needs of the community. The key strategic themes are: Structural Change, Education, Equity, Funding, Partnerships, and Feasibility Studies. In general, the actions under a single measure should collectively address all the key themes.[3] Identification of the themes and their inclusion into the CAP helps plan for implementation. More information on the themes can be found in the CAP.

1.3 GHG Emissions Reductions

The GHG emissions reduction associated with the City of Santa Barbara CAP measures and actions have been calculated and presented in this report in terms of mass emissions (in units of MT CO_2e). Population projections are shown in Table 1 and give context to how emissions scale over time. Population growth well beyond these projections may require additional GHG reductions to achieve the City's goals.[4]

[3] The exception is for measures and actions in the municipal sector because the City has much more leverage to enact changes at a municipal level and may not need to consider each pillar to ensure success during implementation.

[4] City of Santa Barbara's climate action target of carbon neutrality by 2035 is more aggressive than California's goals to reduce GHG emissions 85% below 1990 levels or net zero by 2045 (AB 1279). Therefore, City of Santa Barbara's targets align with state legislation and this document does not include a discussion of 2045 reduction. Future CAP updates will evaluate progress made towards the 2045 time horizon.

Table 1 Population Projections for City of Santa Barbara[1]

	2019	2030	2035
Population	87,670	96,637	100,713

[1] Population estimates for 2035 were provided by traffic consultant, Iteris. RE: Santa Barbara Housing Element Update – Draft CEQA Transportation Impact Analysis Memorandum. Dated December 22,2022. The estimated 2035 population was then interpolated to get a 2019 and 2030 estimate.

A breakdown of the GHG emissions reductions calculated for each measure is included in Table 2.

Table 2 Estimated GHG Emissions Reductions by Measure

Measure Number	GHG Emissions Reduction Measures	2030 Anticipated Reduction/ Sequestration (MT CO_2e)	2035 Anticipated Reduction/ Sequestration (MT CO_2e)
Building Energy			
BE-1 (Municipal)	Decarbonize 50% of municipal buildings and facilities by 2030 and all remaining municipal facilities by 2035	Supportive	Supportive
BE-2 (Municipal)	Procure carbon free or 100% renewable electricity for municipal operations by 2030	Supportive	Supportive
BE-3 (Municipal)	Increase municipally owned distributed renewable energy generation throughout the City	Supportive	Supportive
BE-4	Expand existing natural gas prohibition ordinance for new construction	7,918	12,975
BE-5	Reduce existing residential natural gas consumption by 10% below 2019 levels by 2030 and 17% below 2019 levels by 2035	8,306	14,410
BE-6	Reduce commercial natural gas consumption 10% below 2019 levels by 2030 and 18% below 2019 levels by 2035	5,288	9,307
BE-7	Increase the impact of Santa Barbara Clean Energy (SBCE)	Supportive	Supportive
Transportation			
T-1 (Municipal)	Continue to develop and implement the municipal Transportation Demand Management (TDM) program	Supportive	Supportive
T-2 (Municipal)	Electrify or otherwise decarbonize the municipal fleet by 2035	Supportive	Supportive
T-3	Implement programs that enhance access to safe active transportation, such as walking and biking, to increase active transportation mode share to 6% by 2030 and to 10% by 2035.	952	2,757
T-4	Implement programs to encourage public transportation to increase public transportation mode share to 7% by 2030 and to 8% by 2035.	3,547	4,641
T-5	Support and promote regional programs that reduce the use of single occupancy vehicles	Supportive	Supportive
T-6	Increase zero-emission passenger vehicle use and adoption to 30% by 2030 and to 55% by 2035	53,948	107,774
T-7	Accelerate zero-emission commercial vehicle use and adoption to 26% by 2030 and 45% by 2035	1,777	2,140
T-8	Electrify or otherwise decarbonize 6% of off-road equipment by 2030 and 20% by 2035	2,857	9,859

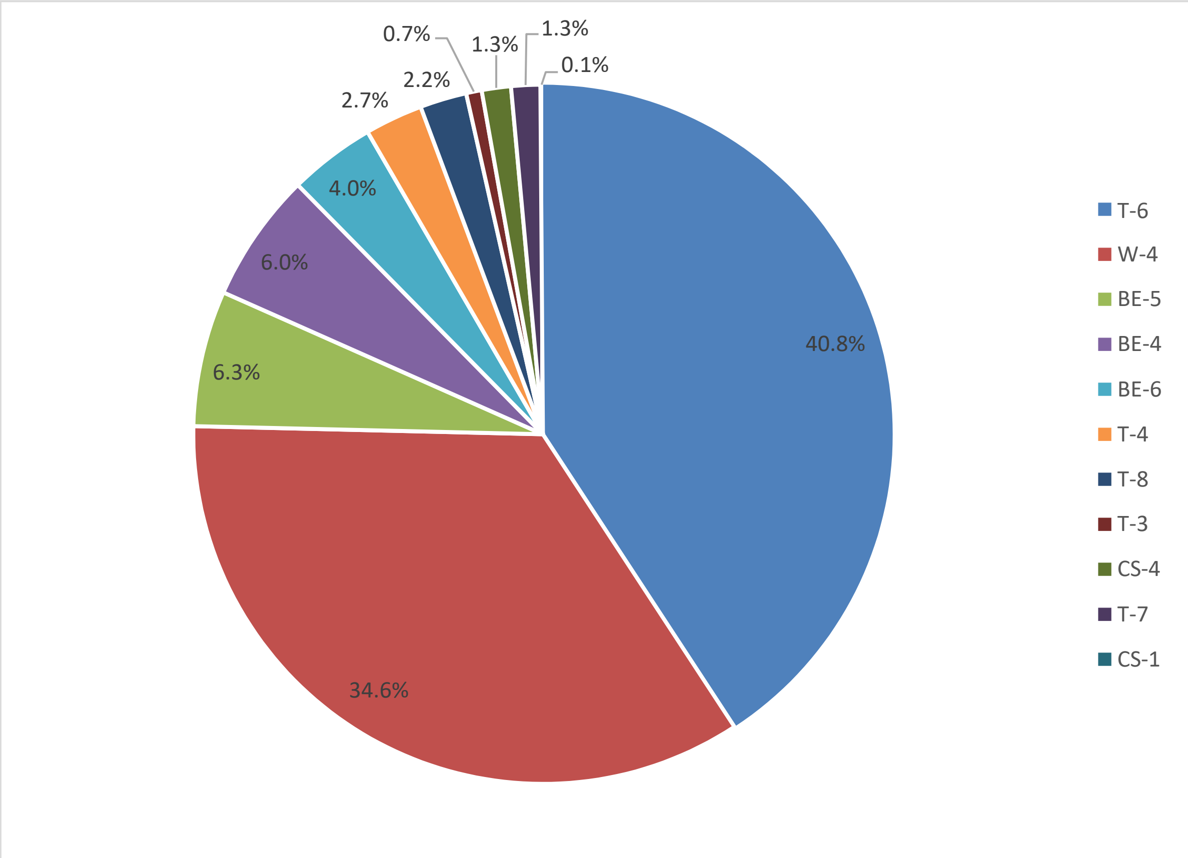
Measure Number	GHG Emissions Reduction Measures	2030 Anticipated Reduction/ Sequestration (MT CO_2e)	2035 Anticipated Reduction/ Sequestration (MT CO_2e)
Water, Solid Waste, and Wastewater			
W-1 (Municipal)	Increase municipal procurement of recovered organic waste products	Supportive	Supportive
W-2 (Municipal)	Reduce municipal water consumption	Supportive	Supportive
W-3	Reduce per capita potable water consumption 1.05% by 2030 and 1.58% by 2035	1.72	0.67
W-4[1]	Reduce organic waste 80% below 2014 levels by 2030 and 85% by 2035	45,773	50,271
Carbon Sequestration			
CS-1	Increase carbon sequestration by maintaining existing trees and natural lands and by planting 4,500 new trees throughout the community by 2030	159	159
CS-2	Explore new carbon sequestration and carbon capture opportunities	Supportive	Supportive
CS-3	Maintain and expand existing restoration projects to sequester carbon through a 25-acre net increase in restored, non-irrigated land areas by 2030	Supportive	Supportive
CS-4[2]	Increase carbon sequestration by applying 0.08 tons of compost per capita annually in the community through 2030 and 2035	1,778	1,853
CS-5	Reduce GHG emissions of residential and commercial building materials 20% by 2030 and a 40% by 2035 in line with AB 2446	Supportive	Supportive
Community Climate Potential			
CP-1	Encourage community innovation and empower the local green economy through investment in a green technology workforce	Supportive	Supportive
Administrative			
A-1 (Municipal)	Facilitate Climate Action Planning updates and supportive programming	Supportive	Supportive
A-2	Staff appropriately across sector-based programs and projects to fully source funds and implement actions	Supportive	Supportive
Total Reductions		**132,305**	**216,147**
Total Reductions (excluding ReSource Center reductions)		**87,615**	**169,936**

[1] Measure includes continued use of Santa Barbara ReSource Center that as of 2021 met SB 1383 compliance obligation of 75% diversion of organic waste. Intent of measure is to exceed SB 1383 compliance obligation.

[2] Measure includes continued use of Santa Barbara ReSource Center that as of 2021 met the 100% of the procurement target. Intent of measure is to continue to meet 100% of procurement target.

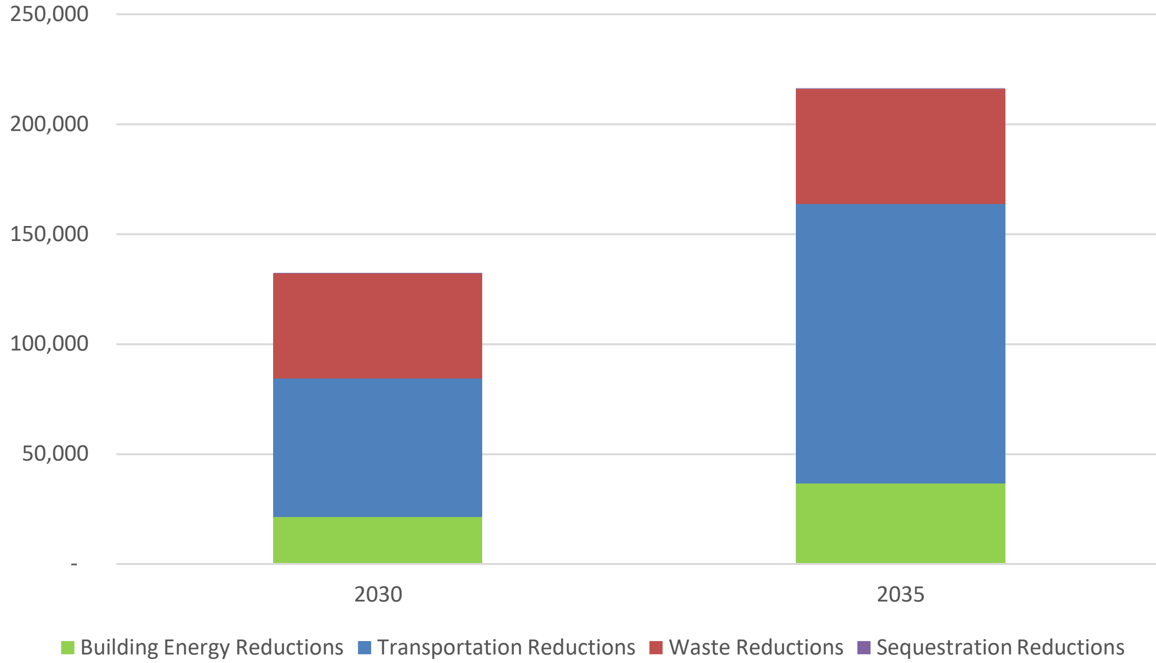
GHG emissions reductions calculated for each measure included in Table 2 is shown below in Figure 1 to visualize the contribution of each measure. As shown in Figure 1, T-6 and W-4 result in the most GHG emissions in 2030. Overall, most GHG emissions reductions come from the transportation sector followed by the waste sector, energy sector, and sequestration sector, as shown in Figure 2.

Figure 1 Estimated GHG Emissions Reduction Percentages by Measure in 2030[5]



[5] Measure W-3 Reduce per capita potable water consumption 1.05% by 2030 and 1.58% by 2035 is not included in this graph because the contribution is less than 0.00% of the total reductions.

Figure 2 Estimated GHG Emissions Reductions by Sector 2030 and 2035 (MT CO_2e)



1.4 GHG Emissions Reductions Compared to Targets

Together, the measures and actions in the CAP provide the City of Santa Barbara with the GHG reductions necessary to meet the state target of 40% below 1990 levels by 2030 (SB 32) (Table 3). However, the 2035 GHG emissions reductions quantified in this report are not yet enough to meet the City's aspirational climate action target of carbon neutrality by 2035. Achieving carbon neutrality will require significant changes to the technology and systems currently in place. The CAP aims to establish new systems that are resilient and equitable and allow for a transition to carbon neutrality in the future. This includes electrification of building and transportation systems, support for land use policies and growth policies that reduce vehicle miles traveled, increased usage of carbon neutral electricity, increased water use efficiency, and waste reduction and diversion. As these measures and actions are implemented, the City will gain more information, new technologies will emerge, and current pilot projects and programs will scale to the size needed to reach carbon neutrality. Furthermore, the state is expected to update state-level regulations and provide additional support for meeting carbon neutrality in the future. Future CAP updates past 2030 will also outline new measures and actions that the City of Santa Barbara will implement to close the remaining gap to achieve the carbon neutrality target.

1.4.1 Benefits of SBCE

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 Santa Barbara Clean Energy (SBCE) in 2021. The default electricity mix offered by SBCE is carbon-free, giving an emission factor of 0 MT CO_2e kWh.[6] Participation is extremely high; both residential and commercial customers have demonstrated an opt out rate of 5%. By receiving electricity from a carbon-free source now, the City

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

of Santa Barbara significantly decreases their electricity emissions to near zero in the short term ahead of SB 100 requirements. These expected reductions from enrollment in SBCE are included in Table 3. GHG reductions associated with switching to SBCE carbon-free energy accounts for a reduction of 75,608 MT CO_2e in 2030 and 19,586 MT CO_2e in 2035. SBCE carbon-free energy also provides the foundation needed for the electrification of buildings and vehicles which are both main pathways for GHG emission reduction in this CAP. For information see the *Santa Barbara GHG Inventory, Targets, and Forecast Memorandum.*

1.4.2 Resource Center

As of 2021, Santa Barbara's ReSource Center, a state-of-the-art waste management facility, came online to increase the community's recycling rate to above 85%, generate resources, such as green energy and compost, and dramatically lower local greenhouse gas emissions. The ReSource Center converts commercial and residential waste into resources by recovering recyclable materials, transforming organics into landscape nutrients, and creating renewable energy in the process.

Even though the ReSource Center has come online, it is still working towards the GHG emission reductions associated with meeting SB 1383 requirements, which lay out specific programs, policies, and objectives for cities to support the state's goal of a 75% reduction from 2014 levels in organics waste by 2025. Therefore, the emission reductions associated with the ReSource Center are not included in the Business-as-Usual or Legislative Adjusted Forecast provided in Table 3. The expected reductions from continued use of the ReSource Center to achieve SB 1383 compliance are included in Table 3 for informational purposes. GHG reductions associated with the ReSource Center accounts for a reduction of 44,690 MT CO_2e in 2030 and 46,210 MT CO_2e in 2035. Reductions associated with the ReSource Center organic waste diversion are included as part of Measure W-4 discussed in further detail in Section 4 *Water, Solid Waste, and Wastewater* of this report. Reductions associated with the ReSource Center procurement compliance are included as part of Measure CS-4 discussed further in detail in Section 5 *Carbon Sequestration* of this report.

1.4.3 Overall Reductions to Meet Targets

Table 3 provides the results summary of the GHG emissions forecast for the City of Santa Barbara, including the BAU Forecast and the Legislative Adjusted Forecast, as well as the reductions anticipated from continued implementation of existing local programs including SBCE and ReSource Center, and the reductions expected from implementation of the CAP measures and actions. It also provides the City of Santa Barbara's 2030 target to meet SB 32, which is consistent with developing a "qualified GHG reduction plan" by establishing a target below which GHG emissions are considered less than significant (Section 15183.5(b)(1) of the CEQA guidelines). The estimated total GHG emission reductions associated with full implementation of this plan exceeds the City's 2030 SB 32 target. However, the actions identified in this plan do not achieve the City's ambitious 2035 target for carbon neutrality. Additional actions will need to be identified over time as new legislation, technologies, and programs are put in place.

As shown in Figure 1, T-6 and W-4 result in the most GHG emissions in 2030. Consequently, implementation of Measure W-4, which includes the ReSource Center meeting SB 1383, would cause the City to achieve its SB 32 goal; however, implementation of additional measures and actions in the CAP would result in further reductions that work towards meeting the City's 2035 carbon neutrality target.

Table 3 Targets Versus GHG Emissions Reductions

Target/Forecast	2030 GHG Emissions (MT CO_2e)	2035 GHG Emissions (MT CO_2e)
Business-as-usual Forecast	698,596	734,467
GHG Emission Reductions from State Laws/Programs	(112,176)	(201,046)
State Legislative Adjusted Forecast	586,420	533,421
GHG Emission Reductions from SBCE	(75,608)	(19,586)
GHG Emission Reductions from ReSource Center[1]	(44,690)	(46,210)
GHG Emissions after implementation of State legislation, SBCE, and ReSource Center	466,122	467,625
GHG Emissions Reductions from Full Implementation of Measures (excluding ReSource Center reductions)[2]	(87,615)	(169,936)
GHG Emissions after Implementation of State Laws/Program, SBCE, ReSource Center, and remaining Measure Reductions	378,507	297,687
City of Santa Barbara Target	486,949	0.0
Target Met?	Yes	No – Additional actions will be needed to meet the aspirational 2035 target

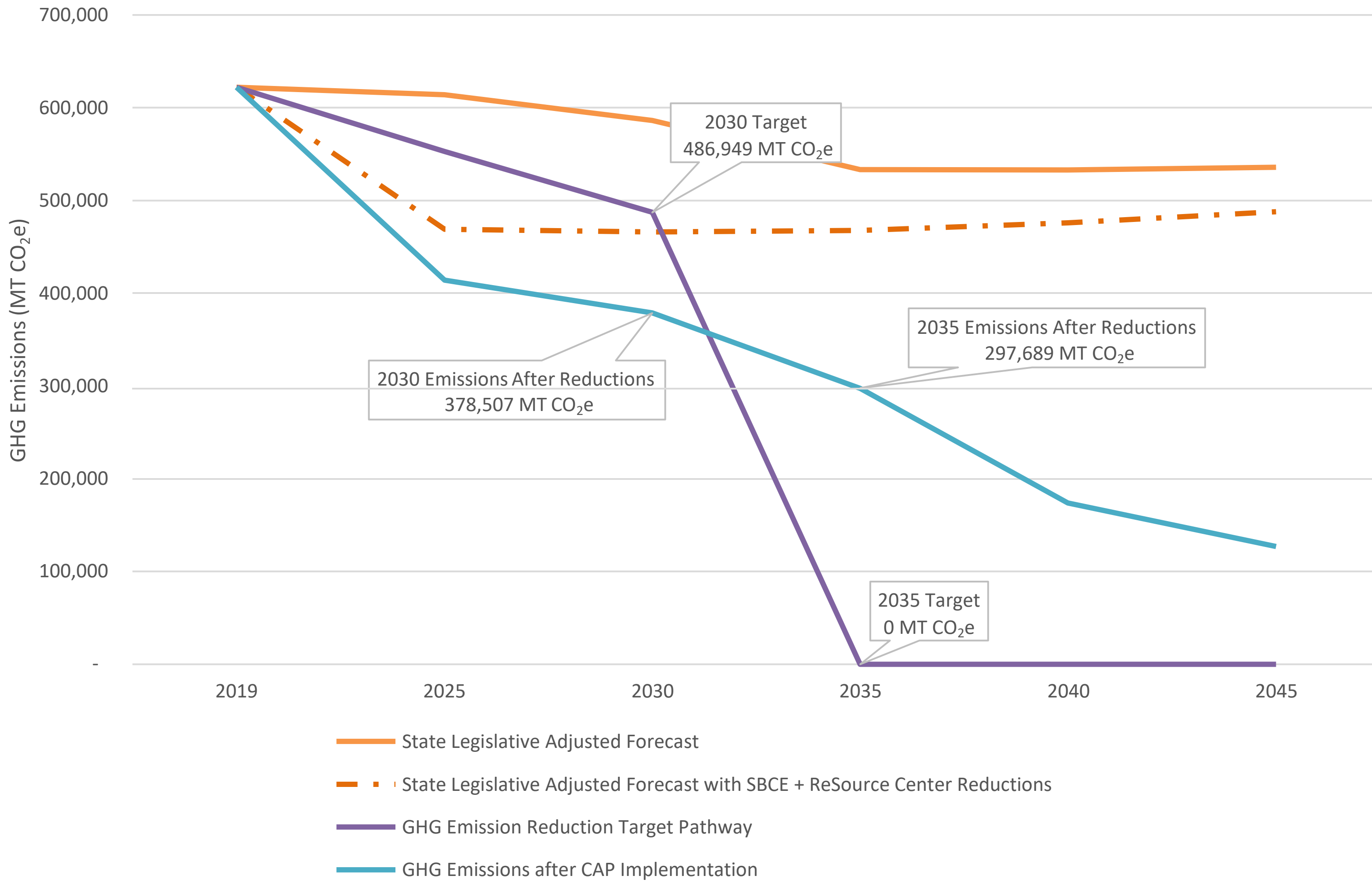
MT CO_2e = metric tons of carbon dioxide

1. The GHG reductions achieved with continued status quo operation of the ReSource Center, which is meeting SB 1383 organic diversion and procurement requirements since 2021, is separated from the rest of the Measures presented in this CAP for informational purposes.

2. Because the GHG reductions associated with the ReSource Center are presented separate from the rest of the CAP Measures in this table, only the reductions from the remaining Measures are presented herein to avoid double counting of reductions.

Figure 3 shows the climate action targets in relation to the City's GHG emissions after measure implementation. Although the actions identified in this plan do not achieve the City's ambitious 2035 target for carbon neutrality; Figure 3 shows how implementation of these actions would make substantial progress toward the 2035 target. Additional actions will need to be identified over time as new legislation, technologies, and programs are put in place. A complete description of each measure and its contributing actions is included in the remainder of the report.

Figure 3 Targets Versus GHG Emissions Reductions



2 Building Energy Measures

The Building Energy Measures are focused on reducing natural gas consumption through the electrification of the building stock. This leverages the renewable energy portfolio offered by SBCE's 100% carbon-free energy plan (100% Green)[7]. All-electric buildings are powered 100% by electricity and when coupled with renewable electricity generation, their operational energy footprint becomes GHG emissions-free. The CAPUpdate's energy measures based on this strategy are as shown in Table 4 below.

