

APPENDIX C

Bakersfield Greenhouse Gas Emissions Inventory, Forecasts, and Targets



Greenhouse Gas Emissions Inventory, Forecast and Targets Report for the City of Bakersfield

Prepared for:

US EPA Region 9
75 Hawthorne Street
San Francisco, CA 94105

September 2025

Greenhouse Gas Emissions Inventory, Forecast and Targets for the City of Bakersfield

Prepared for:

US EPA Region 9
75 Hawthorne Street
San Francisco, CA 94105

Prepared by:

City of Bakersfield
City Manager's Office
1600 Truxton Avenue
Bakersfield, CA 93301
Contact: 661.326.3733

and



Ascent Environmental, Inc. dba Ascent

2550 Fifth Avenue, Suite 640
San Diego, CA 92103

Contact:

Andrew Beecher
Senio Planner
619.489.5677
Andrew.Beecher@Ascent.inc

September 2025

TABLE OF CONTENTS

Section	Page
LIST OF ABBREVIATIONS	IV
1 INTRODUCTION	1
1.1 Project Overview	1
1.2 Purpose of Greenhouse Gas Emissions Analysis	1
2 SUMMARY RESULTS	2
2.1 GHG Emissions Inventory Results	2
2.2 GHG Emissions Forecast Results	3
2.3 GHG Reduction Targets Summary	5
3 2022 GHG EMISSIONS INVENTORY METHODS	6
3.1 Protocols and Methodologies	6
3.2 Emissions Sectors and Sources	7
3.3 Boundaries	9
3.4 Overview of Activity Data and Emissions Factors	11
3.5 Global Warming Potentials and Emissions Units	12
3.6 Data Quality and Accuracy	13
3.7 Inventory Data and Assumptions	13
4 GHG EMISSIONS FORECAST METHODS	26
4.1 Demographics and Vehicle Miles Traveled Projections	26
4.2 Legislation and regulations Considered in Legislative-adjusted BAU Forecast	27
4.3 Building Energy	27
4.4 On-Road Transportation	31
4.5 Off-Road Vehicles and Equipment	32
4.6 Solid Waste	33
4.7 Water Supply	33
4.8 Wastewater Treatment	34
4.9 Agriculture	34
4.10 Discussion	35
5 REDUCTION TARGETS	36
5.1 Statewide Greenhouse Gas Reduction Targets	36
5.2 California's 2022 Climate Change Scoping Plan and 2022 GHG Inventory	36
5.3 Community Greenhouse Gas Emissions Reduction Targets	37
6 REFERENCES	40

Figures

Figure 1	2022 City of Bakersfield GHG Emissions Inventory Results	3
Figure 2	City of Bakersfield GHG Emissions Inventory and Forecasts	4
Figure 3	Emissions Sectors, Sources, and Activities Hierarchy	8
Figure 4	City of Bakersfield Community Legislative-Adjusted BAU Forecasts and GHG Emissions Reduction Targets Below 2022 Levels	39

Tables

Table 1	2022 City of Bakersfield GHG Emissions Inventory Results	2
Table 2	City of Bakersfield 2022 GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts Results (MTCO ₂ e).....	4
Table 3	City of Bakersfield Legislative-Adjusted BAU Forecasts and GHG Emissions Reduction Targets Below 2022 Levels	5
Table 4	Sectors Included in GHG Inventory Compared to Climate Pollution Reduction Grant Requirements.....	9
Table 5	2022 City of Bakersfield Summary of Sectors and Sources	10
Table 6	2022 City of Bakersfield Summary of Activity Data and Emissions Factors	11
Table 7	City of Bakersfield and Kern County Demographic and Land Use Data for 2022	13
Table 8	2022 City of Bakersfield Electricity Emissions Factors.....	15
Table 9	2022 City of Bakersfield Natural Gas Emissions Factors	15
Table 10	2022 City of Bakersfield Community Building Energy Use and GHG Emissions	16
Table 11	2022 City of Bakersfield Community On-Road Transportation VMT and GHG Emissions.....	17
Table 12	2022 City of Bakersfield On-Road GHG Emissions Factors.....	17
Table 13	2022 City of Bakersfield Community Off-Road Vehicles and Equipment GHG Emissions and Scaling Method	18
Table 14	2022 City of Bakersfield Community Solid Waste Quantity and GHG Emissions	19
Table 15	Landfills Receiving Waste from Bakersfield in 2022: Tonnage and LFG Capture System Status.....	19
Table 16	2022 City of Bakersfield Community Water Supply Quantity and GHG Emissions.....	21
Table 17	2022 City of Bakersfield Wastewater Treatment GHG Emissions	21
Table 18	2022 City of Bakersfield Wastewater Treatment GHG Emissions Calculation Parameters	22
Table 19	2022 City of Bakersfield Agriculture GHG Emissions	23
Table 20	2022 City of Bakersfield Fertilizer and Lime Application Data and Emissions.....	23
Table 21	2022 City of Bakersfield Fertilizer and Lime Application Emissions Factors and Sources.....	23
Table 22	2022 City of Bakersfield Agricultural Equipment Data and Sources.....	24
Table 23	2022 City of Bakersfield County GHG Emissions from Regulated Stationary Sources.....	25
Table 24	City of Bakersfield Demographic and Vehicle Miles Traveled Forecasts.....	26
Table 25	Legislative Reductions Summary	27
Table 26	PG&E and CAMX eGRID Electricity GHG Emissions Factors Adjusted for SB 100 and SB 1020.....	28
Table 27	Building Energy Adjustment Factors for 2022 Standards Compared to 2019 Standards.....	29
Table 28	Building Energy Emissions Forecast Methods by Energy Type	29
Table 29	Residential Building Energy GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO ₂ e)	30
Table 30	Nonresidential Building Energy GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO ₂ e)	30
Table 31	On-Road Transportation Emissions Forecast Methods.....	31