Table 4 Building Energy Measures

Measure Number	GHG Emissions Reduction Measures	Anticipated Reduction/ Sequestration (MT CO_2e)
BE-1 (Municipal)	Decarbonize 50% of municipal buildings and facilities by 2030 and all remaining municipal facilities by 2035	Supportive
BE-2 (Municipal)	Procure carbon free or 100% renewable electricity for municipal operations by 2030	Supportive
BE-3 (Municipal)	Increase municipally owned distributed renewable energy generation throughout the City	Supportive
BE-4	Expand existing natural gas prohibition ordinance for new construction	2030: 7,918 2035: 12,975
BE-5	Reduce residential natural gas consumption by 10% below 2019 levels by 2030 and 17% by 2035	2030: 8,306 2035: 14,410
BE-6	Reduce commercial natural gas consumption 10% below 2019 levels by 2030 and 18% by 2035	2030: 5,288 2035: 9,307
BE-7	Increase the impact of Santa Barbara Clean Energy (SBCE)	Supportive

These Building Energy Measures provide the framework of updated regulations, programs, funding mechanisms, education, and advocacy to drive electrification of both new and existing residential and commercial buildings. SBCE procures low or no-carbon renewable energy for the community through renewable energy portfolios that contain sources like wind and solar. Using electricity from SBCE instead of natural gas, propane, or other electricity sources to power buildings reduces the GHG emissions associated with building operations to zero or near-zero. Measure BE-7 supports the City to maintain high levels of participation in SBCE, which increases the GHG reduction potential for SBCE's renewable electricity. Santa Barbara's building stock currently relies heavily on natural gas, therefore, GHG emissions from the City's existing buildings must also be reduced to achieve the City's climate action targets.

[7] Building electrification consists of converting building appliances, such as space heaters, boilers, stoves, clothes dryers, and hot water heaters, that are currently powered by natural gas or propane to electricity as the primary energy source. This most often consists of retrofitting a building to support more electric capacity and replacing natural gas or propane appliances with electric-powered alternatives.

Measure BE-1 (Municipal) Decarbonize 50% of Municipal Buildings and Facilities by 2030 and All Remaining Municipal Facilities by 2035

Action Number	Strategic Theme	Action	Anticipated Reduction ($MT\ CO_2e$)
BE-1.1	Feasibility Study	Develop a plan to electrify 50% of City-owned municipal buildings by 2030 and decarbonize 100% of municipal facilities by 2035. The plan will include an inventory of fossil fuel-powered municipal building equipment, low/zero-carbon technologies available for replacing the equipment (where available), and a short- and long-term schedule for completion. Address diesel generators and recent natural gas investments. Address feasibility concerns around community swimming pool decarbonization. Any buildings that are unable to be electrified due to technological infeasibility should be decarbonized with other technology.	Supportive
BE-1.2	Structural Change	By 2031, develop an ordinance to require the installation of solar and energy storage backup power instead of diesel generators, where feasible.	Supportive
BE-1.3	Structural Change	Implement the municipal building decarbonization plan developed under BE-1.1 to decarbonize 100% of municipal buildings by 2035 (any buildings that are unable to be electrified due to technological infeasibility shall be decarbonized with other technology).	Supportive
BE-1.4	Structural Change	Develop and implement a plan for retrofitting all remaining streetlights, facility lighting, and traffic signals to LEDs by 2035.	Supportive
BE-1.5	Foundational, Funding	Leverage the grant writer position(s) in strategy A-2.2 to expand funding efforts for municipal decarbonization.	Supportive
BE-1.6	Structural Change	Include, at the time of lease renewal, requirements for City-owned leased buildings and facilities to be all-electric.	Supportive

Measure BE-1 involves the City leading by example and includes actions to decarbonize the buildings that are owned and operated by the City. These actions are similar to the community decarbonization actions described in Measure BE-4. This measure is not quantified because the overall GHG emission reductions from building electrification are already accounted for in the community GHG emission reduction estimate.

Measure BE-2 (Municipal) Procure Carbon Free or 100% Renewable Electricity for Municipal Operations by 2030

Action Number	Strategic Theme	Action	Anticipated Reduction ($MT\ CO_2e$)
BE-2.1	Foundational	Require all municipal electrical accounts to remain in SBCE's 100% Green option and purchase carbon-free electricity.	Supportive

Measure BE-2 involves the City leading by example and ensures that all City operations are powered by carbon free or 100% renewable electricity by 2030. This measure is not quantified because the overall GHG emission reductions from building electrification are already accounted for in the community GHG emission reduction estimate.

Measure BE-3 (Municipal) Increase Municipally Owned Distributed Renewable Energy Generation throughout the City

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
BE-3.1	Foundational, Feasibility Study	Implement all feasible microgrid projects at municipal facilities as identified by the 2017 Zero Net Energy study and re-evaluate viability of additional facilities.	Supportive
BE-3.2	Feasibility Studies	Conduct a feasibility study to understand barriers to installing additional distributed energy resources such as solar and battery storage, or other renewable energy generation infrastructure, at municipal facilities. Plan for directing resources through the City for funding, energy storage, and distributed energy resources. Direct municipal efforts to sourcing space for energy storage projects and microgrid implementation.	Supportive

Measure BE-3 involves the City leading by example to increase energy capacity and resilience through improving the microgrid and increasing battery storage. This measure is not quantified because microgrids do not inherently reduce GHG emissions. However, they do support a resilient and fully electrified City.

Measure BE-4 Expand Existing Natural Gas Prohibition Ordinance for New Construction

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
BE-4.1	Structural Change	In 2025 and every 3-years thereafter, revisit building ordinances to update the scope and exemptions to align with industry technology and maximize GHG reduction. Examples include requiring all major remodels (over 50% of building effected or an addition of over 50% of gross floor space) and removing exemptions in the all-electric building requirements. The building code cycle updates are processed in 2025, effective in 2026, and updated every 3-years.	2030: 7,918 2035: 12,975

Measure BE-4 has only one Action (BE-4.1) and involves the City updating their Natural Gas Prohibition (Municipal Code Chapter 22.110) that applies to all building permits submitted on or after January 1, 2022, and prohibits natural gas infrastructure in all newly constructed buildings. The City must actively study the Natural Gas Prohibition ordinance every 18 months and may update the ordinance periodically as needed. The ordinance consists of amendments to local health and safety municipal codes and does not amend the State Energy or Green Building Code. Other supporting actions as part of Measures BE-5, BE-6, and BE-7 (e.g., BE-5.11, BE-6.4, BE- 7.1) also ensure the City provides community resources and education on electrification to further strengthen the implementation of the Natural Gas Prohibition ordinance.

The methods and assumptions used to calculate the GHG emissions reductions associated with this metric are explained further here and shown in Table 5 below. The GHG emissions reduction benefits associated with building electrification of new construction were quantified by estimating the increase in gas use from 2021 to 2030 and 2035, based on the adjusted forecast which does not include the City's Natural Gas Prohibition to ensure there is not double counting of emission reductions. These emissions are expected to be replaced primarily with carbon-free electricity.[8] Reductions associated with Measure BE-4 and supporting actions assume no exemptions for new residential and commercial buildings even though the current Natural Gas Prohibition does allow exemptions for restaurants, clean rooms, laboratories, and projects where electrification is not feasible. We assumed Measure BE-4 will reevaluate and remove these exemptions as electrification technology is more available and consequently, we did not assume any exemptions in the reduction calculation.

Table 5 GHG Emissions Reductions from Measure BE-4

Inputs and Assumptions		
Implementation year for residential development		2022
Implementation year for commercial development		2022
Natural gas emission factor (MT CO_2e/therm)[1]		0.00531
Natural gas fugitive emissions factor (MT CO_2e/therm)[2]		0.05307
Convert kWh to therms (kWh/therm)[3]		29.3
Average increased efficiency of electric appliances over natural gas appliances (%)[3]		300%
GHG Emissions Reductions Calculations	**2030**	**2035**
Residential Reductions		
Forecasted residential NG usage (therms)[4]	13,223,176	13,768,839
NG usage in implementation year (therms)[4]	12,350,115	12,350,115
NG usage avoided (therms)	873,061	1,418,724
Emissions from NG usage avoided (MT CO_2e)	4,637	7,535
Emissions from methane leakage avoided (MT CO_2e)	1,297	2,108
Electricity usage from converting to electric (kWh)	8,526,894	13,856,203
Weighted electricity EF (lbs CO_2e/MWh)[5]	16.91	4.23
Emissions from converted electricity usage (MT CO_2e)	65	27
Residential emission annual reductions (MT CO_2e)	**5,869**	**9,617**
Commercial Reductions		
Commercial NG usage (therms)[4]	8,098,368	8,288,888
NG usage in implementation year (therms)[4]	7,793,538	7,793,358
NG usage avoided (therms)	304,831	495,350
Emissions from NG usage avoided (MT CO_2e)	1,619	2,631
Emissions from methane leakage avoided (MT CO_2e)	453	736
Electricity usage from converting to electric (kWh)	2,977,182	4,837,920
Weighted electricity EF (lbs CO_2e/MWh)[5]	16.91	4.23
Emissions from converted electricity usage (MT CO_2e)	23	9
Commercial emission annual reductions (MT CO_2e)	**2,049**	**3,358**
Total Annual Reductions (MT CO_2e)[6]	**7,918**	**12,975**

Notes: MT CO_2e = metric tons of carbon dioxide; kWh =-kilowatt-hour

[1] EPA's Emission Factors for Greenhouse Gas Inventories

[8] 95% of electricity provided to the City of Santa Barbara is obtained from SBCE and is carbon-free. The remaining 5% of electricity is served by SCE. A weighted emission factor to account for 95% of the electricity coming from SBCE and 5% of SCE was used for emission reduction calculations.

[2] 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 CH4.

[3] Conversion factor of 29.3001 kWh/therms and the assumption that electric appliances are generally three time more efficient than gas appliances obtained from https://help.leonardo-energy.org/hc/en-us/articles/203047881-How-efficient-is-a-heat-pump-.

[4] Values obtained from *City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum*

[5] Electricity emission factors are weighted averages of the SBCE and SCE forecasted emission actors in the target year assuming 95% of electricity is from SBCE based on current opt out rate of 5%.

Measure BE-5 Reduce Existing Residential Natural Gas Consumption by 10% Below 2019 Levels by 2030 and 17% Below 2019 Levels by 2035

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)[1]
BE-5.1	Structural Change	Adopt a time of renovation energy efficiency and electrification requirement by 2025, effective 2026. This ordinance could require replacement of HVAC systems, hot water heaters, and other appliances to be all electric and low hydrofluorocarbons (HFC) gas emitters or provide a checklist of cost-effective efficiency and electrification options for renovations to complete based on the scope of the project. Adopt an electrification ordinance for existing residential buildings by 2028, effective 2029, to be implemented through the building permit process, which bans expansion or reconnection of natural gas infrastructure.	2030: 426 2035: 859
BE-5.2	Feasibility Studies, Education, Equity	Complete an existing building electrification feasibility analysis in collaboration with UCSB or another research institution by 2025 to determine the upfront and on-bill costs associated with building electrification strategies. This information will be used to inform and support future ordinances addressing existing building electrification as well as the building electrification accelerator (BE-5.3). The study will include extensive community input and an equity analysis to ensure all people have affordable access to the health, comfort, economic, and resilience benefits of building electrification.	2030: 7,880 2035: 13,551 (reductions associated with combined actions of Action 5.2-5.18)
BE-5.3	Structural Change, Education, Equity	Create a residential building electrification accelerator program to increase community access to building electrification resources. This program should include the provision and expansion of resources needed to support residents in electrifying their homes. For example, by providing rebates, enhanced funding for income-qualified homeowners, technical expertise, and contractor support.	
BE-5.4	Feasibility Study, Structural Change	Identify opportunities for the strategic reduction of gas infrastructure within the City and develop a gas infrastructure pruning pilot program.	
BE-5.5	Structural Change, Education, Equity	Complete a low income and affordable housing electrification pilot project in collaboration with affordable housing owners, utilities, and the community. The pilot project will ensure no increase in energy bills for occupants of subject buildings.	
BE-5.6	Structural Change, Funding	Provide a rebate at time of sale for qualifying building electrification upgrades including panels, wiring, and heat pump appliances. Implement the rebate program by 2025.	
BE-5.7	Education, Structural Change	Improve the City's building electrification permit process through a comprehensive permitting compliance program that streamlines processes, reduces fees, provides permit and inspection checklists, shortens review times, and educates affected trades and staff, thus	

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)[1]
		reducing barriers to electrification and unlocking available incentives.	
BE-5.8	Feasibility Studies	Conduct a feasibility study of a smart building market demand program, such as Recurve's *flexgrid* program. The study should include a pilot project that allows building owners to track the power generation and consumption of their retrofitted structures and work on making this a widely available and affordable option.	
BE-5.9	Structural Change	Develop the program studied in BE-5.8 that allows building owners to track the power generation and consumption of their retrofitted structures to optimize energy management.	
BE-5.10	Funding	Partner with ReCurve or similar entity to design and implement a market demand program that would pay energy users to save energy during times of peak demand, use energy more efficiently, and help balance the grid.	
BE-5.11	Education	Expand education programs directed at homeowners and renters on energy resource programs (examples include energy efficiency programs, demand response, and market demand programs).	
BE-5.12	Structural Change	Promote residential energy disclosure legislation, requiring home energy score at time of all residential property sale or rental listings.	
BE-5.13	Structural Change, Funding	Establish a program that provides targeted direct install services and cost share for specific electrification measures with multi-unit residential development owners. City to cover incremental cost in addition to an incremental electricity rate from SBCE.	
BE-5.14	Structural Change, Equity	Develop and implement a multi-family residential property regulation by 2028 to promote phased building energy efficiency and decarbonization. The regulation would require periodic energy inspections and prescriptive energy efficiency and decarbonization points requirements from a standardized checklist, with required performance increasing over time.	
BE-5.15	Structural Change	Develop an emergency hot water appliance program where the City provides residents with emergency natural gas hot water heaters within 24 hours of a request, with an agreement that the resident's gas powered hot water heater will be replaced within 6 months with a heat pump water heater.	
BE-5.16	Education	Increase community awareness and understanding of tax benefits for residential building energy efficiency upgrades (Example: the Residential Energy Efficiency Property Tax Credit).	
BE-5.17	Funding	Develop incentives for California Alternate Rates for Energy (CARE)/ Family Electric Rate Assistance (FERA) subsidized rate programs for low-income resident customers to increase energy assurance.	
BE-5.18	Structural Change, Funding	Implement direct installation and/or incentive programs that facilitate the installation of combined solar and battery energy storage system installations on local area single family residential buildings. Target 120 installations by 2035.	
BE-5.19	Moonshot	Adopt a natural gas end of flow date by 2040.[1] Create public engagement and education campaigns around this action to give the community advanced notice as well as signify all progress being made to make this possible.	

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)[1]

[1] Action BE 5.1 is quantified separately from the other actions as quantification is based on the adoption of a specific ordinance. As described in detail *Section Action BE-5.2 through BE-5.18*, GHG emissions reduction anticipated from Actions BE-5.2 through Action BE-5.18 are quantified together as the combination of programs, incentives, and actions will work together to generate a reduction in emissions from voluntary behavior changes.

Measure BE-5 employs a variety of policies, programs, incentives, and requirements to facilitate the transition away from natural gas to electricity in Santa Barbara's residential building stock. GHG emissions reductions stem from two primary strategies. The first is through an electrification requirement at time of renovation (BE-5.1) and the second is through the combination of incentives and other programs that will support the voluntary transition to electric appliances. In addition, the City will develop an existing building residential electrification plan (BE-5.2) which will determine the feasibility for additional electrification requirements and specify any additional programs needed to meet the City's long term decarbonization goals. Developing solutions for potential equity impacts is key to successful implementation when considering the comparably higher capital cost of existing building electrification. (Action BE-5.2, BE-5.5, BE-5.6, BE-5.13, BE-5.17).[9] The residential building electrification plan is designed to give special consideration to the potential equity impacts of an electrification ordinance by investigating up- front and on-bill costs of electrification to residents, potential impacts to renters, potential impacts to electrical grid resiliency, and by specifically targeting equity groups for feedback on a residential building electrification strategy development.

In general, electrification has been found to reduce costs for homeowners over the lifetime of appliances when compared to propane or natural gas-fueled equipment, especially when retrofits are bundled and completed when appliances are already planned for replacement, or when coupled with rooftop solar installation.[10] However, the City anticipates that the residential building electrification ordinance will result in up-front retrofit costs for residents that may be difficult for the community, particularly low-income residents, to bear. The largest barrier to existing building electrification is higher up-front capital costs compared to natural gas.[11] On-bill or financed incentives to offset these costs for the end-user are therefore among the most promising opportunities for electrification.[12] Once up-front costs are financed, long-term savings can be used to achieve cash flow positive retrofits and/or acceptable return on investment. Demonstrating cost-effective pathways for existing building electrification and equity will be a key step before mandatory requirements can be set (Action BE-5.1). Action BE-5.2, BE-5.3, BE-5.5, BE-5.6, BE-5.13, and BE-5.17 commits the City to determining the equity needs and to provide funding to meet those needs, two prominent barriers to electrification. Additional funding opportunities are identified through BE-5.10, and BE-5.18. Actions BE-5.11 and BE-5.16 support the measure through educating residents on the benefits of electrification, how to electrify, and existing tax benefits for electrification.

[9] Greenlining Institute. 2019. Equitable Building Electrification: A Framework for Powering Resilient Communities. Accessed at: https://greenlining.org/wp-content/uploads/2019/10/Greenlining_EquitableElectrification_Report_2019_WEB.pdf

[10] Rocky Mountain Institute (RMI). 2018. The Economics of Electrifying Buildings: How Electric Space and Water Heating Supports Decarbonization of Residential Buildings. Accessed at: https://rmi.org/insight/the-economics-of-electrifying-buildings/

[11] California Center for Sustainable Energy. 2009. Solar Water Heating Pilot Program: Interim Evaluation Report.

[12] Synapse Energy Economics, Inc. October 2018. Decarbonization of Heating Energy Use in California Buildings. https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf

Action BE-5.1

Action BE-5.1 commits the City to planning for an electrification ordinance for existing residential buildings by 2025. Natural gas usage from residential buildings accounted for about 10% of GHG emissions in Santa Barbara in 2019. To address these GHG emissions, the existing residential electrification ordinance could ban natural gas line expansions and reconnections as well as require the installation of electric heating, ventilation, and air conditioning (HVAC) systems, hot water heaters, and other appliances at time of renovation starting in 2025. HVAC system and hot water heaters are targeted in the ordinance due to their large contribution to residential natural gas end-uses.[13] Additionally, Action BE-5.5 commits the City to adopting an electrification ordinance for existing residential buildings by 2028 to be implemented through the building permit process, which bans expansion or reconnection of natural gas infrastructure.

The City recognizes that successful implementation of building electrification programs will require effective permit compliance. Permits are required for many energy efficiency improvements, including hot water heaters, insulation, HVAC systems, duct replacement, and others. However, permit evasion remains an issue in many jurisdictions, with studies finding permitted HVAC systems only accounting for 8-29% of total installations.[14,15] City staff has indicated that this number is much lower in Santa Barbara. Strategies that have proven effective at improving permit compliance in various states and local jurisdictions include streamlining the compliance process, improving third-party enforcement, and advanced training for enforcement staff.[16] Action BE-5.7 aims to re-work existing systems and implement these best practices in streamlining permitting to achieve better permit compliance and therefore, improved ordinance implementation success. Per Action BE-5.7, the City will work to streamline permitting for electrification and other energy projects at a city level.

Common community concerns include the potential for electrification to increase demands on and lower the resiliency of the electrical grid, especially given the potential for service disruptions for public safety power shutoffs (PSPS). Peak grid demand and, therefore, PSPS usually occurs in the summer on the hottest days when most buildings are running air conditioning. Hot water heaters, while used throughout the year, can use electricity during off-peak times by heating water and storing it for use at a later time, significantly avoiding contribution to peak demand in the summer. Electrifying a heat pump or other space heating appliance has the added benefit of being highly efficient and widespread electrification of temperature control appliances would likely reduce electricity demand throughout the year.[17] The e9lectric grid is, therefore, well-suited for absorbing increased electrical demands from building electrification, which, even under full electrification scenarios, would not exceed current peak summer electricity demands.[18]

---

[13] Energy and Environmental Economics (E3). April 2019. Residential Building Electrification in California: Consumer economics, greenhouse gases and grid impacts. Accessed at: https://www.ethree.com/wp-content/uploads/2019/04/E3_Residential_Building_Electrification_in_California_April_2019.pdf

[14] Emily Alvarez and Bruce Mast. BayREN Codes & Standards Program. October 2021. Local Government Policy Calculator for Existing Single-Family Buildings – User Guide. Accessed at: https://www.bayrencodes.org/wp-content/uploads/2021/11/BayREN-Policy-Calculator-User-Guide_10.29.2021.pdf

[15] California Public Utilities Commission (CPUC). September 2017. Final Report: 2014-16 HVAC Permit and Code Compliance Market Assessment (Work Order 6) Volume I – Report. Accessed at: https://www.calmac.org/publications/HVAC_WO6_FINAL_REPORT_VolumeI_22Sept2017.pdfhttp://www.calmac.org/publications/HVAC_WO6_FINAL_REPORT_VolumeI_22Sept2017.pdf

[16] Ryan Meres et al. American Council for an Energy-Efficient Economy (ACEEE). 2012. Successful Strategies for Improving Compliance with Building Energy Codes. Accessed at: https://www.aceee.org/files/proceedings/2012/data/papers/0193-000112.pdf

[17] Pacific Gas & Electric. 2021. Electrification for your home or building. Accessed at: https://www.pge.com/en_US/residential/c ustomer-service/home-services/renovating-and-building/benefits-of-electric-homes-and-buildings/benefits-of-electric-homes-and-buildings.page?

[18] Reem Rayef. National Resources Defense Council. April 2020. California's Grid is Ready for All-Electric Buildings. Accessed at: https://www.nrdc.org/experts/merrian-borgeson/californias-grid-ready-all-electric-buildings

The methods and assumptions used to calculate the GHG emissions reductions associated with Action BE-5.1 are explained further here and shown in Table 6 below. The City will start with voluntary actions and move towards an electrification at time of renovation ordinance[19] by 2025 depending on progress made towards 2030 and 2035 targets. Based on studies conducted by the Harvard Joint Center for Housing Studies (JCHS) using data from the US Department of Housing and Urban Development (HUD), approximately 25 percent of existing homes in 2021 in the Los Angeles metro area conducted renovations.[20] Of the renovation projects, approximately 2 percent and 9 percent of the projects included water heater and HVAC replacements, respectively. This equates to an estimated replacement of water heaters and HVAC units at a 0.4 percent and 2.3 percent annual rate, respectively, due to renovation. For the purposes of this calculation, it was assumed that trends in the City of Santa Barbara are similar to those of the Los Angeles metro area. GHG emissions were quantified by multiplying the annual percent of unit replacement by the number of years since implementation of the ordinance multiplied by the estimated contribution to total natural gas consumption in residences from the unit (e.g., water heater, HVAC). The calculation also assumes that 10% of all appliances being replaced would adhere to the requirement established through Action BE-5.1. This percentage of compliance is based on the CPUC study on HVAC and code compliance and further substantiated by the City staff that have found low permit compliance due to cost and complexity of permitting process.[15]

While the replace at time-of-renovation does help the City achieve the 2030 target, it does not guarantee the City will meet its goal of carbon neutrality by 2035. Achievement of complete building sector decarbonization will depend on the success of the education, funding, and technical assistance the City will provide. As the City will be tracking compliance, future CAP updates may need to outline new actions to close any remaining gaps. Santa Barbara's energy portfolio with carbon-free electricity supports these reductions and is captured in the calculations. Also, it is important to clarify that Action BE-5.19 which looks to adopt a natural gas end of flow date by 2040 was not included in the quantification of emission reductions. This is a City's moonshot action, and more information and community engagement will be needed for the City to determine how that may occur.