Table 32	On-Road Transportation Projected GHG Emissions Factors (Legislative-Adjusted BAU Forecasts)	31
Table 33	On-Road Transportation GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO ₂ e)	32
Table 34	Off-Road Vehicles and Equipment GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO ₂ e)	32
Table 35	Solid Waste GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO ₂ e)	33
Table 36	Water Supply Emissions Forecast Methods	33
Table 37	Water Supply GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO ₂ e)	34
Table 38	Wastewater Treatment GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO ₂ e)	34
Table 39	Agriculture GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO ₂ e)	35
Table 40	2022 Scoping Plan Estimated Change in Emissions by Sector (MMTCO ₂ e)	37
Table 41	Statewide and City of Bakersfield Legislative-Adjusted BAU Forecasts and GHG Emissions Reduction Targets Below 2022 Levels	38

LIST OF ABBREVIATIONS

2022 Scoping Plan	CARB's 2022 Scoping Plan for Achieving Carbon Neutrality
AB	Assembly Bill
ACC	Advanced Clean Cars
ACF	Advanced Clean Fleets
AR6	Intergovernmental Panel on Climate Change Sixth Assessment Report
BAU	business-as-usual
BGP	Bakersfield General Plan
BOD	biological oxygen demand
CAFE	Corporate Average Fuel Economy
CalRecycle	California Department of Resources Recycling and Recovery
CARB	California Air Resources Board
CCAP	Comprehensive Climate Action Plan
CDFA	California Department of Food and Agriculture
CDR	carbon dioxide removal
CEC	California Energy Commission
CH ₄	methane
City	City of Bakersfield
CO ₂	carbon dioxide
CO _{2e}	carbon dioxide equivalent
CVP	Central Valley Project
DOC	California Department of Conservation
DWR	California Department of Water Resources
eGRID	Emissions & Generation Resource Integrated Database
EMFAC2021	California Air Resources Board Emission FACtor 2021 model
EPA	United States Environmental Protection Agency
FMMP	Farmland Mapping & Monitoring Program
g	grams
GHG	greenhouse gas
GWP	global warming potential
HVAC	heating, ventilation, air conditioning, and cooling
ICLEI	ICLEI – Local Governments for Sustainability USA

IPCC	Intergovernmental Panel on Climate Change
kBTU	kilo British thermal unit
Kern COG	Kern Council of Governments
kg	kilogram
kWh	kilowatt-hours
lb CO ₂ /MWh	pounds of CO ₂ per megawatt-hour
lb CO ₂ e/gal	pounds of carbon dioxide equivalent per gallon
lb CO ₂ e/therm	carbon dioxide equivalent per therm
lbs	pounds
LCI	Governor's Office of Land Use and Climate Innovation
LFG	Landfill gas
LPG	liquefied petroleum gas
MMTCO ₂ e	million metric tons of carbon dioxide equivalent
MTCO ₂ e	metric tons of carbon dioxide equivalent
MWh	megawatt-hours
N	nitrogen
N/A	not applicable
N ₂ O	nitrous oxide
PG&E	Pacific Gas and Electric Company
RTAC	Regional Technical Advisory Committee
RTP/SCS	Regional Transportation Plan/Sustainable Communities Strategy
SB	Senate Bill
scf	standard cubic feet
SOAR	Sustainable Opportunities Advancing Resilience
SoCalGas	Southern California Gas Company
SUV	sports utility vehicle
SWP	State Water Project
TCR	The Climate Registry
Valley Air District	San Joaquin Valley Air Pollution Control District
VMT	vehicle mile traveled
WAKC	Water Association of Kern County
WWTP	wastewater treatment plant
ZEB	zero-emission bus
ZEV	zero-emission vehicle