Table 6 GHG Emissions Reductions from Action BE-5.1

Inputs and Assumptions	
Ordinance implementation year	2025
Natural gas emissions factor (MT CO_2e/therm)[1]	0.00531
Methane Leakage (% of NG delivered)[2]	2.8%
Methane Leakage EF (MT CO_2e/therm)[3]	0.05307
Conversion Factor (kWh/therm)[4]	29.3
Average increased efficiency of electric appliances over natural gas appliances (%)[4]	300%
Residences undergoing renovation annually[5]	25%
Renovations including water heater replacement[5]	2%
Renovations including HVAC replacement[5]	9%
Natural gas usage that comes from water heater[6]	38%
Natural gas usage that comes from space heating/cooling[6]	39%

[19] This type of ordinance is triggered by the replacement or upgrade of a natural gas system during renovation of the building.
[20] Joint Center for Housing Studies of Harvard University. 2023. Improving America's Housing 2023. https://www.jchs.harvard.edu/sites/default/files/reports/files/JCHS-Improving-Americas-Housing-2023-Report.pdf

Assumed compliance[7]	10%

GHG Emissions Reductions Calculations	2030	2035
Annual existing building natural gas usage (therms)[8]	12,350,115	12,350,115
Annual existing natural gas usage for water heaters (therms)	4,631,293	4,631,293
Annual existing natural gas usage for space heating (therms)	4,824,264	4,824,264
Percentage of renovated homes with replaced water heaters, assuming some 10% compliance	0.2%	0.4%
NG reduction from water heater replacement (therm)	8,928	17,855
NG reduction from space heater replacement (therm)	54,462	108,925
Percentage of renovated homes with replaced HVAC, assuming some 10% compliance	**1.1%**	**2.3%**
Total NG avoided (therms)	**63,390**	**126,780**
Combustion emissions from total NG saved (MT CO_2e)	337	673
Methane leakage avoided (therms)	1,775	3,550
Emissions from methane leaked avoided (MT CO_2e)	94	188
Electricity usage from converting to electric (kWh)	619,111	1,238,222
Weighted electricity EF (lbs CO_2e/MWh)	16.91	4.23
Emissions from converted electricity usage (MT CO_2e)	5	2
Total Residential Reductions (MT CO_2e)	**426**	**859**

Notes: MT CO_2e = metric tons of carbon dioxide; kWh =-kilowatt-hour

[1] EPA's Emission Factors for Greenhouse Gas Inventories

[2] Based on recent studies, there is a leakage rate of approximately 2.8% of all natural gas delivered. See references from *City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum*

[3] 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.

[4] Conversion factor of 29.3001 kWh/therms and the assumption that electric appliances are generally three time more efficient than gas appliances obtained from https://help.leonardo-energy.org/hc/en-us/articles/203047881-How-efficient-is-a-heat-pump.

[5] JCHS. 2023. Improving America's Housing 2023. https://www.jchs.harvard.edu/sites/default/files/reports/files/JCHS-Improving-Americas-Housing-2023-Report.pdf

[6] Decarbonization of Heating Energy Use in California Buildings (figure 2, page 8) https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf

[7] Based off the percent of energy efficiency requirements for HVAC unit being met or exceeded - this gives indication of likely hood that a piece of equipment will be upgraded with a more efficiency version. In most cases an electric alternative is the more efficient version. See CPUC's Final Report: 2014-16 HVAC Permit and Code Compliance Market Assessment (Work Order 6) Volume I – Report, accessed at: http://www.calmac.org/publications/HVAC_WO6_FINAL_REPORT_VolumeI_22Sept2017.pdf

[8] Values obtained from *City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum*

Action BE-5.2 through BE-5.18

As discussed above, the primary strategy for electrification in the near term will be through voluntary adoption supported by targeted incentives, information, programs and policies outlined by the actions under measure BE-5. The City will begin voluntary actions immediately with the CAP adoption to accelerate the electrification of existing residential buildings. It is assumed that with the programs and incentives in place developed through Measure BE-5, approximately 25% of natural gas appliances would be voluntarily replaced with electric versions at time ofburnout. This would be in addition to the electrification at time of renovation ordinance (Action BE-5.1). This level of reduction is in line with the CARB 2022 State SIP which calls for an end to gas water heater and

HVAC sales by 2030.[21] Furthermore, sales of air source heat pumps have been increasing throughout California and has reached upwards of 20% already while electric water heaters are closer to 11%.[22] With the addition of the incentives and programs identified in Measure BE-5 as well as those provided through the Inflation Reduction Act which would help create upfront cost parity and will increase these adoption rates even higher. Adjustments to the program will be further refined to meet these targets based on the results of the feasibility study performed as part of Action BE-5.2. To estimate the GHG reductions associated with replacing appliances at time of burnout with an electric alternative, the expected life span of each appliance (HVAC, water heater, stove) and the estimated contribution to total natural gas consumption was modeled. References for appliance life span and contribution to overall natural gas usage are included in Table 7.

Table 7 GHG Emissions Reductions from Voluntary Actions as Part of Measure BE-5 (Actions BE 5.2 through BE 5.18)

Inputs and Assumptions	
Program Implementation year	2023
Natural gas emissions factor (MT CO_2e/therm)[1]	0.00531
Methane Leakage (% of NG delivered)[2]	2.8%
Methane Leakage EF (MT CO_2e/therm)	0.05307
Conversion Factor (kWh/therm)	29.3
Average increased efficiency of electric appliances over natural gas appliances (%)[3]	300%
Natural gas usage that comes from water heater[4]	38%
Natural gas usage that comes from space heating/cooling[5]	39%
Average natural gas water heater lifespan[7]	13
Average natural gas HVAC lifespan[8]	21.5
Average natural gas stove lifespan[9]	12
Assumed voluntary implementation[10]	25%

GHG Emissions Reductions Calculations	2030	2035
Building natural gas usage (therms)[11]	12,286,725	12,223,335
Percentage of homes with replaced water heaters, assuming voluntary electrification	13%	23%
NG reduction from water heater replacement (%)	5%	9%
Percentage of homes with replaced HVAC, assuming voluntary electrification	8%	14%
NG reduction from HVAC replacement (%)	3%	5%
Percentage of homes with replaced stoves, assuming voluntary electrification	15%	25%
NG reduction from stove replacement (%)	1%	2%
Total percent reduction of NG (%)	10%	16%
Total NG saved (therms)	1,172,164	1,999,056
Emissions from total NG saved (MT CO_2e)	6,226	10,618
Methane Leakage Avoided (therms)	32,821	55,974
Emissions from Methane Leaked Avoided (MT CO_2e)	1,742	2,970

[21] https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf
[22] https://www.calmac.org/publications/OD-CPUC-Heat-Pump-Market-Study-Report-5-17-2022.pdf

GHG Emissions Reductions Calculations	2030	2035
Electricity usage from converting to electric (kWh)	11,448,132	19,524,118
Weighted electricity EF (lbs CO_2e/MWh)	16.91	4.23
Emissions from converted electricity usage (MT CO_2e)	88	37
Total Residential Reductions (MT CO_2e)	**7,880**	**13,551**

[1] City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum

[2] City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum

[3] Pacific Gas & Electric. 2021. Electrification for your home or building. Accessed at: https://www.pge.com/en_US/residential/customer-service/home-services/renovating-and-building/benefits-of-electric-homes-and-buildings/benefits-of-electric-homes-and-buildings.page?

[4] Decarbonization of Heating Energy Use in California Buildings (figure 2, page 8) https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf

[5] Decarbonization of Heating Energy Use in California Buildings (figure 2, page 8) https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf

[6] https://treehozz.com/how-many-ccf-of-natural-gas-does-a-home-use

[7] EIA. 2018. Updated Buildings Sector Appliance and Equipment Cost and Efficiencies. Appendix C. Accessed at: https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf

[8] EIA. 2018. Updated Buildings Sector Appliance and Equipment Cost and Efficiencies. Appendix C. Accessed at: https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf.

[9] EIA. 2018. Updated Buildings Sector Appliance and Equipment Cost and Efficiencies. Appendix C. Accessed at: https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf.

[10] Assumed percent of voluntary electrification based on market trends and impacts of supportive programs

[11] Natural Gas Prohibition in new buildings from Measure BE-4 and electrification at time of renovation ordinance (Action BE-5.5) accounted for in calculation.

Measure BE-6 Reduce Commercial Natural Gas Consumption 10% Below 2019 Levels by 2030 and 18% Below 2019 Levels by 2035

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
BE-6.1	Structural Change	Based on the results of measure BE-5.2, the existing building electrification feasibility analysis, develop and adopt an ordinance for existing commercial buildings by 2025, effective 2026, that requires the replacement of fossil fuel building systems such as HVAC and Domestic Hot Water systems with heat pumps at time of renovation. Any buildings that are unable to be electrified due to technological infeasibility shall be decarbonized with other technology. Adopt an electrification ordinance for existing commercial buildings by 2028, effective 2029, to be implemented through the building permit process, which bans expansion or reconnection of natural gas infrastructure.	2030: 1,174 2035: 3,158
BE-6.2	Structural Change	Develop and implement a commercial and mixed-use building benchmarking program for commercial and multifamily buildings over 20,000 square feet by 2025, effective 2026. The program would include reporting electricity and natural gas usage (and any other energy source) data through energy star portfolio manager. It would establish monetary penalties for non-compliance. Residential portions of buildings that are part of a mixed-use development would be exempt. Create incentives for buildings not covered to encourage voluntary compliance.	2030: 4,113 2035: 6,149
BE-6.3	Structural Change	Develop and implement a building performance standard by 2028. The standard should identify a GHG emissions per square footage threshold for each commercial building type using the data collected	

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
		under action BE-6.2. The program will start with larger commercial/multifamily residential buildings and decrease in size over time.	
BE-6.4	Structural Change, Feasibility Studies	Re-evaluate building performance program every 3 years to gauge implementation progress and possible expansion to smaller sized buildings.	
BE-6.6	Funding, Feasibility Studies, Partnerships, Education	Expand education, outreach and engagement efforts relating to building electrification and energy resources, including these actions: • Partner with the Santa Barbara South Coast Chamber of Commerce to inform and facilitate electrification for commercial business owners. • Conduct a survey of small businesses detailing obstacles and needed resources to inform equity considerations of the ordinance. • Conduct engagement efforts to the commercial sector to identify ways the City can support commercial energy storage installations and neighborhood scale microgrid opportunities. • Leverage the grant writer position(s) in strategy A-2.2 to facilitate funding opportunities for commercial business electrification by identifying and supporting grant opportunities, prioritizing small businesses and under-resourced communities. Implement feedback provided during the community outreach process to small businesses and under-resourced population-owned businesses to address potential equity impacts of the building performance program.	
BE-6.7	Structural Change	Track and require rental energy use disclosures at all commercial property over 10,000 SF. Require an ASHRAE (American Society of Heating, Refrigeration, and Air-Conditioning Engineers) level-1 audit for properties over 10,000 SF, and property over 20,000 SF requires an ASHRAE level-2 audit to be conducted and disclosed to the City, tenants, and potential buyers prior to sale and/or listing.	
BE-6.8	Structural Change, Funding	Establish a decarbonization incentive rate pilot program that would charge SBCE customers a reduced marginal cost rate for installation of specific electrification measures. Target commercial kitchens/restaurants, Hotel/Motels, etc.	
BE-6.9	Education	Publicize tax breaks for commercial building energy efficiency upgrades. For example, Section 179D Deduction is a federal tax deduction that allows commercial building owners to deduct up to $1.80 per square foot of the cost of qualifying energy-efficient upgrades made to their buildings, including HVAC systems, lighting, and building envelope improvements.	
BE-6.10	Structural Change, Funding	Implement direct installation and/or incentive programs that facilitate the installation of combined solar and battery energy storage system installations on local area commercial buildings. Target 36 installations by 2035.	
BE-6.11	Structural Change	Develop an emergency hot water appliance program where the City provides commercial residents with emergency natural gas hot water heaters within 24 hours of a request, with an agreement that the hot water heater will be replaced within 6 months with a heat pump.	

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
BE-6.12	Structural Change, Education, Equity	Create a commercial and mixed-use building electrification accelerator program to increase community access to building electrification resources. This program should include the provision and expansion of resources needed to support building electrification. For example, providing rebates, enhanced funding for income-qualified homeowners, technical expertise, and contractor support.	

Measure BE-6 supports the electrification of commercial buildings within the City of Santa Barbara through a variety of mandatory actions, incentives, policies and programs. GHG emissions reductions are achieved through two major pathways. Action BE-6.1 commits the City to developing and implementing a commercial building electrification ordinance triggered by retrofits and covers both HVAC and hot water systems. Additional reductions are achieved through a variety of policies and programs which include components such as developing and maintaining a building benchmarking program through Action BE-6.2 and Action BE-6.12 and energy use disclosure through Action BE-6.5. Existing building electrification in the commercial sector is less researched than in the residential sector. While some commercial natural gas end uses may be ripe for electrification (about 27% of commercial floor space heated with fossil fuel systems can be electrified today with a simple payback period of less than 10 years) other end uses may not.[23] However, the commercial sector accounts for a large portion of the City's total natural gas usage (about 7% of the total City emissions), and therefore provides significant opportunity for decarbonization. Because commercial buildings are more variable than residential buildings, and their systems can be more complicated, additional data is needed to identify cost effective decarbonization strategies. The building benchmarking program will allow the City and building owners to gather more data on commercial buildings over time, perform cost saving retro-commissioning, and ultimately plan for the most cost effective decarbonization strategy. Future updates to the building strategy could identify specific GHG emissions reductions targets to allow for additional quantified GHG emissions reductions.

Technologies that currently exist for electrifying HVAC systems and water heaters in the commercial sector range from cost-effective to prohibitively expensive, usually depending on the complexity of the system.[24] Additionally, while all-electric HVAC systems and water heaters can be cost-effective over their lifetimes, up-front costs may be substantially higher with payback periods longer than 10 years.[25] Financial incentives are needed to make conversion of about 73% of commercial floor space cost effective, not to mention other end uses that are less well studied.[26] However, it should be noted that these costs are not specific to Santa Barbara, and additional study (through action BE-5.2) will provide more detail related to cost effectiveness. To bridge the gap between gas and electric infrastructure costs, Actions BE-6.3, BE-6.6, and BE-6-9 support Measure BE-6 by establishing pathways for funding, such as rebate and grant programs, and incentivizing

[23] Steven Nadel and Chris Perry. American Council for an Energy-Efficient Economy (ACEEE). October 2020. Electrifying Space Heating in Existing Commercial Buildings: Opportunities and Challenges. Accessed at: https://www.aceee.org/press-release/2020/10/report-electrifying-heating-existing-commercial-buildings-could-cut-their

[24] Steven Nadel and Chris Perry. American Council for an Energy-Efficient Economy (ACEEE). October 2020. Electrifying Space Heating in Existing Commercial Buildings: Opportunities and Challenges. Accessed at: https://www.aceee.org/press-release/2020/10/report-electrifying-heating-existing-commercial-buildings-could-cut-their

[25] Steven Nadel and Chris Perry. American Council for an Energy-Efficient Economy (ACEEE). October 2020. Electrifying Space Heating in Existing Commercial Buildings: Opportunities and Challenges. Accessed at: https://www.aceee.org/press-release/2020/10/report-electrifying-heating-existing-commercial-buildings-could-cut-their.

[26] Steven Nadel and Chris Perry. American Council for an Energy-Efficient Economy (ACEEE). October 2020. Electrifying Space Heating in Existing Commercial Buildings: Opportunities and Challenges. Accessed at: https://www.aceee.org/press-release/2020/10/report-electrifying-heating-existing-commercial-buildings-could-cut-their

electrification of commercial properties by owners. Actions BE-6.11 and Action BE-6.12 establish programs to allow commercial owners a grace period to transition to electric water heaters in the case of emergencies and aim to accelerate commercial building electrification through community access to electrification resources.

Education has been shown to improve code compliance when implemented in addition to a permitting compliance program and has therefore, been identified as a key component of the electrification ordinance implementation process.[27] To close the knowledge gap about commercial building electrification in Santa Barbara, Actions BE-6.1, BE-6.6, BE-6.9, and BE-6.12 commits the City to engaging with the commercial sector and business community to understand barriers, equity concerns, cost impacts, and opportunities associated with electrification of commercial natural gas end uses. Outreach would include engagement with the local business community, such as the Santa Barbara South Coast Chamber of Commerce, to continuously understand the challenges of electrification and removed challenges and provide support. Action BE-6.10 commits the City to enforcing the electrification requirements on commercial buildings through the same permitting program established under Measure BE-5 (Action BE-5.7).

While electrification is not expected to result in additional strain on the electrical grid due to the efficiency of heat pumps,[28] commercial- scale energy assurance projects present an opportunity to improve the resilience of the electrical grid and provide cost savings over the lifetime of the equipment through battery storage.[29] 2022 California Building Energy Code requires new commercial construction over 5,000 square feet to install PV and storage to meet 60% of the building's energy load and reduce exports to 10%.[30] Action BE-6.9 commits the City to exploring opportunities to support commercial battery storage installations beyond these requirements for existing buildings.

Action BE-6.1

The methods and assumptions used to calculate the GHG emissions reductions associated with this metric are explained further here and shown in Table 8 below. The reductions gained from commercial building electrification follow a similar process as residential buildings with the development of programs to accelerate and encourage voluntary electrification of commercial businesses followed by the adoption of a time of renovation electrification ordinance by 2027. Further, by 2028 an ordinance banning reconnection to natural gas infrastructure will be adopted. Based on the market research report by IBISWorld on commercial property remodeling in the United States, the commercial building renovation market made up about 22 percent of the total commercial building market in 2022.[31] It is anticipated that the commercial renovation market will continue to grow and make up a larger portion of the commercial building market due to the aging building stock and need for upgrades. A study by the Lawrence Berkely National Laboratory found that of the renovation and retrofit projects occurring at commercial buildings, approximately 18 percent and 20 percent of the projects included water heater and HVAC system replacements,

---

[27] Ryan Meres et al. American Council for an Energy-Efficient Economy (ACEEE). 2012. Successful Strategies for Improving Compliance with Building Energy Codes. Accessed at: https://www.aceee.org/files/proceedings/2012/data/papers/0193-000112.pdf

[28] Reem Rayef. National Resources Defense Council. April 2020. California's Grid is Ready for All-Electric Buildings. Accessed at: https://www.nrdc.org/experts/merrian-borgeson/californias-grid-ready-all-electric-buildings

[29] National Renewable Energy Laboratory (NREL). June 2021. Battery Storage for Resilience. Accessed at: https://www.nrel.gov/docs/fy21osti/79850.pdf

[30] Kelsey Misbrener. Solar Power World. August 2021. California Energy Commission mandates solar + storage on new commercial buildings. Accessed at: https://www.solarpowerworldonline.com/2021/08/california-energy-commission-mandates-solar-storage-new-commercial-buildings/

[31] IBISWorld. May 2023. Commercial Property Remodeling Industry in the US – market Research Report. Accessed at: https://www.ibisworld.com/united-states/market-research-reports/commercial-property-remodeling-industry/

respectively.[32] This equates to an estimated replacement of water heaters and HVAC units at a 4.0 percent and 4.5 percent annual rate, respectively, due to renovation or retrofit. Similar to Measure BE-5, GHG emissions were quantified by multiplying the annual percent of unit replacement by the number of years since implementation of the ordinance, multiplied by the estimated contribution to total natural gas consumption in residences from the unit (e.g., water heater, HVAC). The calculation also assumes that 25% of all appliances being replaced would be in compliance with the requirements established through Action BE-6.1 and BE-6.2. This percentage of compliance is based on recent findings by the Natural Resources Defense Council (NRDC) that only about 25 percent of commercial HVAC replacements are permitted and undergo inspection.[33]

Table 8 GHG Emissions Reductions from Action BE-6.1

Inputs and Assumptions	
Ordinance implementation year	2027
Natural gas emissions factor (MT CO_2e/therm)[1]	0.00531
Methane Leakage (% of NG delivered)[2]	2.8%
Methane Leakage EF (MT CO_2e/therm)[3]	0.05307
Conversion Factor (kWh/therm)[4]	29.3
Average increased efficiency of electric appliances over natural gas appliances (%)[4]	300%
Commercial buildings undergoing renovation annually[5]	22%
Renovations including water heater replacement[6]	18%
Renovations including HVAC replacement[6]	20%
Natural gas usage that comes from water heater[7]	28%
Natural gas usage that comes from space heating/cooling[7]	42%
Assumed compliance[8]	25%

GHG Emissions Reductions Calculations	2030	2035
Annual existing building natural gas usage (therms)[9]	7,793,538	7,793,538
Annual existing natural gas usage for water heaters (therms)	2,164,872	2,164,872
Percentage of renovated homes with replaced water heaters, assuming 25% compliance	3.0%	8.1%
NG reduction from water heater replacement (therm)	65,506	174,683
Annual existing natural gas usage for space heating (therms)	3,247,307	3,247,307
Percentage of renovated homes with replaced HVAC, assuming some 10% compliance	3.4%	9.0%
NG reduction from HVAC replacement (therm)	109,177	291,138
Total NG avoided (therms)	**174,683**	**465,821**
Emissions from total NG saved (MT CO_2e)	928	2,474
Methane Leakage Avoided (therms)	4,891	13,043
Emissions from Methane Leaked Avoided (MT CO_2e)	260	692

[32] Cindy Regnier P.E., Paulk Mathew Ph.D., Alastair Robinson, Jordan Shackelford, Travis, Walter Ph.D. February 2020. System Retrofit Trends in Commercial Buildings: Opening Up Opportunities for Deeper Savings. Lawrence Berkeley National Laboratory. Accessed at: https://buildings.lbl.gov/sites/default/files/Regnier%20-%20Systems%20Retrofit%20Trends.docx 1.pdf

[33] Kiki Velez, Merrian Morgeson. April 2023. Poor-Quality HVAC Installs are Costing Us – A solution is within reach. NRDC. Accessed at: https://www.nrdc.org/bio/kiki-velez/poor-quality-hvac-installs-are-costing-us-solution-within-reach

GHG Emissions Reductions Calculations	2030	2035
Electricity usage from converting to electric (kWh)	1,706,068	4,549,515
Weighted electricity EF (lbs CO_2e/MWh)	16.91	4.23
Emissions from converted electricity usage (MT CO_2e)	13	9
Total Residential Reductions (MT CO_2e)	**1,174**	**3,158**

MT CO_2e = metric tons of carbon dioxide; kWh =-kilowatt-hour

[1] EPA's Emission Factors for Greenhouse Gas Inventories

[2] Based on recent studies, there is a leakage rate of approximately 2.8% of all natural gas delivered. See references from *City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum*

[3] 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 CH4.

[4] Conversion factor of 29.3001 kWh/therms and the assumption that electric appliances are generally three time more efficient than gas appliances obtained from https://help.leonardo-energy.org/hc/en-us/articles/203047881-How-efficient-is-a-heat-pump-.

[5] IBISWorld. May 2023. Commercial Property Remodeling Industry in the US – market Research Report. Accessed at: https://www.ibisworld.com/united-states/market-research-reports/commercial-property-remodeling-industry/

[6] Cindy Regnier P.E., Paulk Mathew Ph.D., Alastair Robinson, Jordan Shackelford, Travis, Walter Ph.D. February 2020. System Retrofit Trends in Commercial Buildings: Opening Up Opportunities for Deeper Savings. Lawrence Berkeley National Laboratory. Accessed at: https://buildings.lbl.gov/sites/default/files/Regnier%20-%20Systems%20Retrofit%20Trends.docx 1.pdf

[7] Decarbonization of Heating Energy Use in California Buildings (figure 2, page 8) https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf

[8] Kiki Velez, Merrian Morgeson. April 2023. Poor-Quality HVAC Installs are Costing Us – A solution is within reach. NRDC. Accessed at: https://www.nrdc.org/bio/kiki-velez/poor-quality-hvac-installs-are-costing-us-solution-within-reach

[9] Values obtained from *City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum*

Action BE-6.2 through BE-6.12

In addition to the reductions associated with the electrification at time of retrofit program identified under BE-6.1, the City has also identified a suite of actions to promote voluntary electrification of gas appliances at time of replacement. To estimate the GHG reductions associated with replacing appliances at time of burnout with an electric alternative, the expected life span of each appliance (HVAC, water heater) and the estimated contribution to total natural gas consumption was modeled. References for appliance life span and contribution to overall natural gas usage are included in Table 9. It is assumed that with the programs and incentives in place, approximately 25% of appliances replaced at burnout would be electrified. This level of reduction is in line with the CARB 2022 State SIP which calls for an end to gas water heater and HVAC sales by 2030.[34] While market penetration of heat pumps in commercial buildings specifically in California is less well understood, market trends show an overall increase in heat pump installations.[35] Furthermore, the City has the option to leverage the building performance standard to require additional GHG emission reductions based on performance of the voluntary programs. Quantification of actions BE-6.2 through BE-6.12 are shown below in Table 9.

[34] https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf

[35] https://www.pmmag.com/articles/104065-heat-pump-water-heaters-poised-for-growth-in-commercial-markets

Table 9 GHG Emissions Reductions from Voluntary Actions as Part of Measure BE-6

Inputs and Assumptions	
Program implementation year	2023
Natural gas emissions factor (MT CO_2e/therm)[1]	0.00531
Methane leakage (% of NG delivered)[2]	2.8%
Methane leakage EF (MT CO_2e/therm)	0.05307
Conversion factor (kWh/therm)	29.3
Natural gas usage that comes from water heater[3]	28%
Natural gas usage that comes from space heating/cooling[4]	42%
Average natural gas water heater lifespan[5]	10
Average natural gas HVAC lifespan[6]	23
Assumed voluntary implementation[7]	25%

GHG Emissions Reductions Calculations	2030	2035
Commercial NG usage after new building electrification ordinance is implemented (therms)	7,618,855	7,327,717
Percentage of buildings with replaced water heaters, assuming some non- compliance	18%	25%
NG reduction from water heater replacement (%)	5%	7%
Percentage of commercial buildings with replaced HVAC, assuming some non-compliance	8%	13%
NG reduction from HVAC replacement (%)	3%	5%
Total percent reduction of NG (%)	8%	12%
Total NG saved (therms)	611,901	907,115
Emissions from total NG saved (MT CO_2e)	3,250	4,818
Methane leakage avoided (therms)	17,133	25,399
Emissions from methane leaked (MT CO_2e)	909	1,348
Electricity usage from converting to electric (kWh)	5,976,231	8,859,487
Weighted electricity EF (lbs CO_2e/MWh)	16.91	4.23
Emissions from converted electricity usage (MT CO_2e)	46	17
Total Commercial Emission Reductions (MT CO_2e)[8]	**4,113**	**6,149**

[1] City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum

[2] City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum

[3] Decarbonization of Heating Energy Use in California Buildings (figure 2, page 8) https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf

[4] Decarbonization of Heating Energy Use in California Buildings (figure 2, page 8) https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf

[5] EIA. 2018. Updated Buildings Sector Appliance and Equipment Cost and Efficiencies. Appendix C. Accessed at: https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf

[6] EIA. 2018. Updated Buildings Sector Appliance and Equipment Cost and Efficiencies. Appendix C. Accessed at: https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf

[7] Assumed percent of voluntary electrification

[8] See Calculations for Measure BE-1

Measure BE-7 Increase the Impact of Santa Barbara Clean Energy (SBCE)

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO2e)
BE-7.1	Foundational	Adopt a reach code requiring all non-residential new construction and major remodels to include solar PV and potentially batteries as well.	Supportive
BE-7.2	Structural Change, Education	Convert SCE direct access customers to SBCE through targeted programs, incentives, and engagement. Direct access customers purchase electricity from a competitive provider called an Electric Service Provider (ESP), instead of from a regulated electric utility like Southern California Edison (SCE).	Supportive
BE-7.3	Structural Change	Develop targeted rate structures and other incentives for large commercial customers including demand response.	Supportive
BE-7.4	Education, Equity	Develop a local education program detailing incentives for electrification and promoting the benefits of opting in to SBCE's service, particularly for under-resourced populations.	Supportive
BE-7.5	Education, Foundational	Maintain SBCE opt-out rates below 5%.	Supportive
BE-7.6	Structural Change, Foundational	Create innovative pilots for SBCE through local partnerships addressing technical, low-income, market, and policy barriers to progress the City's sustainability and resilience goals. Consider working with departments at UCSB like Technology and Management Program for innovative solutions that leverage technology, Engineering for data driven solutions, and Environmental Science for cutting edge environmental research.	Supportive
BE-7.7	Structural Change	Develop a Feed-In Tariff to increase and incentivize distributed energy resources. Feed-In Tariffs allow eligible small-scale renewable energy generating sources to sell their energy back to the utility or major energy grid.	Supportive

For Santa Barbara to reach its 2030 reduction target and 2035 carbon-neutrality target, energy utilized in the City will need to be carbon-free. Renewable electricity procurement by SBCE is essential for decarbonizing the City's emissions from electricity and creates the foundation for a carbon-free future. Decarbonizing electricity works hand-in-hand with building electrification and EVs to achieve carbon neutrality in both the building and transportation sectors. The actions associated with increasing SBCE's impact are supportive in nature because GHG emissions reductions have already been quantified in the emissions forecast. These actions work to support additional reductions and support a resilient and carbon-free power supply. Action BE-7.1 will ensure that all new non-residential development is equipped to generate its own renewable energy. BE-7.2, BE-7.3, and BE 7.5 work towards maintaining low SBCE opt-out rates to maximize the renewable energy provided by SBCE. BE-7.4 works together with other educational actions in the building sector to assist residents and businesses in taking necessary steps towards electrification. BE-7.6 ensures that the City stays up-to-date with cutting edge technology to improve electrification as the field evolves. BE-7.7 incentivizes small-scale renewable energy generation by developing a market for selling energy and supplementing the grid. As these actions are developed and implemented, it is assumed that tracking their effectiveness will be available and therefore, quantifying their associated GHG reduction will be feasible.

3 Transportation Measures

The City has many existing programs to support all modes of transportation in Santa Barbara. In order to meet its carbon neutrality target, the City must further reduce transportation emissions as passenger vehicles accounted for 41% of GHG emissions in Santa Barbara in 2019. Reducing these emissions is complicated as it requires reducing each individual's number of miles driven by fossil fuel-powered vehicles.

The City's transportation strategy consists of a multi-pronged approach for incentivizing alternatives to fossil fuel-powered vehicle trips, including shifting transportation mode share to active transportation and public transit options, electrifying passenger and commercial vehicle trips, and decarbonizing off-road equipment. [36] This CAP prioritizes reducing vehicle miles travelled (VMT) by improving active and public transportation mode share, supporting regional programs that reduce the use of single occupancy vehicles, and shifting the remaining VMT to Zero Emission Vehicles. While, in theory, 100% electrification of all vehicles in Santa Barbara could achieve zero-emissions in the transportation sector without reducing VMT, the City recognizes that cars and roadways carry huge amounts of embodied emissions (emissions associated with the construction of cars and roads)that are not accounted for in the inventory .[37, 38]

Reducing VMT carries additional potential benefits outside of GHG emissions reductions as well, including reduced congestion, reduced space needed for roadways and parking, local economic revitalization, and lifestyle improvements.[39] Based on this strategy, the CAP's transportation measures are shown in Table 10 below.

[36] Mode share in this context is used to refer to percentage of passenger trips that can be attributed to one transportation mode or another. For example, 5% active transit mode share means that 5% of all passenger trips are taken using active transit modes (walking, biking, scootering, etc.). Importantly, mode share does not refer to percentage of passenger VMT that can be attributed to a specific transportation mode, since not all trips are the same length. To convert from mode share to percent of VMT, some assumption about the length of trip in each type of mode must be applied.

[37] Mark Mills. August 2021. The tough calculus of emissions and the future of EVs. Accessed at: https://techcrunch.com/2021/08/22/the-tough-calculus-of-emissions-and-the-future-of-evs/

[38] Embodied emissions are associated with energy used in the extraction, processing, and transportation of materials.

[39] Richard Campbell and Margaret Wittgens. March 2004. The Business Case for Active Transportation. Accessed at: http://thirdwavecycling.com/pdfs/at_business_case.pdf

Table 10 Transportation Measures

Measure Number	GHG Emissions Reduction Measures	Anticipated Reduction/ Sequestration (MT CO_2e)
T-1 (Municipal)	Continue to develop and implement the municipal Transportation Demand Management (TDM) program	Supportive
T-2 (Municipal)	Electrify or otherwise decarbonize the municipal fleet by 2035	Supportive
T-3	Implement programs that enhance access to safe active transportation, such as walking and biking, to increase active transportation mode share to 6% by 2030 and to 10% by 2035	2030: 952 2035: 2,757
T-4	Implement programs to encourage public transportation to increase public transportation mode share to 7% by 2030 and to 8% by 2035.	2030: 3,547 2035: 4,641
T-5	Support and promote regional programs that reduce the use of single occupancy vehicles	Supportive
T-6	Increase zero-emission passenger vehicle use and adoption to 30% by 2030 and 55% by 2035	2030: 53,948 2035: 107,774
T-7	Accelerate zero-emission commercial vehicle use and adoption to 26% by 2030 and 45% by 2035	2030: 1,777 2035: 2,140
T-8	Electrify or otherwise decarbonize 6% of off-road equipment by 2030 and 20% by 2035	2030: 2,857 2035: 9,859

These Measures and associated actions will build off existing City programs to provide incentivized options and infrastructure to increase active transportation, public transportation, Zero Emission Vehicle (ZEV) use and reduce the use of single occupancy vehicles. Measure T-3 aims to achieve greater mode-shifts to active transportation as well as low-stress and convenient infrastructure. To increase safe access to bicycle and pedestrian facilities, infrastructure improvements are needed in order to remove existing barriers to active transportation. With safer, more accessible active transportation opportunities, more people will choose active transportation modes.[40].

To achieve greater reliability in public transit (Measure T-4), MTD and the City will continue to develop and improve public transit programs and services. This measure prioritizes shared and public transit in the city, makes transit more convenient, and reduces the time it takes to reach a destination via transit—important determining factors for shared and public transit mode share. Measure T-5 provides the supportive framework for the goals in Measures T-3 and T-4 by creating programs and policies that both incentivize use of the active transportation and transit network, while also disincentivizing driving a single-occupancy vehicle, such as limited parking options. Reduction in single-occupancy vehicle VMT is largely based on behavior change which can be influenced with a combination of infrastructure that provides the alternative network to use and incentives/disincentives to single-occupancy vehicles. While the City cannot require its residents or businesses to buy ZEVs, Measures T-6 and T-7 will ensure that the ZEV infrastructure and incentives are available throughout the City to continue to remove barriers to passenger and commercial ZEV adoption. Lastly, Measure T-8 directs City efforts and activity in decarbonizing off-road equipment.[41]

[40] Smith, M., Hosking, J., Woodward, A. et al. Systematic literature review of built environment effects on physical activity and active transport – an update and new findings on health equity. Int J Behav Nutr Phys Act 14, 158 (2017). https://doi.org/10.1186/s12966-017-0613-9

[41] Off road equipment includes vehicles and equipment that operates not on traditional roadways https://ww2.arb.ca.gov/sites/default/files/offroadzone/pdfs/offroad_booklet.pdf

Measure T-1 (Municipal) Continue to Develop and Implement the Municipal Transportation Demand Management (TDM) Program

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
T-1.1	Structural Change, Foundational, Funding	Provide free or discounted access to public transit passes and the electric bicycle share program for all municipal employees and expand the WorkTRIP program to offer additional carbon-free or carbon-reduced modes of travel incentives.	Supportive
T-1.2	Structural Change	Explore a hybrid remote work program policy that supports municipal office employees to work from home as feasible (including alternative work schedules where feasible). City to explore financial assistance to help offset costs associated with home office needs.	Supportive
T-1.3	Structural Change, Funding	Provide cash incentives or paid time off for City employees to bike, walk, and carpool to work.	Supportive
T-1.4	Feasibility Studies	Conduct a detailed survey of City staff commute data annually including employee feedback to identify both major emission sources and potential gaps in planning.	Supportive
T-1.5	Feasibility Study, Structural Change	Identify opportunities for accessing bike lockers and showers at municipal office buildings.	Supportive

All actions of Measure T-1 work together to reduce the emissions associated with City staff commutes. Action T-1.2 allows for staff to work from home and eliminate commuter emissions on those days. Actions T-1.1 and T-1.3 provides incentives to carpool, use transit, or use alternative transportation when commuting and Actions T-1.4 and T-1.5 addresses challenges associated with these modes of transportation. The development and implementation of a successful TDM program will act as a case-study for other agencies, organizations, and businesses in the city to learn from and implement accordingly. This measure is not quantified to avoid double counting. Municipal emissions are a subset of community emissions and are already quantified under the community actions.

Measure T-2 (Municipal) Electrify or Otherwise Decarbonize the Municipal Fleet by 2035

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
T-2.1	Foundational	Complete and implement the City's Zero Emission Vehicle Acquisition Policy to convert fossil fuel municipal fleet vehicles, where feasible, to electric or otherwise decarbonize the fleet by 2035, including a short and long-term schedule for completion as well as potential for regional bulk procurement. Gain approval from City Council to allow discretionary electric vehicle purchases from different vendors.	Supportive
T-2.2	Structural Change	Install additional zero emission vehicle chargers in municipal parking lots for fleet and employee use.	Supportive
T-2.3	Foundational, Feasibility Studies	Procure biofuels (renewable diesel and biogas) to operate municipally owned on and off-road equipment with no existing opportunities for decarbonization. Re-evaluate decarbonization opportunities regularly to ensure biofuels are not being used for equipment that could otherwise be decarbonized.	Supportive
T-2.4	Structural Change	Develop and adopt a purchasing policy for smaller equipment (e.g., landscaping equipment) that includes reviews and prioritization of emissions-free equipment each time equipment is purchased.	Supportive

Actions in Measure T-2 build from existing work the City has done doing to reduce emissions associated with electrification and decarbonization of the municipal fleet. Action T-2.1 will implement the City’s existing zero-emission vehicle first purchasing policy for all municipal vehicles and Action T-2.4 will adopt a new policy for smaller equipment. Actions T-2.2 and Actions T-2.3 involves the provision of additional infrastructure and resources to support electric and biofuel vehicles. Municipal emissions are a subset of community emissions and are already quantified under the community actions.

Measure T-3 Implement Programs that Enhance Access to Safe Active Transportation, such as Walking and Biking, to Increase Active Transportation Mode Share to 6% by 2030 and to 10% by 2035

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
T-3.1	Foundational, Funding	Implement the City's Bicycle Master Plan and Pedestrian Master Plan goals and policies to enhance community access to safe active transportation options. Using these guiding documents, identify, design and procure funding for projects that can forward the goals of the BMP and PMP, and create bike and pedestrian infrastructure that is safer, easier to use, and widely accessible for all community members.	2030: 952 2035: 2,757
T-3.2	Foundational, Funding	Pursue funding and coordinate with existing streets maintenance programs to close gaps in the pedestrian and bike network, as identified in the Bicycle Master Plan, Pedestrian Master Plan, and Capital Improvement Program.	Supportive
T-3.3	Feasibility Studies, Structural Change	Evaluate existing bike parking facilities and identify what improvements can be made to increase parking supply, reduce theft, and increase rider attraction. Include analysis of last mile limitations and hurdles and add bike parking near transit stops accordingly. Consider AB 2097 and expanding bike parking with private facilities when vehicle parking is limited.	Supportive

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
T-3.4	Structural Change, Equity	Adopt the State's Slow Streets Program and expand the City's existing neighborhood traffic calming efforts with a focus on equity considerations for additional locations.	Supportive
T-3.5	Partnerships, Education	Engage MOVE SBC, SBCAG, MTD, Santa Barbara County Public Health Department, Cottage Hospital, school districts, local law enforcement, bike advocates, and community stakeholders to continue to identify and implement additional short-term and long-term bikeway and pedestrian infrastructure improvements, Vision Zero messaging and efforts, and general education regarding the safe utilization of our public active infrastructure.	Supportive
T-3.6	Equity, Foundational	Build new infrastructure to ensure there is equitable access to safe bike and pedestrian infrastructure in all areas of the city. Focus planning, development, and construction of active transportation infrastructure in regionally defined disadvantaged communities.	Supportive
T-3.7	Structural Change	Evaluate amending the zoning ordinance to increase bike parking and types of bike parking facilities for land development projects.	Supportive
T-3.8	Foundational	Implement the recommended bike facilities outlined in the Santa Barbara Bicycle Master Plan to add 30 miles of bike ways to the City by 2030.	
T-3.9	Foundational, Equity	Implement Santa Barbara's Vision Zero Strategy to eliminate serious injuries and fatalities on City streets.	Supportive
T-3.10	Feasibility Studies	Leverage technology to track mode shifts to active transportation. Conduct an annual review of progress on implementation progress, data quality, and potential barriers to implementation. Once an effective tracking method is developed, the City shall aim to achieve 6% increase in active transportation mode share by 2030 and 10% by 2035.	Supportive
T-3.11	Structural Change, Equity	Increase bike parking in nonresidential places like populated areas, City Parks, beaches, etc.	Supportive
T-3.12	Structural Change	Accelerate the production and availability of affordable housing near urban centers by updating and adopting the Housing Element and Zoning Code to reduce VMTs; by exploring alternative strategies to create and preserve affordable housing, such as co-ops, housing or land trusts; and by streamlining project review with objective design standards.	Supportive

Santa Barbara is ranked 3rd in the nation for the percentage of bicycle commute trips for cities of its size (65,000 to 100,000 people), and 8th overall.[42] A complete description of the goals, strategy, policy, and implementation framework for expanding and improving Santa Barbara's bikeway network is included in the Bicycle Master Plan (BMP) that was adopted in 2016. The BMP will continue to be updated as needed to identify new projects for implementation, and to ensure that improvement projects are correctly prioritized and meet the plan's guiding principles. The most recent update occurred in 2022.

The overall goal of the City's BMP is to provide a long-term vision for improving the active transportation network in Santa Barbara and enhance connections to residential areas, transit facilities, employment, retail and commercial centers, and public facilities. The community-driven

[42] 2016 Bicycle Master Plan – Chapter 1: Introduction https://santabarbaraca.gov/sites/default/files/documents/Public%20Works/Bicycle%20Master%20Plan/2016%20Bicycle%20Master%20Plan%20-%20Introduction.pdf

2016 BMP identified bikeway projects to help create a continuous bicycle network and enhance safety with a goal to increase commuting bicycle mode share by 6.9% by 2025 compared with 2016 bicycle mode share.[43] These projects were prioritized across three phases with milestone implementation years of 2020, 2025, and 2030. Implementing the BMP will consist of coordinating City departments with stakeholders (e.g., MOVE SBC, and underserved communities) to accomplish bikeway projects. The 2016 BMP documented 61 miles of bicycle routes. As of 2019, there were approximately 76 miles of bicycle routes in the city. As of the most recent BMP update in 2022, there were 84.6 miles of bike ways in the city and the overall goal of the BMP is to add an additional 30 miles by 2030, for which the City is on track to accomplish.[44]

Improving active transportation networks is an important part of building complete streets, which are streets that accommodate bikes, cars, shared transit, and pedestrians in an accessible way. Santa Barbara's Bicycle Master Plan and Pedestrian Master Plan implements the City's Complete Streets Policy.[45] Nationally, 48% of all vehicle trips were three miles or less in 2019, a distance easily travelled by foot, bicycle, or other micro mobility platforms.[46] An improved and expanded pedestrian network is the most effective and direct approach for shifting those shorter vehicle trips to walking, and studies show that distance to destinations is one of the strongest predictors of walking as a mode choice. However, little research has been conducted to determine quantitatively how improving the pedestrian network (rather than shortening the distance) translates to increased pedestrian mode share. This is further complicated by the fact that while improved pedestrian networks almost always have a positive correlation with increased walking, that does not always translate to decreased VMT. In other words, increased walking does not mean that walking trips are replacing driving trips. Therefore, while Santa Barbara will implement many projects to increase its active transportation network, the mode shift associated with this was estimated more conservatively and does not include reductions associated with increased walking. Lastly, the actions included in Measure T-5, which support and promote regional programs that reduce the use of the single occupancy vehicles, will also work to support Measure T-3 by encouraging programs that enhance the need for safe active transportation.

In order to estimate the mode shift potential associated with Measure T-3, other cities with similar buildouts (bike network mileage versus city land square footage) were compared. Results from significant investment in bicycle infrastructure in California suggest that bicycle mode share can be increased on par with leading bicycle cities in the state. The City of Davis leads the state with a 20% bicycle mode share[47] and 9.2 miles of bike lane per square mile of the city.[48] City of Berkely has a 9.7% bicycle mode [49] with approximately 4.8 miles of bike land per square mile of the city.[50] Santa Barbara's bicycle mode share in 2019 was 3.9% according to Census data[51] and had 3.6 miles of bike

[43] https://santabarbaraca.gov/government/departments/public-works/public-works-downtown-team/transportation-policy#:~:text=The%20community%2Ddriven%20Santa%20Barbara,the%20City%20of%20Santa%20Barbara.
[44] Communications with Samuel Furtner, City of Santa Barbara Mobility Coordinator and Associate Transportation Planner via email on June 8, 2023.
[45] 2016 Bicycle Master Plan – Goal 3: Complete Streets & Multi-modal Access. https://santabarbaraca.gov/sites/default/files/documents/Public%20Works/Bicycle%20Master%20Plan/2016%20Bicycle%20Master%20Plan%20-%20Goal%203%3A%20Complete%20Streets%20%26%20Multi-modal%20Access.pdf
[46] https://inrix.com/blog/2019/09/managing-micromobilty-to-success/
[47] https://www.theguardian.com/cities/2015/aug/03/davis-california-the-american-city-which-fell-in-love-with-the-bicycle
[48] https://www.cityofdavis.org/city-hall/public-works-engineering-and-transportation/bike-pedestrian-program/davis-bike-and-pedestrian-infrastructure#:~:text=4%20miles%20of%20buffered%20bike,and%20twenty%2Done%20underpass%20crossings.
[49] City of Berkeley. May 2017. City of Berkeley Bicycle Plan. Accessed at: https://www.cityofberkeley.info/uploadedFiles/Public_Works/Level_3_-_Transportation/Berkeley-Bicycle-Plan-2017-Executive%20Summary.pdf
[50] https://www.visitberkeley.com/media-press/press-kit/fact-sheet/
[51] 5-year estimate of bicycle mode share in 2019 according to census data obtained from: https://data.census.gov/table?t=Commuting&g=160XX00US0669070&tid=ACSST1Y2019.S0801

lane per square mile of the city.[52,53] With the City on track to add an additional 30 miles of bike lane by 2030[54] there would be approximately 5.4 miles of bike lane per square mile of city. Based on other similar cities it would seem that this increase in bicycle lane miles would lead to a bicycle mode share of approximately 10%. However, Census data has shown that bicycle mode share in the city has been slowly decreasing over time despite an increase in bicycle lanes, with 2021 Census data showing a 2.9% bicycle mode share.[55] This may be due in part to commuting characteristics of the community and spread out structure of the city compared with Berkely and Davis that are significantly more condensed. As Measure T-3 includes programs and policies to not just increase the quantity of bicycle lanes, but also the quality and safety of bicycle infrastructure and include programs to enhance affordable housing and equitable access to bicycle infrastructure, it is anticipated that there will be an increase in bicycle mode shift compared with current levels. As such, to remain conservative Measure T-3 sets a goal of increasing bicycle mode share to 6% by 2030 and 10 % by 2035.