1 INTRODUCTION

1.1 PROJECT OVERVIEW

The City of Bakersfield (City) is developing a Comprehensive Climate Action Plan (CCAP) to reduce greenhouse gas (GHG) emissions within the city and build capacity to strengthen community resilience to climate change. The development of the CCAP is part of the Sustainable Opportunities Advancing Resilience (SOAR) Bakersfield project that aims to address community climate challenges through projects, programs, and policies that provide economic and resiliency benefits. Recognizing the synergies with other planning efforts, the City is aiming for consistency between the CCAP and the Bakersfield General Plan (BGP), as key climate change policies may be included in the BGP policy document.

The CCAP will focus on GHG emissions generated from activities occurring citywide (i.e., community emissions). The initial steps in the preparation of the CCAP include developing a community GHG emissions inventory for the year 2022, preparing GHG emissions forecasts, and evaluating GHG emissions reduction targets for years aligned with State goals. This technical report provides the results of the 2022 community inventory and the emissions forecasts, and describes the underlying methods, assumptions, and emissions factors. It also presents the City's GHG reduction targets that have been developed in line with State targets and goals and discusses the methodology used to establish these targets. The GHG emissions forecasts and reduction targets will provide the foundation for the forthcoming steps of the City's climate action planning process, including the development and quantification of GHG emissions reduction measures and "gap analysis" evaluation (i.e., the calculated gap between the estimated GHG reductions from local action and the evaluated targets).

1.2 PURPOSE OF GREENHOUSE GAS EMISSIONS ANALYSIS

The GHG emissions analysis included in this report is intended to develop a quantitative baseline and forecasts for GHG emissions generated by activities within the geopolitical control of the City of Bakersfield, such that data-based decisions can be made on ways to reduce local GHG emissions and align with State GHG reduction targets. The analysis utilizes the most recently available data and follows best practices in GHG emissions accounting and reduction planning. The results will be used to inform additional analysis completed as part of the SOAR Bakersfield project, including the identification of GHG reduction measures and the quantification of GHG emissions reductions from measure implementation. The analysis includes three components:

- ▶ **GHG Emissions Inventory** (also referred to as GHG inventory or inventory) estimates GHG emissions generated within the City of Bakersfield geographic boundary for the year 2022. It identifies the sectors, sources, and activities that produce these emissions and the relative contribution of each, while also providing a baseline used to forecast emissions trends into the future. This information is used to set reduction targets that are consistent with State objectives and then to create solutions for reducing GHG emissions locally through the creation of a CCAP.
- ▶ **GHG Emissions Forecast** estimates future GHG emissions under "business-as-usual" (BAU) and legislative-adjusted BAU scenarios for years 2030, 2040, and 2045. The BAU scenario does not account for GHG emissions reductions resulting from legislation and regulations adopted by regional, State, or federal agencies. The legislative-adjusted BAU scenario reflects legislation and regulations enacted by regional, State, and federal agencies, without considering any local (City) actions to reduce GHG emissions.
- ▶ **GHG Reduction Target** identifies GHG emissions reduction targets for sectors relevant to the City's GHG emissions inventory for years 2030, 2040, and 2045 based on statewide reduction targets.

2 SUMMARY RESULTS

The following sections present the summary results for the 2022 GHG emissions inventory, the GHG emissions forecast, and GHG reduction targets.

2.1 GHG EMISSIONS INVENTORY RESULTS

This section includes the results for the GHG inventory for the year 2022, which is documented in detail in this report.