The methods and assumptions used to calculate the GHG emissions reductions associated with these actions are shown in Table 11 below. EMFAC data for Santa Barbara County was utilized to determine the average trips per vehicle mile traveled and this is the best available data for the City. This factor was then used to convert City passenger VMT to the number of trips. The number of trips was multiplied by the bicycle mode share percentage to determine the number of trips that would be substituted by bicycle travel rather than passenger vehicle with the implementation of Measure T-3. It was assumed the average bike trip length was 1.5 miles[56] and therefore for every vehicle trip replaced by bicycle trip, 1.5 vehicle miles traveled would be reduced. Emission reductions were calculated by multiplying the replaced VMT by the emission factor for internal combustion engine passenger vehicles in the target year obtained from EMFAC.

[52] Based on information from the City of Santa Barbara Mobility Coordinator and Associate Transportation Planner, there was 76 miles of bike lanes completed in the city in 2019.

[53] City of Santa Barbara includes 21 square miles of land obtained from: https://santabarbaraca.gov/getting-around/maps-santa-barbara/area-city-explained#:~:text=The%20total%20area%20of%20the,total%20of%2043.09%20square%20miles.

[54] Communications with Samuel Furtner, City of Santa Barbara Mobility Coordinator and Associate Transportation Planner via email on June 8, 2023.

[55] https://data.census.gov/table?t=Commuting&g=160XX00US0669070&tid=ACSST5Y2021.S0801

[56] Caltrans California Household Travel Survey (2013)/CARB Bike Path Reductions Technical Documentation (2019)

Table 11 Measure T-3 Calculations

	2030	2035
Mode share target	6%	10%
Mode share increase beyond baseline[1]	2.1%	6.1%
Passenger VMT[2]	841,131,670	904,613,570
Passenger trips per mile[3]	0.1261	0.1258
Estimated passenger vehicle trips	106,090,611	113,832,239
New bike trips substituted for vehicle trips[4]	2,227,903	6,943,767
Passenger VMT reduced with bike trips (miles)[5]	3,341,854	10,415,650
Passenger Vehicle Emission Factor (MTCO_2e/mile) (EMFAC)[3]	0.00028494	0.00026472
Total reductions (MT CO_2e)	**952**	**2,757**

[1] Santa Barbara 5-year estimate from 2019 is at 3.9% bicycle mode share. https://data.census.gov/table?t=Commuting&g=1600000US0669070&tid=ACSST1Y2019.S0801

[2] Values from forecast. See City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum

[3] Derived from EMFAC model output for Santa Barbara County 2030 and 2035; note that EMFAC generates data at the County level, and this is the best available data for the City.

[4] Determined by multiplying estimated passenger trips by the mode share increase beyond baseline.

[5] Assume the average bicycle trip is 1.5 miles. Caltrans California Household Travel Survey (2013)/CARB Bike Path Reductions Technical Documentation (2019)

Providing education on the benefits of active transportation as well as technical information such as trip planning, safety best practices, incentives and other programs will help generate momentum around active transportation and support the overall strategy. The City continues to work with MOVE SBC, SBCAG, MTD, Santa Barbara County Public Health Department, Cottage Hospital, school districts, local law enforcement, bike advocates, and community stakeholders to identify and implement additional short-term and long-term bikeway and pedestrian infrastructure improvements, Vision Zero messaging and efforts, and general education regarding the safe utilization of our public active infrastructure. The additional promotional activities identified under this measure, including leveraging technology to track mode shifts in active transportation, would involve conducting an annual review of progress on implementation progress, data quality, and potential barriers to implementation.

Measure T-4 Implement Programs to Encourage Public Transportation to Increase Public Transportation Mode Share to 7% by 2030 and to 8% by 2035

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
T-4.1	Structural Change, Feasibility Studies	Explore alternative forms of public transit, such as micro transit and/or new electric shuttle routes, in areas with higher congestion and population densities. Micro transit is a type of on-demand, shared transportation service that typically operates with smaller vehicles, such as vans or mini-buses, and offers flexible routes and schedules.	2030: 3,547 2035: 4,641
T-4.2	Education, Foundational	Market and publicize public transportation improvements as they are planned and implemented in a variety of methods (social media, newspaper, radio, etc.) and languages to help facilitate use and success of improvement.	
T-4.3	Partnerships, Feasibility Studies	Partner with Santa Barbara MTD to determine transit priority projects and determine best potential locations for expansion and increased service.	
T-4.4	Partnerships, Foundational	Work with nonprofit and community stakeholders to enhance public transit opportunities.	
T-4.5	Equity, Foundational	Work with Santa Barbara MTD to ensure public transportation access and improvements are prioritized in low-income and high population density areas of the City.	
T-4.6	Partnerships	Work with MTD to identify and implement pilot projects and infrastructure updates to make transit safer, more consistent, and more convenient.	

In general, increases and improvements to public transportation systems reduce a city's dependence on fossil fuels and reduce VMT. To further support a transition to shared transit, the City has identified six actions which work together to improve transit adoption. In order to estimate the mode shift potential associated with Actions T-4.1 through T-4.6, other cities with similar levels and types of public transportation investment were compared. Success in other cities suggests that significant investment in public transportation can increase public transportation mode share on par with those cities. The City of San Francisco leads the state with 26% public transportation mode share in 2017 (pre-COVID). The City of Seattle has documented significant increases in public transportation mode share to 48% in 2017 (pre-COVID). Key strategies employed by these cities include significant expansions of public transportation service lines, designated streets or lanes for bus lines to decrease headways, implementation of taxes to support transit, and reduced parking availability (Measure T-5.6). Santa Barbara is following the lead of San Francisco and Seattle by implementing Actions T-4.1, T- 4.3, T-4.4. T-4.5, and T-4.6. Most of these actions involve the City working with Santa Barbara Metropolitan Transit District (MTD), a public transit agency providing bus service in the southern portion of Santa Barbara County, California. It serves the surrounding local communities (i.e., Carpinteria, Goleta, Summerland, Isla Vista, and Montecito) which often commute to Santa Barbara for work, travel, or recreation. The City will work with MTD to determine transit priority projects and determine best potential locations for expansion and increased service, which will be prioritized in low-income and high population density areas of the City. The best ways to improve a transit system and reduce driving is to expand its geographical reach and increase the frequency and reliability of transit service. Approximately 1% increase in transit frequency saves 0.5% in VMT. Bus Rapid Transit can also yield a corridor-level VMT reduction of 1-2%.[57]

[57] https://www.smartgrowthamerica.org/app/legacy/documents/smartgrowthclimatepolicies.pdf

Action T-4.1 involves the City exploring alternative forms of transit, such as providing micro-transit and/or new electric shuttle routes. These will be alternative means of shifting mode share to transit with the goal of increasing the convenience of transit by reducing the time it takes to reach a destination via transit as well as reducing wait times (headways) for transit. One recent study modeled automated shuttles in Santa Clara County that would result in several benefits: a decrease in gasoline-based trips, an overall increase in transit usage, and additional first- and last-mile connections to transit, proving a higher accessibility of transit, especially during night hours.[58] Many cities in California and throughout the Country have been conducting micro-transit projects for several years and the number of projects is continuing to grow.[59], [60] Action T-4.2 directs the City to improve communication of the transportation improvements with the local community. Effective communication, especially communication that takes advantage of new and emerging technologies to accurately and easily disseminate trip planning and real-time status information, is a strong factor in helping customers decide to use transit for business or leisure trips.[61] Further, improving transit access has the potential to shift trips from cars to transit, which may reduce vehicle trips, VMT, and GHG emissions, with time spent getting to a transit stop being the key indicator of transit access.[62]

Santa Barbara's baseline public transit mode share of 3.9% was calculated from 2019 Census data.[63] Based on T-4.1 through T-4.6 Actions, which includes strategies similar to San Francisco (26% public transit mode share) and Seattle (48% public transit mode share), it is reasonable to assume that Santa Barbara can achieve a 4% increase in transit mode share (reaching a 7% public transit mode share) in 2030. Lastly, the actions included in Measure T-5, which support and promote regional programs that reduce the use of the single occupancy vehicles will also support Measure T-4.

The methods and assumptions used to calculate the GHG emissions reductions associated with these actions are shown in Table 12 below. To avoid double-counting of VMT reduction, passenger VMT reduced due to mode shift to bicycle trips calculated as part of Measure T-3 were subtracted from total passenger VMT in the target year. The adjusted passenger VMT was converted to trips using passenger trips per mile from EMFAC, similar to the calculations described in Measure T-3. The number of trips was multiplied by the transit mode share percentage to determine the number of trips that would be substituted by transit rather than passenger vehicle with the implementation of Measure T-4. It was assumed the average transit trip length on a bus was 3.8 miles[64] and therefore for every vehicle trip replaced by a bus trip, 3.8 vehicle miles traveled would be reduced. Emission reductions were calculated by multiplying the replaced VMT by the emission factor for internal combustion engine passenger vehicles in the target year obtained from EMFAC.

[58] Poliziani C, Hsueh G, Czerwinski D, Wenzel T, Needell Z, Laarabi H, Schweizer J, Rupi F. Micro Transit Simulation of On-Demand Shuttles Based on Transit Data for First- and Last-Mile Connection. ISPRS International Journal of Geo-Information. 2023; 12(4):177. https://doi.org/10.3390/ijgi12040177
[59] https://www.apta.com/research-technical-resources/mobility-innovation-hub/microtransit/
[60] https://transweb.sjsu.edu/research/2249-Demand-Responsive-Transportation-Shared-Mobility
[61] https://transitleadership.org/docs/TLS-WP-Improving-the-Customer-Experience.pdf
[62] https://ww3.arb.ca.gov/cc/sb375/policies/transitaccess/transit_access_brief120313.pdf
[63] 5-year estimate obtained from: https://data.census.gov/table?t=Commuting&g=160XX00US0669070&tid=ACSST1Y2019.S0801
[64] American Public Transportation Association. December 2018. 2018 Public Transportation Fact Book. Accessed at: https://www.apta.com/wp-content/uploads/Resources/resources/statistics/Documents/FactBook/2018-APTA-Fact-Book.pdf

Table 12 Measure T-4 Calculations

	2030	2035
Mode share increase from baseline	7%	8%
Mode share increase beyond baseline[1]	3.1%	4.1%
Passenger miles (VMT)[2]	837,789,816	894,197,921
Passenger trips per mile[3]	0.1261	0.1258
Passenger trips	105,669,109	112,521,584
New transit trips substituted for vehicle trips[4]	3,275,742	4,613,385
VMT reduced with transit trips[5]	12,447,821	17,530,863
Passenger emission factor[3]	0.00028494	0.00026472
Emission reductions from VMT avoided (MT CO_2e)	**3,547**	**4,641**

[1] Santa Barbara 5-year estimate from 2019 is at 3.9% public transportation mode share. https://data.census.gov/table?t=Commuting&g=1600000US0669070&tid=ACSST1Y2019.S0801

[2] Values from forecast less VMT reduced with bicycle trips calculated in Measure T-3 (Table 17). See City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum.

[3] Derived from EMFAC model output for Santa Barbara County 2030 and 2035; note that EMFAC generates data at the County level, and it is assumed that this is the best available data for the City.

[4] Determined by multiplying estimated passenger trips by the mode share increase beyond baseline.

[5] Assume that the majority of public transit in the City is bus. The average bus trip is 3.8 miles. 2018 Public Transportation Fact Book

Measure T-5 Support and Promote Regional Programs that Reduce the Use of Single Occupancy Vehicles

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
T-5.1	Structural Change, Partnerships, Education, Foundational	Continue to work with SBCAG to encourage employers to develop Transportation Demand Management (TDM) Plans for their employees. TDM plans should include incentives for employees to bike, walk, carpool, or take the bus to work and should be publicized on a website.	Supportive
T-5.2	Feasibility Studies, Partnerships, Equity	To enhance the Santa Barbara community's ability to telecommute, implement SBCAG's Broadband Regional Study to identify areas of the City that have limited access to broadband service due to infrastructure and financial limitations.	Supportive
T-5.3	Funding, Equity	To enable telecommuting, leverage the grant writer position(s) in strategy A-2.2 to identify funding opportunities to bridge the broadband access gap in the City by helping to fund installation of infrastructure or subsidize broadband service for low-income households.	Supportive
T-5.4	Funding, Equity	Provide active and alternative transportation resources across all businesses in the city prioritizing small, women owned, and minority owned businesses regardless of Transportation Demand Management Plan (TDM) membership.	Supportive
T-5.5	Foundational	Implement AB 2097 which prohibits the City from imposing minimum parking requirements on residential and commercial development, if located with ½ mile of public transit that is consistent with AB 2097.	Supportive

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
T-5.6	Structural Change, Funding	In line with the General Plan, develop and implement a program to manage parking of single-occupancy vehicles. Utilize on street parking pricing for all downtown parking locations and use revenue to fund active transportation, public transportation projects, and neighborhood improvements. The program should address parking issues citywide and consider measures to prevent impacts to surrounding areas and coastal access. This analysis may include citywide use of parking permit programs and other measures.	Supportive
T-5.7	Structural Change	Develop the Pilot Bike Share Program into a permanent and dependable bike share network that provides access to key destinations throughout the City, and work with regional partners to assess potential for a regional bike share system.	Supportive
T-5.8	Education, Foundational	Coordinate with SBCAG and regional partners to update regional active transportation maps. Distribute active transportation maps and educational materials to various stakeholders. Prioritize education regarding digital mapping that is available on regularly used platforms like Google Maps.	Supportive
T-5.9	Partnerships	Partner with the tourism and business sectors of the greater Santa Barbara County region to identify pathways to increase active transportation by tourists and employees.	Supportive
T-5.10	Equity, Education	Reduce driving of single occupancy vehicles through public education and engagement. Examine equity concerns around reducing single occupancy vehicles and ensure there are adequate resources available for alternative forms of transportation.	Supportive
T-5.11	Structural Change, Feasibility Study	Explore options to address long distance commuter parking. For example, add a parking lot outside of the downtown area for long distance commuters and use mode share to bring these employees into the downtown area from the new parking lot, reducing parking congestion.	Supportive

Measure T-5 supports a transition to alternative modes of transportation besides single occupancy vehicles and therefore, is supportive of both Measure T-3 and T-4. The Actions included under Measure T-5 have been shown to be effective in changing community choices around transportation. The impacts of incentive-based policies and programs improving infrastructure for safe and convenient active transportation (Measure T-3) and transit use (Measure T-4) increase when coupled with disincentives for less favorable choices, such as making it less convenient to drive a gasoline-fueled single passenger vehicle. However, disincentive-based policies can be unpopular and place a burden on the community if not implemented carefully. Measure T-5 includes both incentives and disincentives to support the infrastructure changes and programs developed in Measure T-3 and T-4. Measure T-5 includes several actions focused on developing incentives and programs to promote active transportation (Action T-5.7, Action T-5.8, Action T-5.9), alternative transportation (Action T-5.4), and teleworking (Action T-5.2, Action T-5.3). By leveraging the grant writing position through Action T-5.3), the City will work to identify funding for telework efforts and ensure low-income and disadvantage communities also have access to telework options where possible. Under Action T-5.1, the City will work with SBCAG to encourage employers to develop and implement Transportation Demand Management (TDM) Plans that incentivize alternative modes of commute for their employees.

Reduced parking supply, when combined with other VMT reduction measures such as efficient public transit, land use policies, and urban parking pricing can reduce VMT.[65] Reduced parking supply makes driving single-passenger vehicles less attractive and can shift traveler choice to other options. Parking supply can be reduced by decreasing parking requirements for new development when near public transit (Action T-5.5) and eliminating parking spots for single-occupancy vehicles (Action T-5.6). Additionally, studies have indicated that implementing a paid parking program can lead to a 1 to 2.8 percent decrease in regional VMT.[66] However, potential VMT reduction is variable and highly dependent on the specific community design, supporting programs, and how parking limits interact with other efforts to reduce VMT such as public transit and active transportation infrastructure. Structural change actions limiting single-occupancy vehicle parking and developing a street parking price for all downtown parking (Action T-5.6) should be supported by feasibility planning and engagement efforts. Action T-5.6 will generate the additional analysis needed to better understand the scale of GHG reductions that might be achieved.

Actions T-5.10 and T-5.11 provide the engagement efforts and feasibility planning needed to make structural changes limiting single-occupancy vehicle parking and developing a street parking price for all downtown parking (Action T-5.6) successful. These actions, as well as part of Action T-5.6 are also focused on identifying equity concerns so that they may be addressed in the implementation of such programs. Measure T-5 supports Measure T-3 and Measure T-4 in reducing communitywide VMT and therefore, the GHG emission reductions are not quantified.

[65] Lee Provost. Caltrans Division of Research, Innovation and System Information. March 2018. Pricing and Parking Management to Reduce Vehicle Miles Travelled (VMT). Accessed at: https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/preliminary-investigations/final-pricing-parking-management-to-reduce-vehicles-miles-traveled-pi-a11y.pdf

[66] Steven Spears, Marlon G. Boarnet, Susan Handy. California Environmental Protection Agency Aire Resources Board, Policy Brief. September 2014. Impact of Parking Pricing and Parking Management on Passenger Vehicle Use and Greenhouse Gas Emissions. Accessed at: https://ww2.arb.ca.gov/sites/default/files/2020 06/Impacts_of_Parking_Pricing_Based_on_a_Review_of_the_Empirical_Literature_Policy_Brief.pdf

Measure T-6 Increase Zero-Emission Passenger Vehicle Use and Adoption to 30% by 2030 and 55% by 2035

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
T-6.1	Structural Change	In 2025 and every 3-years thereafter, amend the Municipal Code to require increased number of electric vehicle capable charging spaces in new construction and major redevelopment for commercial, mixed-use, and multi-family development.	2030: 53,948 2035: 107,774
T-6.2	Structural Change	In 2025 and every 3-years thereafter, revisit commercial and multi- family building ordinances to be updated and require large commercial (more than 10,000 square feet) and large multi-family (more than 20 units) building owners that are providing parking to install working electric vehicle chargers in 20% of parking spaces for existing buildings when undergoing a major remodel (over 50% of building effected or an addition of over 50% of gross floor space).	Supportive
T-6.3	Foundational	Add 1,788 (by 2030) and 3,536 (by 2035) new publicly accessible electric vehicle charging stations throughout the City and at City-owned facilities to support community EV charger access.	Supportive
T-6.4	Foundational	Support private development of EV charger installations by effectively streamlining City processes, such as expediting permitting, easing onerous regulations, develop a permitting design guide.	Supportive
T-6.5	Equity, Partnerships	Identify private sector partnerships and develop affordable, zero- emission vehicle car share programs to serve affordable housing and/or multi-unit developments with a priority to target under- resourced populations.	Supportive

Measure T-7 Accelerate Zero-Emission Commercial Vehicle Use and Adoption to 26% by 2030 and 45% by 2035

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
T-7.1	Feasibility Studies	Develop and implement a City Zero Emission Vehicle Action Plan (ZEVAP) to identify policies to accelerate ZEV adoption community wide.	2030: 1,777 2035: 2,140
T-7.2	Funding, Education, Equity	Identify and connect commercial vehicle owners, particularly those serving under-resourced communities, to resources that can incentivize vehicle electrification. This could include local tax breaks	Supportive
T-7.3	Education, Partnerships	Provide information to the public on low-carbon fuel standards (LCSF) and how businesses can develop LCSF credits or other state and federal programs to help fund conversion of commercial fleets to zero emissions vehicles.	Supportive
T-7.4	Funding	Create a small business truck buyback program to buyback trucks from local small businesses to upgrade to electric.	Supportive
T-7.5	Moonshot	Consider establishing a licensing fee for commercial delivery vehicles operating on fossil fuels (such as Amazon and FedEx) to provide funding for new active transportation and EV charging/ZEV fueling infrastructure and discounting the fee for the proportion of electric vehicles the delivery company uses.	Supportive

Together the Actions within Measures T-6 and T-7 will encourage electric vehicle (EV) adoption within the community. The state has established a goal of putting 5 million EVs on the road by 2030.[67] However, the recent passing of executive order N-79-20 calls for 100% of passenger vehicles sold to be all electric by 2035.[68] This new executive order puts the total number of EVs on the road by 2035 at approximately 15 million.[69] Based on the current number of vehicles registered in California and a 2% growth rate per year, 15 million EVs accounts for 35% of total vehicles in 2035. Interpolating between today's EV percentage at the state level (5%) and this projected growth yields an expected EV adoption rate of 25% by 2030. As a part of this CAP, the City has established its own goal in line with this and aims to reach 30% passenger EV adoption by 2030 and 55% by 2035. As of 2020, Santa Barbara has 8,408 electric vehicles, fuel cell, and plug-in hybrid vehicles out of 116,101 vehicles currently registered, together accounting for 7% of the vehicles registered within the City.[70]

The City has also adopted commercial EV adoption goals, with 26% by 2030 and 45% by 2035. This is backed by new regulations that CARB adopted in June 2020, requiring truck manufacturers to transition from diesel trucks and vans to electric zero-emission trucks beginning in 2024, and establishing a target for every new truck sold in California to be zero-emission by 2045.[71] CARB recently adopted the Advanced Clean Fleets rule requiring private services, federal fleets, state and local government fleets to begin their transition toward zero emission vehicles starting in 2024 with the goal of achieving a zero-emission truck and bus California fleet by 2045.[72] The Advanced Clean Fleets rule also includes an end of combustion truck sales in 2036. Companies in the commercial sector are already moving to electrify their fleets, with Amazon planning to have 100,000 electric delivery vehicles on the road by 2030.[73] If both passenger and commercial EV adoption rates are outpacing EV charging infrastructure, adjustments can be made over time to reflect total EVs as well as charging technologies and consumer behaviors.

While the City cannot require residents or businesses to buy and use EVs rather than gas-powered vehicles, the City will take actions to incentivize this behavior change and support this level of EV adoption. As a part of this strategy, the City's primary target will be to provide one public EV charger for every 20 EVs and ensure as many privately owned chargers are installed in new development as practicable, in line with the leading cities in California (San Francisco, Los Angeles, and San Jose) and recent charging infrastructure studies. Since the City of Santa Barbara already has 132 existing public charging stations [74], there is currently one public EV charger for every 64 EVs, and the City will need to have 1,788 new public chargers installed to meet the forecasted demand from passenger vehicles by 2030. The actual number and ideal locations for these EV charging stations would need to be further investigated through a Zero Emission Vehicle Action Plan including analysis of greater fast charging infrastructure needed to power the 19 zero-emission commercial truck models set to come to the North American market over the next three years (Action T-7.1).[75] Increasing the amount of EV charging infrastructure overall will support these vehicles operating in Santa Barbara. As the need for charging infrastructure changes over time depending on new technologies such as smart chargers, megawatt-scale charging systems tailored specifically to medium- and heavy-duty

---

[67] https://www.cpuc.ca.gov/zev/

[68] https://ww2.arb.ca.gov/resources/fact-sheets/governor-newsoms-zero-emission-2035-executive-order-n-79-20

[69] https://spectrumnews1.com/ca/la-west/transportation/2020/10/05/what-it-will-take-to-sell-100--evs-in-california

[70] https://www.dmv.ca.gov/portal/uploads/2020/09/MotorVehicleFuelTypes_City_01012020.pdf

[71] https://ww2.arb.ca.gov/news/california-takes-bold-step-reduce-truck-pollution#:~:text=SACRAMENTO%20%E2%80%93%20Today%2C%20the%20California%20Air,California%20will%20be%20zero%2Demission.

[72] https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets/about

[73] https://www.businessinsider.com/amazon-creating-fleet-of-electric-delivery-vehicles-rivian-2020-2

[74] https://www.plugshare.com/directory/us/california/santa-barbara

[75] https://www.greenbiz.com/article/we-should-be-talking-about-charging-infrastructure-heavy-duty-trucks

electric trucks, and trends in personal EV adoption, it will be important for the City to continue updating its long-term goals as necessary.[76]

T-6.1 through T-6.3 will account for the majority of the targeted number of EV chargers in 2030 and 2035. A 2015 report by Idaho National Laboratory, *Plugged In: How Americans Charge Their Electric Vehicles*, found that nearly 98% of all EV charging events occurred at home or work.[77] In support of these findings, and to address the challenges faced by those who may not be able to install their own home chargers, amendment of the Municipal Code (Action T-6-1) to require increased number of electric vehicle capable charging spaces would support increased infrastructure at new and existing commercial and multi-family residential developments. EV-ready building codes are one of the most effective and low-cost strategies for states and local governments to encourage consumers to buy or lease electric vehicles and can save consumers thousands of dollars in installation costs.[78]

Title 24, Part 11, Chapter 5 of the California Green Building Standards Code requires non-residential new construction to provide some parking spaces with electrical infrastructure sufficient to support future installation of electric vehicle supply equipment/system (EVSE).[79] This strategy ensures that Santa Barbara will have clear guidelines and standards in place for installing EVSE infrastructure. It also calls for creating a streamlined permitting and inspection procedure for EVSE to ensure reduced wait times and costs for new EV owners. Applying for a permit and waiting for an inspector can be time intensive and costly – as many as three separate visits by the installer may be required to apply for the permit, perform the work, and complete the inspection, and a fourth visit may be needed if the utility requires a separate inspection. To avoid this, the City will implement Action T-6.4 and streamline the EVSE permitting and inspection process to further ease the burden on new EV owners and support Measure T-6. The next phase for EVSE expansion will provide additional publicly accessible charging (Action T-6.3).

Establishing a licensing fee for commercial delivery vehicles will also help support Measure T-7 and decrease emissions from the commercial transportation sector. This would provide additional funding for the City to install additional EV charging infrastructure. The retail delivery sector is already trending in this direction, with Amazon revealing its first electric vehicle delivery van in 2020, which began making deliveries in 2021. The company has ordered 100,000 electric delivery vehicles already from electric vehicle maker Rivian.[80]

The methods and assumptions used to calculate the GHG emissions reductions associated with these actions are shown in the table below. The number of new public chargers needed to support Santa Barbara's passenger EV adoption goals were also calculated, shown below in Table 13. This was based on 2020 vehicle registration data from the DMV and the assumption that one public charger should be available for every 20 EVs. The existing 6.83% of passenger EVs and 6.57% of commercial EVs[81] in the City were also taken into account. Total registered vehicles were forecasted based on the 2020 ratio of registered vehicles to population. Emission reductions from the actions in Measure T-6 and T-7 were calculated together as emissions saved by meeting EV adoption goals in 2030 and 2035. Emission reduction calculations are shown below in Table 14.

[76] https://www.nrel.gov/transportation/medium-heavy-duty-vehicle-charging.html
[77] https://www.osti.gov/biblio/1369632-plugged-how-americans-charge-electric-vehicles
[78] https://www.swenergy.org/cracking-the-code-on-ev-ready-building-codes
[79] https://codes.iccsafe.org/content/CAGBSC2016/chapter-5-nonresidential-mandatory-strategys
[80] https://www.businessinsider.com/amazon-creating-fleet-of-electric-delivery-vehicles-rivian-2020-2
[81] EMFAC, 2021

Table 13 EV Charger Count for Passenger Vehicles Calculations

	2030	2035
Population[1]	96,637	100,713
Total registered vehicles[2]	127,976	133,374
Registered EV goal[3]	38,393	73,356
EVs per charger[4]	20	20
New publicly available EV chargers needed[5]	1,788	3,536

[1] Values from forecast. See Appendix A.

[2] Based on a calculated value for cars for capita (1.321) derived by dividing the total number of registered vehicles in Santa Barbara in 2020 (https://www.dmv.ca.gov/portal/uploads/2020/09/MotorVehicleFuelTypes_City_01012020.pdf) by the 2020 population of Santa Barbara as established in Appendix A.

[3] Calculated as total registered vehicles multiplied by EV adoption percentage in above table

[4] https://theicct.org/sites/default/files/publications/US_charging_Gap_20190124.pdf

[5] Based on the assumption that approximately one public EV charger is needed per 20 EVs, taking into account the existing 132 EV chargers already in Santa Barbara. This assumption may change over time due to better technology, changes to consumer behavior, or both. The total number of chargers especially in 2035 will need to be revisited to ensure the numbers reflect the current EV landscape. https://theicct.org/sites/default/files/publications/US_charging_Gap_20190124.pdf

Table 14 GHG Emissions Reductions from Measure T-6 and T-7

	2030	2035
Passenger Vehicles		
Passenger VMT after alternate transit VMT reductions	825,341,995	876,667,058
EV adoption beyond baseline[2]	23%	47%
Passenger Vehicle Emission Factor (MTCO$_2$e/mile) (EMFAC)[3]	0.000284942	0.000264718
Emissions Reductions from EV Passenger VMT (MT CO$_2$e)[4]	54,489	108,063
EV electricity usage (kWh/EV-mile)	0.369	0.369
EV electricity usage from increased EV adoption (kWh)	70,470,365	150,621,912
Electricity EF (lbs CO$_2$e/MWh)[5]	16.91	4.23
Emissions from electricity usage for EVs	541	289
Total Passenger Vehicle Emission Reductions	**53,948**	**107,774**
Commercial Vehicles		
Commercial VMT after mode shift to bikes and transit (VMT)[1]	8,797,048	8,998,020
EV adoption beyond baseline[2]	19%	27%
Commercial Vehicle Emission Factor (MTCO$_2$e/mile) (EMFAC)[3]	0.00104733	0.00089524
Emissions reduced from EV adoption (MT CO$_2$e)[4]	1,790	2,144
EV electricity usage (kWh/EV-mile)	1.02	1.00
Additional kWh from new EV miles	1,736,036	2,389,197
Electricity EF (lbs CO$_2$e/MWh)[5]	16.91	4.23
Emissions from electricity usage for EVs	13	5
Total Commercial Vehicle Emission Reductions	1,777	2,140
Total reductions (MT CO$_2$e)	**55,725**	**109,914**

[1] VMT from forecast (see Appendix A) minus VMT avoided from mode shift to bikes in Strategy T-1

[2] Baseline EV penetration rates for Santa Barbara County obtained from EMFAC2021. EV adoption beyond the baseline is based on executive order N-79-20 100% of passenger vehicle sales will be electric by 2035. Assuming 15 million EVs by 2035 due to N-79-20 and a 2% growth rate from current vehicle registrations (32,000,000) and a 5% current share of EVs California would be projected to have 25%

	2030	2035
EVs by 2030. 25% is in line with State goals. (https://spectrumnews1.com/ca/la-west/transportation/2020/10/05/what-it-will- take-to-sell-100--evs-in-california)		
[3] Derived from EMFAC model output for Santa Barbara County 2030 and 2045; note that EMFAC generates data at the County level, and it is assumed that this is the best available data for the City.		
[4] Emissions reduced from EV adoption is calculated as the VMT after mode shift, multiplied by the EV adoption beyond baseline percentage multiplied by the weighted vehicle emission factor in that year.		
[5] The residential electricity emission factor was calculated based on opt-out rates for Santa Barbara according to EMFAC.		

Measure T-8 Electrify or Otherwise Decarbonize 6% of Off-Road Equipment by 2030 and 20% by 2035[1]

Action Number	Strategic Theme	Action	Anticipated Reduction ($MT\ CO_2e$)
T-8.1	Structural Change, Funding	Align with or exceed AB 1346 and expand enforcement of the ordinance that bans gas powered small off-road engines by 2024 (e.g., lawn and garden equipment). Provide income tiered incentives or buyback programs for burdened residents and businesses. Identify staffing needs for an enforcement and implementation tracking program run by the relevant City department.	2030: 2,857 2035: 9,859
T-8.2	Education	Inform, educate, and support the transition of local employers to zero emission off-road equipment, including major construction companies, manufacturers, landscapers, and warehouse companies.	Supportive
T-8.3	Feasibility Studies	Investigate off-road equipment fleets in the City of Santa Barbara, identify fleets with highest decarbonization potential, and conduct engagement to under-resourced communities to understand how to support conversion.	Supportive
T-8.4	Partnerships, Funding	Partner with Santa Barbara County Air Pollution Control District to expand rebate and incentive programs for upgrading off-road equipment to hybrids, biofuels, or fully electric.	Supportive
T-8.5	Funding	Leverage the grant writer position(s) in strategy A-2.2 to source state funding to decarbonize off-road equipment as a result of Executive Order N-79-20 and State Climate Funding Package.	Supportive
T-8.6	Education	Develop a landscape equipment education and incentive program incentivizing motorized landscape equipment electrification (electric leaf blowers already required, but can get rolled into an education campaign) for hedge trimmers, etc.	Supportive

[1] This would not apply to recreational or commercial marine vessels. The California Air Resources Board currently has regulations in place to develop a performance standard program for commercial marine vessels. This requires zero- emission options where feasible, and cleaner combustion Tier 3 and 4 engines on all other vessels. Implementation of these regulations will occur in 2023 through the end of 2032.

Off-road equipment in Santa Barbara accounts for 7% of the community's GHG emissions. While only a small part of GHG emissions in the city, achieving carbon neutrality will involve decarbonizing all of the off-road equipment, which currently runs on gasoline, diesel, and natural gas. To support a gasoline and diesel phase-out ordinance for off-road equipment, Action T-8.1 commits the City to enforcing a ban on the operation of gasoline and diesel-powered small off-road equipment by 2024 (in compliance with AB 1346). The City expects that this action will be further supported by future CARB regulations for off-road equipment that may ban their sale in the region by 2035.[82] While some off-road equipment does not have market-ready zero-emissions alternatives, lawn and garden equipment, light-duty off-road equipment, and portable off-road equipment can generally be

[82] See: https://ww2.arb.ca.gov/rulemaking/2021/sore2021

electrified or use biodiesel today. In 2030, it is forecasted that portable and lawn and garden equipment would make up 16% total off-road equipment.[83] Therefore, a 6% reduction in overall off-road emissions is feasible through the enforcement of an off-road electrification ordinance that bans gasoline and diesel-powered portable and lawn and garden equipment.

Action T-8.3 commits the City to investigating the feasibility of reducing emission from major off-road equipment fleets in the City. The study will help the City better understand what types of commercial off-road equipment exists, how old it is, how much potential there is, and how the City can support electrification or decarbonization.

Actions T-8.2, T-8.4, T-8.5, and T-8.6 support implementation through increased education, funding, and equity considerations. These partnerships can ensure that vulnerable communities receive needed resources as well as funding to make the switch.

The methods and assumptions used to calculate the GHG emissions reductions associated with this metric are explained further here and shown in Table 15 below. The GHG reductions were quantified based on a reduction in fuel use by 6 percent and 40 percent from the forecasted fuel consumption in 2030 and 2035, respectively. Forecasted fuel use was obtained from California Air Resources Board's off-road emissions inventory tool, 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.[84] Off-road diesel, gasoline, and natural gas emissions were acquired through EMFAC fuel usage data and multiplied by respective emissions factors.[85]

Table 15 GHG Emissions Reductions from Measure T-8

	2030	2035
Decarbonized Percentage	6%	20%
Diesel Fuel Use (gal)	2,707,729	2,798,265
Gasoline Fuel Use (gal)	1,866,281	1,946,720
Natural Gas Fuel Use (gal)	399,675	400,051
Weighted Emission Factor[1]	0.009574	0.009581
Fuel Use Reduction (gal)	298,421	1,029,007
Total Reductions (MT CO_2e)[2]	**2,857**	**9,859**

[1] A weighted emission factor for all fuel is based on the forecasted fuel consumption by fuel type and the specific fuel type emission factor.

[2] Total reductions do not account for the emissions associated with electric to biofuel usage because these emissions would be minimal due to Santa Barbara's carbon-free electricity.

[83] City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum (utilizes CARB's OFFROAD 2021 Santa Barbara County off-road emissions and attributes them to Santa Barbara).

[84] City of Santa Barbara 2019 Greenhouse Gas Emissions Inventory, Forecast, and Targets Technical Memorandum

[85] See: https://arb.ca.gov/emfac/emissions-inventory/c58cfe3d0072dfc3ea8eae4234049042e52ed4df

4 Water, Solid Waste, and Wastewater Measures

Santa Barbara's waste measures build on the City's existing infrastructure and programs that reduce solid waste generation and increase diversion from the landfill. Emphasis is placed on reduction of organic waste sent to landfills, as landfilled organic waste is the major source of waste-related greenhouse gas emissions. The measures in this section also support the City's overall goal of working toward zero wasted resources such as water. The actions that address inorganic waste have relatively smaller impacts in meeting the City's communitywide greenhouse gas emissions reduction goals and, therefore, the impact of diverted inorganic waste is not quantified.

The CAP's water, solid waste, and wastewater measures are as shown in Table 16.

Table 16 Water, Solid Waste, and Wastewater Measures

Measure #	GHG Emissions Reduction Measures	Anticipated Reduction/ Sequestration (MT CO_2e)
W-1 (Municipal)	Increase municipal procurement of recovered organics waste products.	Supportive
W-2 (Municipal)	Reduce municipal water consumption.	Supportive
W-3	Reduce per capita potable water consumption 1.05% by 2030 and 1.58% by 2035.	2030: 1.72 2035: 0.67
W-4	Reduce organic waste 80% below 2014 levels by 2030 and 85% by 2035.	2030: 45,773 2035: 50,271

The City has been successful in reducing potable water consumption through implementation of programs and policies in the Enhanced Urban Water Management Plan, enforcing the Model Water Efficient Landscape Ordinance, increasing the available supply in infrastructure for use of recycled water, and providing water efficient devices and appliance incentives.

Measure W-1 (Municipal) Increase Municipal Procurement of Recovered Organics Waste Products

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
W-1.1	Structural Change, Funding	Require City agencies to procure and apply compost generated from municipal organic waste to the exterior of suitable facilities as part of their operations.	Supportive
W-1.2	Structural Change	Increase signage for municipal buildings, parking, and sidewalk bins on accepted landfill, recyclable, and compostable materials.	Supportive
W-1.3	Feasibility Studies	Investigate opportunities for procuring recovered organic waste products within municipal facilities.	Supportive

Measure W-1 includes municipal actions to increase the use of organic waste for all City agencies. This measure is not quantified because emission reductions are captured in the community-wide emission reductions.

Measure W-2 (Municipal) Reduce Municipal Water Consumption

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO2e)
W-2.1	Foundational	Continue implementing City policies for water-conserving equipment upgrades and practices at City government facilities. Implement additional facility, landscape, and procedure improvements to further conserve water as identified and determined feasible.	Supportive
W-2.2	Structural Change, Foundational	Create a Green Community Infrastructure Program based on the Stormwater BMP Guidance Manual with upgraded public spaces, green parking lots, green alleys and increased green stormwater infrastructure on City facilities.	Supportive

Measure W-2 includes municipal actions to improve landscaping and infrastructure on City green spaces with the goal of reducing water usage. Energy used to transport water is low and has minimal carbon emissions due to SBCE's provision renewable energy. Even so, water conservation is important as California expects to experience more drought conditions in the future. Emission reductions associated with this measure are not quantified since reductions are captured in the community-wide emission reductions.

Measure W-3 Reduce Per Capita Potable Water Consumption 1.05% by 2030 and 1.58% by 2035

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
W-3.1	Structural Change, Foundational	Implement all cost-effective measures identified in the Water Conservation Strategic Plan.	2030: 1.72 2035: 0.67
W-3.2	Structural Change, Funding	Leverage the grant writer position(s) in strategy A-2.2 to source funding for the Water Conservation Strategic Plan programs and rebates.	
W-3.3	Education, Foundational	Educate the community through the Water Resources division of Public Works to understand available incentives, options, and programs to reduce per capita water use.	
W-3.4	Education	Expand public engagement campaigns to promote the available rebates through the City's Water Conservation Programs.	
W-3.5	Education	Utilize available enhanced water consumption data from the City's Automated Metering Infrastructure, along with the WaterSmart customer portal, to educate water customers about water use patterns and leak detection.	
W-3.6	Funding, Equity	Leverage the grant writer position(s) in strategy A-2.2 to provide specialized rebate or other funding to low and medium incomes homes for installing laundry to landscape, rainwater catchment system, low-flow appliances, and fixing water leaks.	

Action W-3.1 commits the City to implementing all cost-effective measures identified in the Water Conservation Strategic Plan. The Water Conservation Strategic Plan provides measures for commercial uses, residential uses, irrigation, and community and education. Action W-3.2 leverage grant writer position(s) to implement the Water Conservation Strategic Plan. Actions W-3.3 and W-3.4 commit the City to continuing public engagement and conservation programs, focusing on frontline communities. Engagement on these topics has been shown to improve the efficacy of structural changes to water systems and build community wide trust and stewardship.[86] The City will also expand existing programs to provide specialized rebate or other funding to low and medium income homes for installing laundry to landscape, rainwater catchment system, low-flow appliances, and fixing water leaks. These actions provide funding for integrating more water conservation practices into the City's households, providing more opportunity for lower-income residents to adopt these technologies.

Because the City has other methods of tracking and calculating water use reduction in the city and the emission reduction associated with water use reduction is minimal; a simple percent reduction from the forecasted projection was applied. The 2035 reduction is lower than 2030 due to the expected decreasing electricity emissions factor in line with the City's carbon-free electricity.

Table 17 GHG Emissions Reductions from Measure W-3

	2030	2035
Water use reduction	1.05%	1.58%
Imported water delivery (acre feet)	475	491
Water Emissions (MT CO_2e)	163	42
Total Reductions (MT CO_2e)	**1.72**	**0.67**

Measure W-4 Reduce Organic Waste 80% below 2014 levels by 2030 and 85% by 2035

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
W-4.1	Foundational	Meet the requirements of SB 1383 to reduce organics in the waste stream by 80% below 2014 levels. Include existing activities of: • Pilot and evaluate emerging technologies like at-sourceorganic waste digestion to reduce organic waste by restaurants and other major food waste producers. • Implement enforcement and fee for incorrectly sorted materials with sensitivity to shared collection. • Increase bin signage across commercial and residential areas of acceptable landfill, recyclable, and compostable materials.	2030: 45,773 2035: 50,271
W-4.2	Education, Funding	Create a templated training for businesses to educate their employees about circular economy-based practices annually by providing training resources and rebate program to fund employee time for training. Support lower-impact reusable and reduced packaging businesses.	Supportive
W-4.3	Education, Equity	Conduct targeted multicultural education and assistance campaigns to enhance reuse, ways to prolong the useful life of common materials and items, and sustainable purchasing practices.	Supportive
W-4.4	Education	Conduct a Bring Your Own (BYO) education and outreach training for the community on reusables and implementing more sustainable packaging into daily use. Provide resources of education on City website. Educate community on food scraps on resource center.	Supportive
W-4.5	Feasibility Studies	Conduct waste characterization studies every 4-5 years to inform programs and policies. Leverage study to understand the waste stream and create a plan to increase diversion and reduce contamination.	Supportive

[86] Dean AJ, Fielding KS, Ross H and Newton F. (2016) Community Engagement in the Water Sector: An outcome-focused review of different engagement approaches. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities. Accessed here: https://watersensitivecities.org.au/wp-content/uploads/2016/05/TMR_A2-3_CommunityEngagementWaterSector-1.pdf

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
W-4.6	Partnerships, Structural Change	Collaborate with the County and Resource Conservation District to develop a regional compost trading program to provide farmers with compost to meet organic procurement target set by SB 1383.	Supportive
W-4.7	Funding	Establish regional consortium to plan and pursue funding for infrastructure beyond 2025 SB 1383 targets.	Supportive
W-4.8	Equity, Education	Establish relationships with multi-unit property owners/managers to develop signage for their properties. Go door-to-door at each multi-unit unit yearly to provide supplies and education for proper sorting.	Supportive
W-4.9	Equity, Education	Conduct outreach campaign to low and medium -income residents educating them on issues related to abandoned waste and informing them on how to access bulky item and abandoned waste services at no cost.	Supportive
W-4.10	Structural Change, Partnerships	Partner with the harbor, airport and other major Santa Barbara facilities to facilitate no single use plastic practices.	Supportive
W-4.11	Structural Change, Foundational	Continue to provide different bin size options for green waste, recycling, and trash at different costs (smaller bins being cheaper options) and work towards discontinuing the use of larger waste containers as feasible.	Supportive
W-4.12	Structural Change, Foundational	Ban items without means of recycling or recycling markets, such as sale of polystyrene, produce bags, plastic packaging, straws, plastics #4-7, and mixed materials.	Supportive
W-4.13	Structural Change	Implement pilot project for reusable restaurant to-go containers.	Supportive
W-4.14	Structural Change, Partnerships	Explore opportunities to promote a "circular economy" among local manufacturers and industry. Build on existing AB 619 legislation to fund temporary or permanent food facility item reuse.	Supportive
W-4.15	Education, Partnerships	Partner with libraries and other existing facilities to market campaigns about waste reductions, reuse, and repair.	Supportive
W-4.16	Feasibility Studies, Partnerships	Partner with UCSB, ICLEI and other organizations to cost effectively evaluate and develop resources around consumption-based emissions. Utilize consumption-based emissions inventory to understand Santa Barbara's most carbon intensive consumption habits and emission reduction potential and promote closed-loop circular economy. Based on the results, create a plan to achieve the objective of zero growth of waste generation. Consider reusable diaper service, plant-based diets, etc.	Supportive
W-4.17	Equity, Education	Create a training/education program that is free and accessible to all residents and employees to learn about circular economy practices and diversion strategies and effects of overconsumption.	Supportive

As of 2021, Santa Barbara’s ReSource Center, a state-of-the-art waste management facility, came online to increase the community’s recycling rate to above 85%, generate resources such as green energy and compost, and dramatically lower local greenhouse gas emissions.[87] The ReSource Center converts commercial and residential waste into resources by recovering recyclable materials, transforming organics into landscape nutrients, and creating renewable energy in the process.

The Resource Center works to address two factors: 1) waste generation (reducing the amount of waste generated regardless of its destination such as landfilling, recycling, and composting); and 2)

[87] https://lessismore.org/material_categories/9-trrp/

waste diversion (i.e., recycling the waste that is generated through available facilities). Measure W-4 provides quantitative goals addressing waste generation and diversion.

Actions for reducing organic waste are underpinned by SB 1383 requirements, which lay out specific programs, policies, and objectives for the City to support the state's goal of a 75% reduction from 2014 levels in organics waste by 2025. While not explicitly modeled, many of these actions support the achievement of SB 1383 goals. Actions that address inorganic waste are not quantified in this analysis due to their very minimal impact on communitywide greenhouse gas emission reduction goals.

Emission reductions in the waste sector are already being implemented due to the new ReSource Center and driven by the City surpassing compliance with SB 1383, which sets a statewide target to reduce organic waste disposal 75 percent relative to 2014 levels and recover 20 percent of edible food by 2025. CalRecycle has provided a suite of activities that jurisdictions are required to complete to achieve this target, including the following:

- Provide organic waste collection services for all residents and businesses and monitor contamination.
- Implement an edible food recovery program for commercial edible food generators, with compliance beginning between 2022 and 2024.
- Procure organic waste to meet organic waste product procurement targets as notified by CalRecycle by 2022.
- Conduct education and outreach to businesses, residents, and commercial edible food generators by 2022 and annually thereafter.
- Ensure there is adequate capacity and collection services to comply with SB 1383 requirements.
- Adopt enforceable ordinances prior to 2022 encompassing requirements for organics and edible food generators in the City.
- Monitor compliance beginning in 2022, conduct enforcement beginning in 2024, and maintain records of implementation.

The City is expected to provide the level of composting and food donation that will exceed SB 1383 requirement of organic waste disposal by 75% by 2025. Landfilled organics are a large source of methane emissions and the majority of anerobic waste emissions, as such it is assumed that an 80% reduction in organic waste equates to an 80% reduction in emissions.[88]

Educational actions such as W-4.2, W-4.3, W-4.4 will not lead to direct GHG emission reductions but they are critical components of the strategy behind SB 1383 implementation. For example, education around composting and food waste reduction can provide the information needed by residents to start a home compost pile and reduce their overall waste. Providing these materials in multiple languages in a culturally appropriate manner will further the impacts of this action.

Action W-4.5 and W-4.17 encompass studies and plans that will not directly impact GHG emissions but will support the City's goal to reduce all waste generation. Action W-4.6 will directly support implementation of SB 1383, as providing farmers with compost to meet organic procurement target falls within SB 1383's scope.

[88] See: https://calrecycle.ca.gov/climate/organics/#:~:text=Anaerobic%20decomposition%20of%20organic%20materials,a%2020%2Dyear%20time%20period.

Action W-4.3 will support SB 1383's targets by enacting a local ordinance to reduce single use items across the City. Adoption is further encouraged through partnerships with local businesses in Action W-4.2 and W-4.14 promoting reusable items to reduce general waste production.

Additionally, these actions complement Measure CS-2 which is to increase carbon sequestration by applying 0.08 tons of compost per capita annually in the community through 2030 and 2045. See *Section 5 Carbon Sequestration.*

The methods and assumptions used to calculate the GHG emissions reductions associated with metrics in Measure W-4 are shown in Table 18 below. As mentioned previously, the ReSource Center already began meeting the SB 1383 organic waste diversion obligation in 2021 and Measure W-4 is intended to exceed the compliance obligation. Therefore, the table below presents the amount of GHG reductions achieved with the ReSource Center meeting the compliance obligation and exceedance of the obligation to be achieved with implementation of Measure W-4. The GHG emissions reduction benefits associated with organic diversion were quantified by multiplying the forecasted waste emissions by the target organics diversion rate. This is because organic materials are anaerobically converted into methane and make up 100% of landfill related methane emissions.[89] The actual diversion rate will be tracked on an annual basis and if there is a circumstance in which the City doesn't achieve the incremental targets the CAP will be updated accordingly.

Table 18 GHG Emissions Reductions from Measure W-4

Calculations	2030	2035
Waste Emissions	57,216	59,142
ReSource Center Organic Waste Diversion Compliance Obligation (%)	75%	75%
Emissions Reduction from continued ReSource Center SB 1383 Compliance	42,912	44,357
Measure W-4 Organic Waste Target Achievement (%)	80%	85%
Exceedance of SB 1383 Compliance Obligation (%)	5%	10%
Emissions Reduction from exceedance of SB 1383 Compliance Obligation	2,861	5,914
Total Reductions (MT CO_2e)	**45,773**	**50,271**

[89] US Community Protocol Appendix E – Solid Waste https://icleiusa.org/ghg-protocols/

5 Carbon Sequestration

Carbon sequestration describes the process in which plants and water-based algae take carbon from the atmosphere and store it in their biomass via photosynthesis. Plants also release carbon, in the form of carbohydrates and other molecules (collectively called exudates), into the soil through their roots, where they increase soil organic carbon and support a diversity of soil microbes and fungi, which facilitate soil carbon sequestration. Natural lands act as carbon sinks by sequestering carbon from the atmosphere and storing it in vegetation and soils, playing an increasingly important role in pursuing state carbon neutrality goals. Maintaining healthy natural lands is key to human well-being as they are responsible for our water supply and quality, air quality, and biodiversity, which in turn influences socioeconomics and social equity.

Carbon capture involves the capture of GHG emissions from industrial processes, such as steel and cement production, or from the burning of fossil fuels in power generation. This carbon is then transported from where it was produced, via ship or in a pipeline, and stored deep underground in geological formations. The CAP's carbon sequestration and carbon capture measures are as shown below.

Table 19 Carbon Sequestration Measures

Measure Number	GHG Emissions Reduction Measures	Anticipated Reduction/ Sequestration (MT CO_2e)
CS-1	Increase carbon sequestration by maintaining existing trees and natural lands and by planting 4,500 new trees throughout the community by 2030.	2030: 159 2035: 159
CS-2	Explore new carbon sequestration and carbon capture opportunities.	Supportive
CS-3	Maintain and expand existing restoration projects to sequester carbon through a 25-acre net increase in restored land areas by 2030.	Supportive
CS-4	Increase carbon sequestration by applying 0.08 tons of compost per capita annually in the community through 2030 and 2035.	2030: 1,778 2035: 1,853
CS-5	Reduce GHG emissions of residential and commercial building materials 20% by 2030 and 40% by 2035 in line with AB 2446.	Supportive

Santa Barbara's Parks and Recreation system includes over 1,800 acres of parkland including developed parks, open space, beaches, trails, and sports facilities. The Santa Barbara Parks and Recreation Department has a Creeks Restoration and Water Quality Improvement Division (Creeks Division) which has a mission to improve creek and ocean water quality and restore natural creek systems through storm water and urban runoff pollution reduction, creek restoration, and community education programs. To accomplish this mission, the Creeks Division executes large capital projects to reconstruct creeks and wetlands, returning them to more natural conditions by reshaping the creek channels, removing of aging infrastructure, manage invasive species, and install native plants and trees. These projects have many benefits, including increasing carbon sequestration. The measures and actions in this CAP build off of existing City programs to expand their impact and quantify the carbon sequestration associated with them. Carbon sequestration quantification and tracking is a relatively newer field. However, with the large role carbon sequestration will play in meeting state and the City's carbon neutrality goals, communities are beginning to take a conservative approach to carbon sequestration quantification as a starting point while the state develops more specific goals and guidance. Passed in 2022, AB 1757 directs the

California Natural Resource Agency to determine carbon sequestration reduction targets by 2024 and develop a methodology to track them by 2025. Once that is completed, the City will integrate those goals and tracking methods within these measures and actions and update them as needed.

Measure CS-1 Increase Carbon Sequestration by Maintaining Existing Trees and Natural Lands and by Planting 4,500 New Trees throughout the Community by 2030

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
CS-1.1	Education, Structural Change, Partnerships	Continue to implement and expand the City's Urban Forest Management Plan to include goals for promoting street tree health, enhancing resiliency, increasing the environmental benefits and co-benefits resulting from street trees and shading, community engagement around the urban forest. Include activity to promote street tree health and maintaining existing trees through partnerships with the community and local non-profits.	2030: 159 2035: 159
CS-1.2	Structural Change, Feasibility Studies	Continue to look for opportunities to increase carbon sequestration via land acquisitions and tree protections in alignment with the City's Open Space, Parks and Recreation Element.	Supportive
CS-1.3	Structural Change, Foundational	Implement the City's Community Wildfire Protection Plan to reduce fire risk and carbon loss due to wildfires by conducting vegetation management throughout the City. Ensure that vegetation management projects minimize full removal of vegetation or conversion of land cover type from a higher carbon sequestration land cover (shrubs and trees) to a lower carbon sequestration land cover type (annual grasses).	Supportive
CS-1.4	Feasibility Study	Develop a City-wide, or participate in a regional, carbon sequestration analysis and plan to explore opportunities to increase sequestration in the City.	Supportive
CS-1.5	Structural Change, Equity, Education	Implement the City of Santa Barbara's Creek Tree Program to assist private creekside landowners with improving wildlife habitat along creeks in Santa Barbara through the protection and planting of native trees. Develop a wildlife habitat installation program where the City provides carbon sequestering plants and creek trees and removes non-natives as feasible for appropriate creekside properties. Prioritize low-income areas for implementation of the Creek Tree Program and keep an updated publicly accessible page on the City website with important information about the program.	Supportive
CS-1.6	Feasibility Studies	Update tree canopy coverage data within the City to measure the change in coverage over time as it relates to sequestration as part of the next Urban Forest Management Plan update.	Supportive
CS-1.7	Partnerships	Invest and participate in regional development of local carbon off-set program in partnership with the County and/or Central Coast Regional Collaborative.	Supportive
CS-1.8	Equity	Prioritize low-income areas of the City with less existing tree canopy for tree plantings and increase shading in gathering spaces.	Supportive

Action CS-1.1 is to continue to implement the City's Urban Forest Management Plan and expand the goals to capture more co-benefits. The City has a robust urban forest management program that involves a number of City departments including Parks and Recreation, Public Works, Community Development, and Fire. Planting and maintenance of City trees is primarily the responsibility of the Parks and Recreation Department. Other departments such as Fire, Community Development, and Public Works are involved as part of public safety, public capital improvement projects, and land use planning and development. Public review and policymaking related to tree planting, maintenance, and preservation is provided by the Street Tree Advisory Committee, Parks and Recreation

Commission, Single Family Design Board, Historic Landmarks Commission, Architectural Board of Review, Planning Commission, and City Council. There are also additional planning efforts that support the urban forest management program including the Street Tree Master Plan, Santa Barbara Municipal Code (e.g., Chapter 15 and Chapter 22), the Local Coastal Plan, and the General Plan. Additionally, Action CS-1.2 looks to update the Open Space, Parks and Recreation Element to include policy guidance and support for activities to increase carbon sequestration.

Continued expansion and implementation of the urban forest management program, especially to focus on under-resourced communities, will need strong community partnerships and education. Action CS-1.5 and CS 1.6, and CS-1.8 look to Identify and partner with local community-based organizations with connections to under-resourced communities to assist with identification of priority planting areas, provide education, and support community tree planting events.

Due to the success of the City's programs and the additional actions in this measure, City could set a goal of planting and maintaining an additional 4,500 trees by 2030. The City does not currently have a confirmed goal for tree planting past 2030. However, the 4,500 trees planted by 2030 will continue to sequester carbon on an annual basis throughout their lifespan. GHG emission reductions were estimated based on the number of trees to be added to the inventory and the average CO_2e accumulation factor per tree (0.0354 MT CO_2e/tree/year).[90] The calculations and assumptions used to estimate emission reductions from Measure CS-1 are provided in Table 20. Although there many actions under CS-1 that collectively support substantial increases in carbon sequestration, this analysis conservatively only quantifies carbon sequestration associated with planting trees. As more feasibility studies are done (Actions CS-1.4 and CS-1.6) and more tracking and monitoring are put in place, then the City will have additional substantial evidence to better quantify carbon sequestration reduction potential. Although not quantified here, urban greening can further reduce building carbon emissions by reducing the heat island effect in cities which reduces the need to rely on air conditioning in homes.[91]

Table 20 Measure CS-1 GHG Emission Reduction Calculations

Calculation Factor	2030	2035
Newly Planted Trees (compared to 2019)	4,500	4,500
Tree Sequestration Factor (MT CO_2e/tree/year)[1]	0.0354	0.0354
Total GHG Emissions Reductions (MT CO_2e)	**159**	**159**

Notes: MT CO_2e = metric tons of carbon dioxide; kWh =-kilowatt-hour Values may not add up due to rounding

[1] Default annual CO_2e sequestration per tree per year with a maximum lifespan of 20 years per tree is 0.0354 MT CO_2e/tree/year was obtained from CAPCOA. 2010. Quantifying Greenhouse Gas Mitigation Measures.

Measure CS-2 Explore New Carbon Sequestration and Carbon Capture Opportunities

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
CS-2.1	Partnerships, Feasibility Studies	Create an organizational body (internally within the City or through a partnership like with UCSB or the Santa Barbara Botanical Garden) to lead program development and research for facilitating emergent carbon sequestration and carbon capture plans relevant to the City.	Supportive

[90] CAPCOA. 2011. Quantifying Greenhouse Gas Mitigation Measures. http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf

[91] The Trust for Public Land (TPL). Quantifying the greenhouse gas benefits of urban parks. August 2008.

CS-2.2	Education	Pilot and promote carbon sequestering construction materials like low-carbon concrete and mass timber.	Supportive
CS-2.3	Education, Partnerships	Work with local architects, construction trades, and workforce development organizations to expand industry knowledge and adoption of carbon sequestering building materials and techniques.	Supportive
CS-2.4	Feasibility Studies	Conduct a feasibility study to explore carbon capture and storage opportunities for the community.	Supportive
CS-2.5	Feasibility Studies, Partnerships	Initiate a study partnering with local academic institutions and the ReSource Center to identify and research ways to create a circular economy around organic waste and increasing edible food rescue.	Supportive
CS-2.6	Feasibility Studies	Conduct a feasibility study to explore repurposing biosolids into biochar locally and replacing conventional fertilizer through Public Works.	Supportive
CS-2.7	Partnerships, Feasibility Studies	Invest in the existing kelp farming efforts by studying regional environmental impacts and sequestration potential through a partnership with UCSB.	Supportive
CS-2.8	Partnerships	Partner with furniture, home renovation, and construction companies to promote sustainable and locally harvested timber to reduce embodied carbon from transit of construction materials and reduce the price premium of emerging timber uses.	Supportive
CS-2.9	Funding	Leverage the grant writer position(s) in strategy A-2.2 to expand funding for the carbon sequestration program.	Supportive
CS-2.10	Equity	If there are localized co-benefits to any sequestration projects focus development, when possible, to benefit historically adversely impacted under-resourced communities.	Supportive

Measure CS-2 focuses on exploring new carbon sequestration and carbon capture opportunities in the City of Santa Barbara. Over time as GHG emissions are reduced from more and more sectors, carbon sequestration and carbon removal will play an increasingly important role in California’s and the City’s ability to achieve carbon neutrality. The measure includes several actions aimed at facilitating research, partnerships, education, feasibility studies, and funding to identify and develop potential carbon sequestration projects. Actions CS-2.1, CS-2.2, CS-2.3, CS-2.4, and CS-2.6 focus on establishing partnerships with various entities, such as UCSB, the Santa Barbara Botanical Garden, and local academic institutions, to conduct research and development in the field of carbon capture and sequestration. This approach acknowledges that the technology for high levels of carbon capture and sequestration may not be readily available or cost-effective for the City to pursue independently at this time. Actions CS-2.5 and CS-2.7 propose investing in existing local efforts, such as the ReSource center and kelp farms, to expand carbon sequestration opportunities and promote the development of a circular economy. This highlights the City's commitment to utilizing available resources and infrastructure to advance carbon sequestration goals. Action CS-2.9 supports the measure through focusing on funding opportunities specific to carbon capture and sequestration such as through CARB. This demonstrates a proactive approach to seeking financial support for the implementation of carbon capture and sequestration projects. Action CS-2.10 will promote how identified carbon capture and sequestration opportunities bring benefits to the underserved communities. The potential for GHG reduction via carbon capture and carbon sequestration varies drastically depending on the technology and methods used for carbon capture and sequestration. Therefore, until the technology or means for carbon capture is identified, the measure remains supportive and will not be quantified until adequate data is available from an implementable project.

Measure CS-3 Maintain and Expand Existing Restoration Projects to Sequester Carbon through a 25-acre Net Increase in Restored Land Areas by 2030

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
CS-3.1	Structural Change, Partnerships, Equity, Education	Develop a Citywide restoration plan in partnership with the Creeks Division, Parks and Recreation, and Public Works to achieve target net increases in restored land area and waterways. Prioritize implementation of restoration projects in disadvantaged communities. Facilitate community outreach through surveys and public meetings on ways to best restore lands and waterways within the City as well as identify additional priority areas.	Supportive
CS-3.2	Structural Change, Equity	Should parcels be identified for potential rezoning from their existing state to a park or open space, consider the following: 1) Provide flexible solutions for developing urban parks in infill areas where traditional neighborhood and community parks are not feasible; 2) Aim to achieve the greatest carbon sequestration possible, given constraints around use and amenities to be included. Use and amenities are determined by Parks and Recreation staff through a community process; and 3) Selection of parcels be made with an aim to serve underserved communities.	Supportive
CS-3.3	Partnerships	Expand Creeks Division volunteering programs to help maintain creek restoration projects. Coordinate projects with Parks and Recreation and Sustainability and Resilience Departments.	Supportive
CS-3.4	Structural Change, Feasibility Studies, Education	Facilitate annual reporting as part of the urban forestry, wildfire prevention, and City-wide restoration efforts by developing and maintaining existing projects to gauge progress over time and identify any gaps related to ongoing projects. Incorporate GHG reduction calculations into this monitoring plan.	Supportive
CS-3.5	Funding, Foundational	Leverage the grant writer position(s) in strategy A-2.2 to pursue funding for restoration activities with a focus on projects that have not reached completion due to funding constraints.	Supportive
CS-3.6	Structural Change, Foundational	Include long term maintenance in restoration planning and implementation by partnering with the community and local organizations to assist in maintenance activities. Include continued maintenance and expansion of Creeks Division projects of the Upper Las Positas Creek, Mission Creek, Palermo Open Space, Arroyo Burro, and the Andree Clark Bird Refuge.	Supportive

Measure CS-3 includes actions to facilitate and track City-led restoration efforts that will help to increase carbon sequestration. Implementing and tracking restoration efforts that increase carbon sequestration will be critical for the City to meet its 2035 carbon neutrality goal. Action CS-3.1 includes a restoration plan that will provide goals, targets, and actions to facilitate restoration throughout the city. Actions CS-3.3, CS-3.5, and CS-3.6 develop volunteer programs, partnerships, and grant funding positions(s) to help implement CS-3.1. CS-3.4 will create a reporting program to showcase the City's progress and monitor GHG sequestration. As the goals and targets for carbon sequestration associated with restorations have yet to be developed, the measure is not yet quantified.

Measure CS-4 Increase Carbon Sequestration by Applying 0.08 tons of Compost per Capita Annually in the Community through 2030 and 2035

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
CS-4.1	Structural Change	Enforce compliance with SB 1383 and aim to exceed the baseline requirement by establishing a minimum level of compost application per year on applicable/appropriate land throughout the City including City-owned land twice that of SB 1383 requirements.	2030: 1,778 2035: 1,853
CS-4.2	Feasibility Studies	Identify additional locations within the City to apply compost and provide household incentives for small-scale implementation.	Supportive
CS-4.3	Structural Change	Maintain procurement policies to comply with SB 1383 requirements for jurisdictions to purchase recovered organic waste products.	Supportive
CS-4.4	Partnerships, Education	Work with the ReSource Center to provide residents, businesses, and developers with educational material on where compost can be acquired and how it can be used (i.e., landscaping).	Supportive
CS-4.5	Partnerships	Collaborate with Santa Barbara Community College, UC Santa Barbara, local schools, and Public Works to identify opportunities to apply compost to landscaping.	Supportive

Compost is also discussed under Measure W-4 because compost application is part of the overall waste management process and is a requirement under SB 1383. The City surpassed compliance with SB 1383, which sets a statewide target to reduce organic waste disposal 75 percent relative to 2014 levels and recover 20 percent of edible food by 2025. CalRecycle has provided a suite of activities that jurisdictions are required to complete to achieve this target, which includes waste product procurement targets.

The ReSource Center began meeting the SB 1383 procurement obligation in 2021. Measure CS-4 is intended to ensure the City continues to meet the procurement obligation in the future. Actions CS-4.1 through CS-4.5 build upon existing City programs but provide additional support to identify application gaps (Action CS-4.2), improve processes (CS-4.3), provide education (Action CS-4.4) and develop additional partnerships (Action CS-4.5). Emission reductions associated with procurement of 0.08 tons of recovered organic waste products, such as compost, per person are demonstrated in Table 21 below.

Table 21 GHG Emissions Reductions from Measure CS-4

Inputs and Assumptions		
City procurement requirement in 2021 (tons)[1]		7,444
City population that procurement is requirement based on[1]		93,055
Procurement requirement per capita		0.0800
Emission reduction factor associated with mixed organics compost application due to avoided landfill emissions, decreased soil erosion, decreased fertilizer use (MT CO_2e/ton)[2]		0.23
Calculations	**2030**	**2035**
Population	96,637	100,713
Estimated procurement requirement (tons)	7,731	8,057
City Recovered Organic Waste Product Procurement Obligation (%)	100%	100%
Measure CS-4 Procurement Target (%)	100%	100%

Emissions Reduction from Continued ReSource Center SB 1383 Compliance of Procurement Requirements (MT CO_2e)[3]	**1,778**	**1,853**

[1] https://calrecycle.ca.gov/organics/slcp/procurement/recoveredorganicwasteproducts/

[2] https://ww2.arb.ca.gov/sites/default/files/classic/cc/waste/cerffinal.pdf

[3]These emissions are also associated with the implementation of Measure CS-2. To review the actions that will implement Measure CS-2 are discussed in Section 5 *Carbon Sequestration.*

Measure CS-5 Reduce GHG Emissions of Residential and Commercial Building Materials 20% by 2030 and 40% by 2035 in Line with AB 2446

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
CS-5.1	Feasibility Studies	Conduct a feasibility study on carbon capture technologies to locally produce calcium carbonate (low carbon concrete) creating sequestration via construction materials. Determine viability within the City and project demand.	Supportive
CS-5.2	Partnerships, Feasibility Studies	Partner with UCSB to pilot a building specific embodied carbon reduction project for planned construction.	Supportive
CS-5.3	Moonshot	Develop a strategic construction and procurement plan to promote construction projects that use alternative materials to reduce embodied carbon. Include scoring criteria in City request for proposals for construction projects that identify resilience features such as water and energy efficiency, reduced urban heat, and decrease the embodied carbon in line with AB 2446.	Supportive

AB 2446, adopted in 2022, requires CARB to develop a strategy for achieving a 40 percent net reduction in the embodied carbon in building materials by end of 2035.[92] As part of this bill, CARB is also tasked with developing a framework for measuring and tracking the reduction in building material carbon intensity by 2025. Measure CS-5 supports the state's efforts to reduce embodied carbon emissions in construction materials and prepares the City for legislation related to building materials that may be passed in the coming years. Under Action CS-5.1 the City will conduct a feasibility study to evaluate the viability of products like low carbon concrete and carbon sequestering concrete. Concrete is one of the most extensively used materials in buildings and traditional manufacturing of concrete is a carbon intense process.[93] There are a number of emerging technologies that reduce the emissions from concrete production as well as technologies for using concrete as a means to sequester carbon emissions.[94] Understanding the feasibility of other building materials is the first step to development a strategy to reduce embodied emissions in building materials. Through Action CS-5.2 the City will develop a partnership with UCSB to pilot a project focused on reducing embodied carbon in building construction. This collaborative effort aims to explore and implement strategies to minimize the carbon footprint associated with planned construction projects. By leveraging the expertise of UCSB, the City, can benefit from cutting-edge research and innovative approaches to reduce GHG emissions in the building environment. Action CS-5.3 is a moonshot effort by the City that would involve the development of a strategic construction and procurement plan to promote of alternative materials with lower embodied

[92] 2022 - Assembly Bill 2446 (Holden, Chris), Embodied Carbon Emissions: Construction Materials (Chaptered) | California Air Resources Board

[93] Jeremy Gregory, Hessam Azarijafaris, Ehsan Vahidi, and Randolph Kirchain. September 2021. The role of concrete in life cycle greenhouse gas emissions of US buildings and pavements. PNAS Vol. 118 No. 37. Accessed Here: https://www.pnas.org/doi/full/10.1073/pnas.2021936118

[94] CarbonCure's Sustainable Concrete Solution - Concrete Technology Reducing Carbon Impact

carbon and construction designs that increases climate resiliency. At this time the Measure is supportive to the overall efforts of the City but is not quantifiable since lifecycle emissions are not quantified in the overall GHG inventory.

6 Community Climate Potential

Any increase in government and private sector spending related to the CAP and associated greenhouse gas reduction measures will generate economic activity, resulting in changes to employment. To meet the City's goals in the CAP, the City will need to help transform its economy into one that supports a zero-carbon future and moves toward energy efficiency. This greener economy will involve an increasing number of sectors with lower carbon outputs and decreased environmental impacts. Early studies show that there will be some economic decline in certain industries and limited job losses; however, the overall economic impact is expected to be net positive. For this reason, it is important that the City needs to address equity explicitly in the green transition. Ensuring equitable outcomes result from transformative climate investments is critical. Measure CP-1 outlines the City's plan to integrate innovation and equity into the green economy.

Measure CP-1 Encourage Community Innovation and Empower the Local Green Economy through Investment in a Green Technology Workforce

Action Number	Strategic Theme	Action	Anticipated Reduction (MT CO_2e)
CP-1.1	Structural Change	Create a Green Technology incubator in partnership with UCSB to determine technological advancement research into clean power, built environment advancement, and carbon sequestration.	Supportive
CP-1.2	Funding	Leverage the grant writer position(s) in strategy A-2.2 to source funding for the Green Technology incubator through involvement of venture capitalist and private equity firms.	Supportive
CP-1.3	Education	Facilitate workforce training by partnering with local academic institutions to offer scholarships for students pursuing climate trades.	Supportive
CP-1.4	Education	Partner with Santa Barbara Community College and/or UCSB to develop a clean energy technology certificate program.	Supportive
CP-1.5	Moonshot	Leverage the grant writer position(s) in strategy A-2.2 to establish an Innovation Bootcamp with funding from SBCE to encourage forward thinking sustainability and resilience ideas and pilots. The Innovation Bootcamp will be tiered based on stages.	Supportive
CP-1.6	Moonshot	Create a climate innovation competition for local area students where the prize is a scholarship or grant.	Supportive

Green jobs are broadly defined as occupations that include tasks associated with meeting green economic goals and improving the environment. This could be jobs in businesses that produce goods or provide services that conserve natural resources or reduce the environmental impact of production processes. Green goods, services, and production processes typically fall into the following categories of economic activity: renewable energy; energy efficiency; greenhouse gas reduction; pollution reduction and cleanup; recycling and waste reduction; natural resources conservation; and education, compliance, public awareness and training.

Green jobs may include, but are not limited to, the following:

- Clean renewable energy
- Public transportation
- Waste management/recycling

- Eco-tourism
- Sustainable agriculture
- Land conservation/remediation
- Construction/Building remediation

These measures and actions in the CAP will increase spending on projects that are expected to increase employment in these jobs. While increased jobs are generally viewed as a positive impact, Measure CP-1 contains actions to ensure equitable outcomes of this job creation, such as implementing retraining programs and outreach for underrepresented communities. Actions CP-1.1 and CP-1.2 will create a Green Technology incubator to understand how anticipated growth—particularly ones spurred by transformative climate investments—can create employment opportunities that connect with historically underrepresented, under-served and under-resourced members of the community.

Actions CP-1.3, CP-1.4, CP-1.5, and CP-1.6 work together to facilitate the training and help the development of a local green workforce. Workforce development ensures and expands employability by aligning skills of employees with business needs and labor market trends. These workforce development initiatives need to be holistic and take form multiple ways which is why the City has actions to include apprenticeship programs, targeted development programs, and funding incentives. Coordination among business and education communities, labor and trade groups as well as the local and regional governments will ensure sound delivery of workforce development initiatives. Being proactive in developing a green workforce is particularly important in Santa Barbara where it is difficult to attract and retain talent due to the region’s high costs for housing.

Rincon Consultants, Inc.

Environmental Scientists *Planners* *Engineers*

M E M O R A N D U M

■ **Santa Barbara**
319 East Carrillo Street, Suite 105
Santa Barbara, California 91301
(805) 644 4455

Carlsbad:	(760) 918 9444	**Sacramento:**	(916) 706 1374
Fresno:	(559) 228 9925	**San Diego:**	(760) 918 9444
Los Angeles:	(213) 788 4842	**San Luis Obispo:**	(805) 547 0900
Monterey:	(831) 333 0310	**Santa Barbara:**	(805) 319 4092
Oakland:	(510) 834 4455	**Santa Cruz:**	(831) 440 3899
Redlands:	(909) 253 0705	**Ventura:**	(805) 644 4455
Riverside:	(951) 782-0061		

Date: January 13, 2023

To: City of Santa Barbara
Melissa Hetrick <mhetrick@santabarbaraca.gov>; Alelia Parenteau <aparenteau@santabarbaraca.gov>

From: Rincon Consultants, Inc.
Lexi Journey <ljourney@rinconconsultants.com>; Ryan Gardner <rgardner@rinconconsultants.com>; Erik Feldman <efeldman@rinconconsultants.com>

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;
- 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 EVelectricity.

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 = metrictons,

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 methane (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, to calculate the number of septic users in the City.[21] Based on the 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 = metrictons

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 thecommunity 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 community's 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, regardlessof

[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 waste 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 ($MT\ CO_2e$)

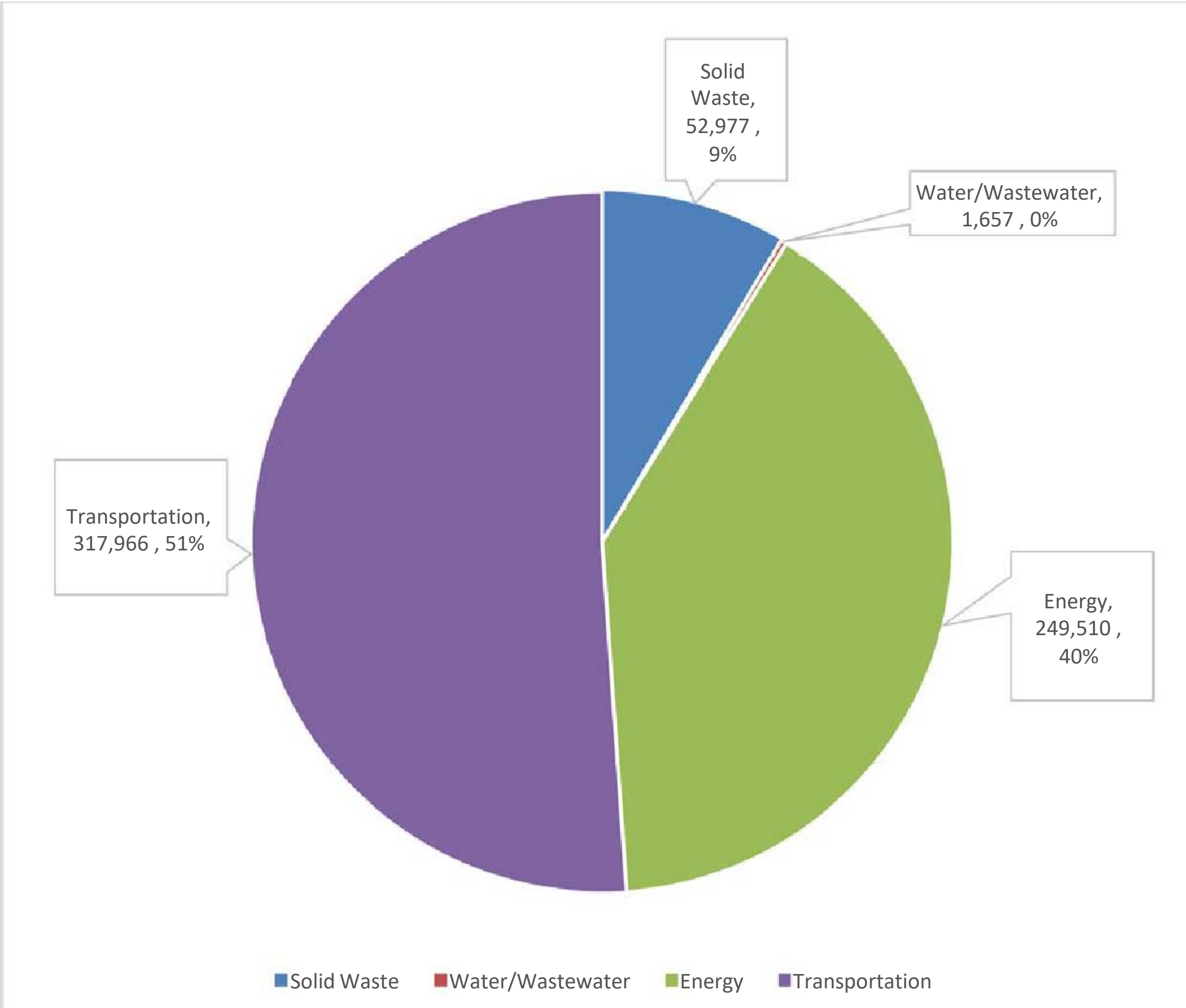


Table 13 Santa Barbara 2019 GHG Emissions Inventory Summary

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 anypolicies or legislation that would reduce local emissions;
- *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

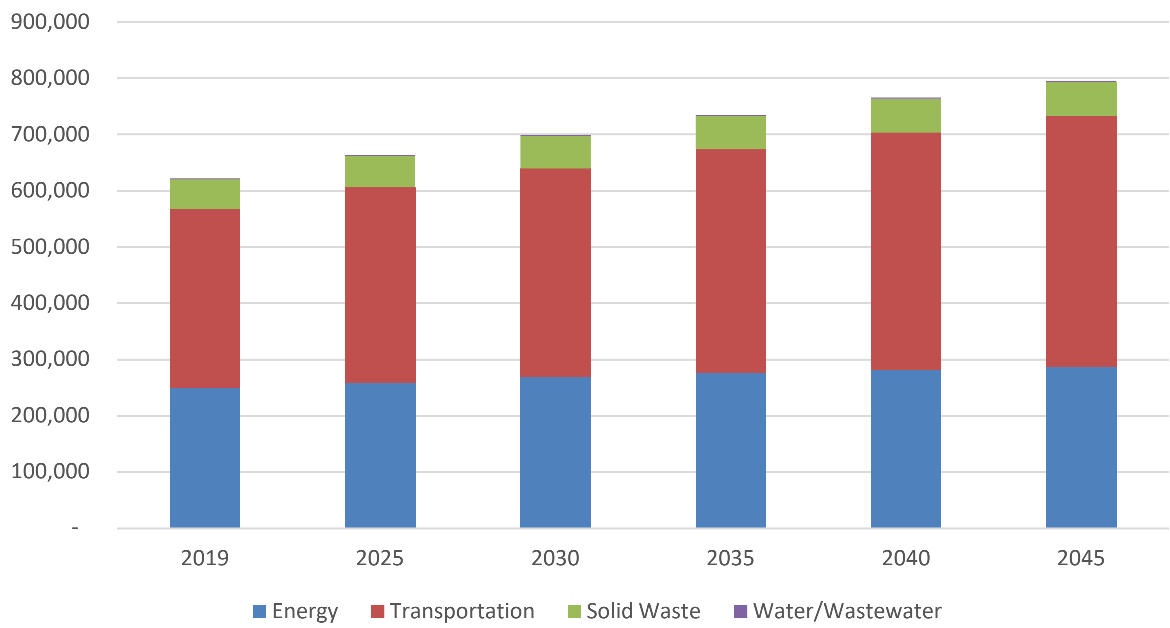
The following provides a summary of the results of the BAU GHG emissions forecast for each source in the City of Santa Barbara. The results have been reported in MT CO_2e. The BAU forecast projects an increase in GHG emissions above the baseline 2019 GHG emissions inventory from all sectors due to projected 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 impacts of these regulations were 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 the 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 legislations 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 standardsin 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 by2045.
- **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 tookeffect 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 establishestargets 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 residentialelectricity;
  - 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 are 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 providedin 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 forecasthttps://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 accountedfor.

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 ElementUpdate
2. Derived from EMFAC2021 for Santa Barbara County and applied to City of Santa Barbara. Vehicle categories include the followingvehicle 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 lower GHG emissions from reduced electricity and natural gas consumption in new buildings. Compliance with SB 100 requirements are expected to further lower 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 reduce 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 legislations are summarized in Table 24.

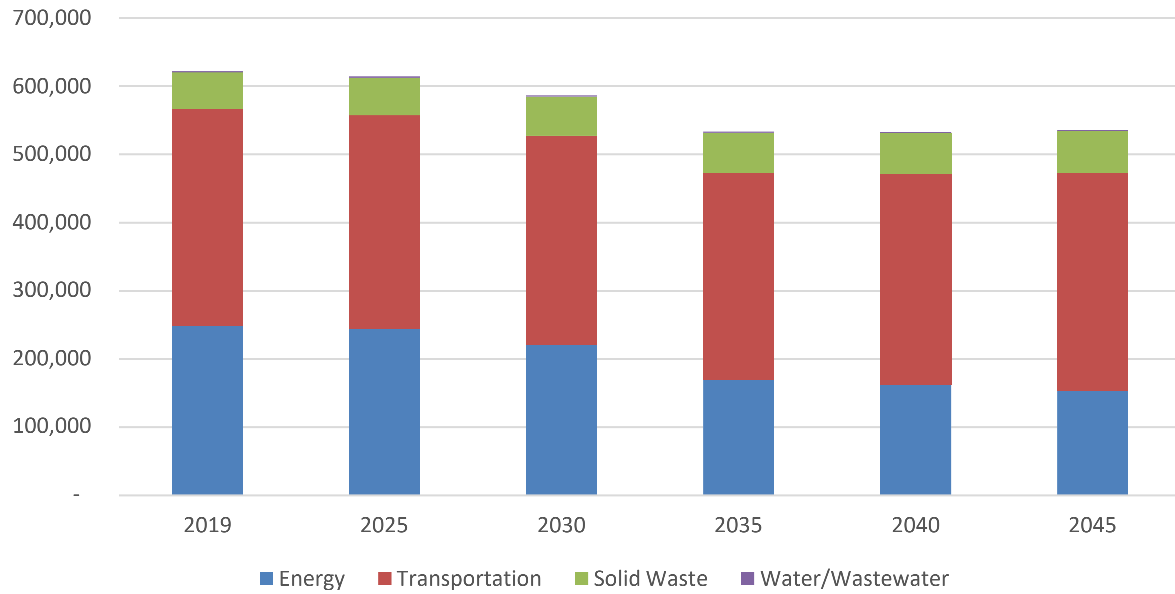
Table 24 City of Santa Barbara Legislative Adjusted GHG Emissions Forecast Detail

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. The two options offered by SBCE are "100% Green" which is fully carbon-free electricity (giving an emission factor of 0 MT CO_2e/kWh) and "Green Start" which is at least 50% carbon-free electricity.[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

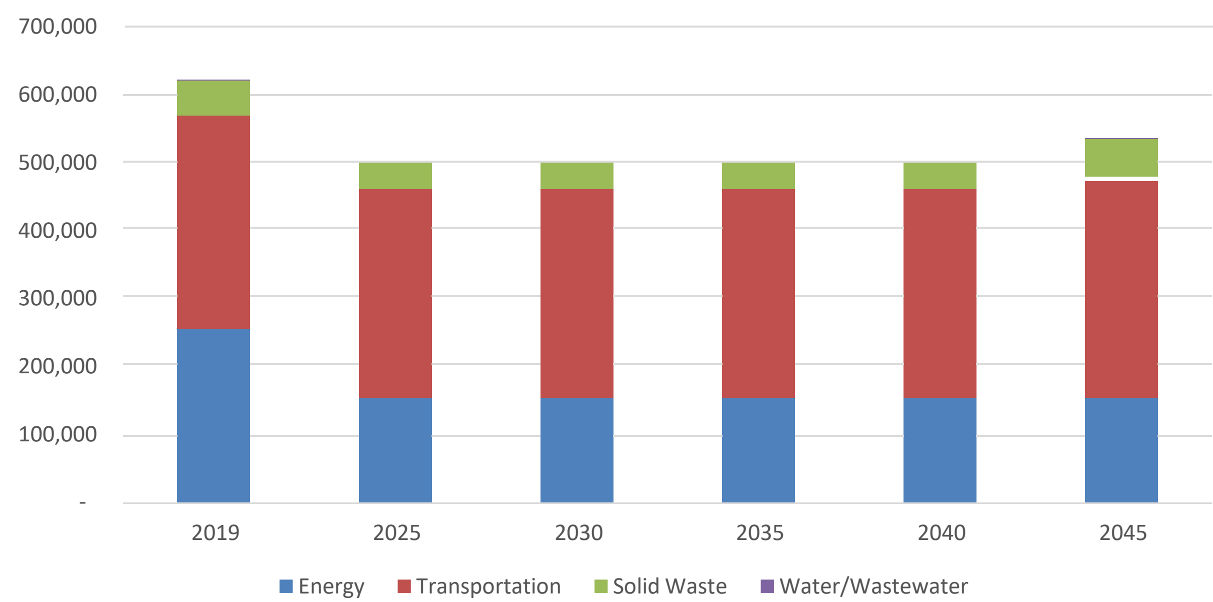


Table 26 provides the results summary of the GHG emissions forecast for the City of Santa Barbara, including the BAU Forecast, the Legislative Adjusted Forecast, the SBCE Adjusted (State Legislation and SBCE) Forecast, and the reductions expected from individual legislation and SBCE.

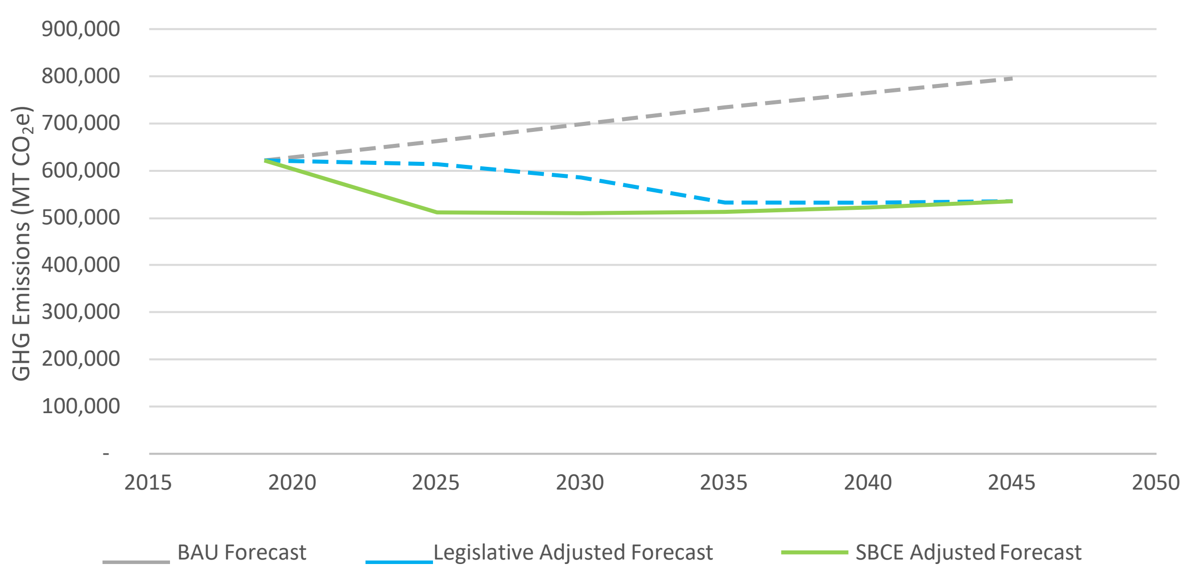
Table 26 City of Santa Barbara GHG Emissions Forecast Results Summary

	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 of GHG reductions 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 by2030, 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 neutralityby 2045.
- Aspirational targets
  - Carbon-neutrality by 2035. This target represents the most ambitious target that the Cityhas 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

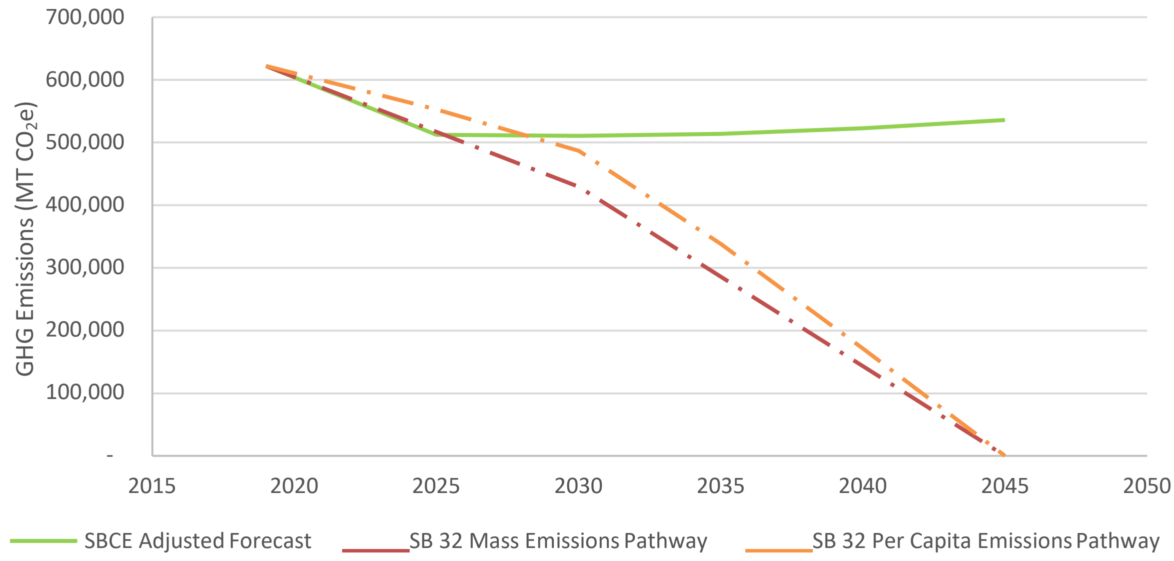
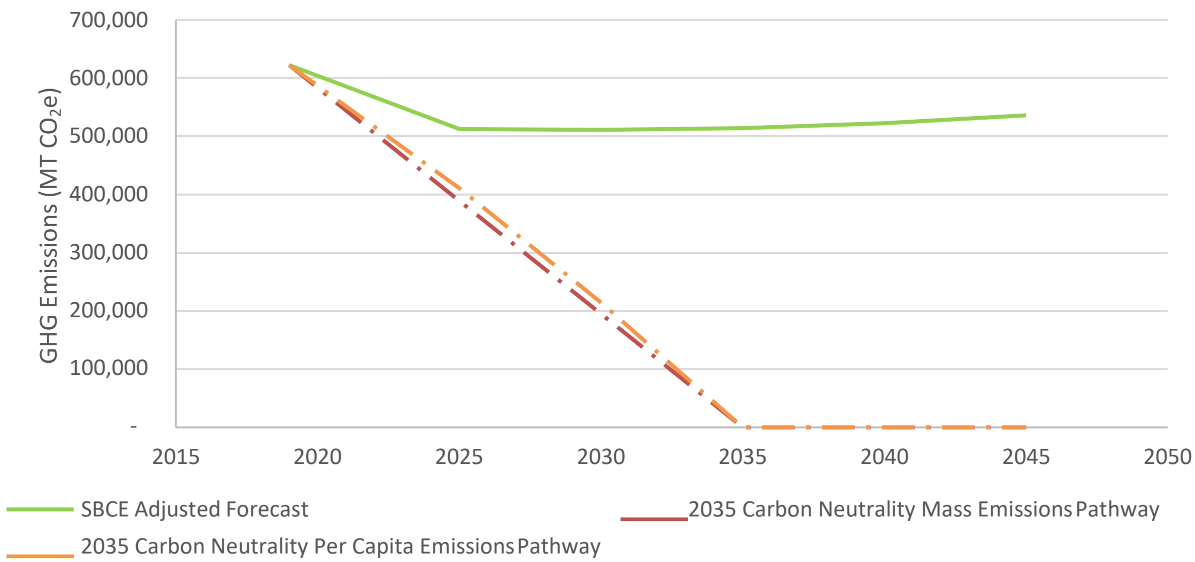


Figure 7 GHG Emissions Gap Analysis for 2035 Carbon Neutrality Targets



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 be 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.