2.1.1 2022 GHG Emissions Inventory Results

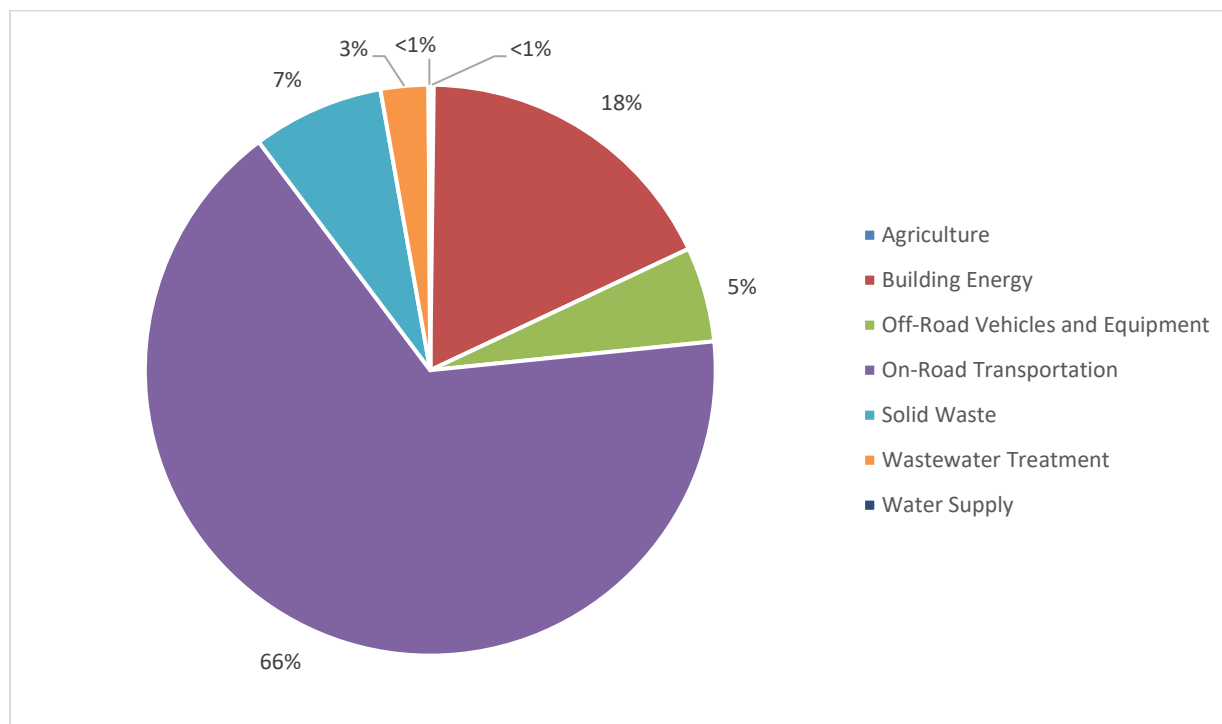
Based on the modeling conducted, community activities in the city generated approximately 2,714,021 metric tons of carbon dioxide equivalent (MTCO₂e) in 2022, or 6.7 MTCO₂e per capita. The largest emissions-generating sectors include on-road transportation, building energy, and solid waste. The 2022 inventory will be the City's GHG emissions baseline for SOAR Bakersfield and will be used to forecast emissions and identify emissions reduction targets. Table 1 and Figure 1 present the results of the City's 2022 community GHG emissions inventory by sector. Descriptions of each emissions sector, including key sources of emissions, are provided in further detail in Section 3, "2022 GHG Emissions Inventory Methods."

Table 1 2022 City of Bakersfield GHG Emissions Inventory Results

Sector	GHG Emissions (MTCO ₂ e)	Percent of Total
On-Road Transportation	1,754,459	66%
Building Energy	472,748	18%
Solid Waste	197,045	7%
Off-Road Vehicles and Equipment	144,505	5%
Wastewater Treatment	71,372	3%
Agriculture	9,563	<1%
Water Supply	2,670	<1%
Total	2,652,362	100%

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent.

Source: Analysis conducted by Ascent in 2025.

Figure 1 2022 City of Bakersfield GHG Emissions Inventory Results

Source: Analysis conducted by Ascent in 2025.

2.2 GHG EMISSIONS FORECAST RESULTS

The BAU GHG emissions forecasts provide an assessment of how emissions generated by community activities may change over time without further State, federal, regional, or local action. In addition to accounting for the city's population, employment, and land use change(s) under a BAU scenario, an adjusted BAU forecast (i.e., the legislative-adjusted BAU forecast) was prepared, which includes adopted legislation and regulations at the State and federal levels that would affect emissions without any local action. Examples include regulatory requirements to increase vehicle fuel efficiency and increase renewable energy sources in grid electricity portfolios. These forecasts provide the City with information needed to focus efforts on certain emissions sectors and sources that have the greatest opportunities for GHG emissions reductions. It is important to note that the legislative-adjusted BAU forecasts only account for emissions reductions associated with adopted legislation and regulations; they do not account for unadopted goals established by regional, State, and federal agencies or executive orders outside of adopted legislation and regulations.

The GHG emissions forecasts for 2030, 2040, and 2045 described in this section are aligned with the State's GHG reduction target years established in key legislation, including Senate Bill (SB) 32 and Assembly Bill (AB) 1279, as well as the horizon of the City's General Plan (i.e., 2045). 2040 forecasts are provided as an interim point between the State targets. The adopted statewide GHG reduction targets and goals are:

- ▶ 40 percent reduction below 1990 levels by 2030 (SB 32);
- ▶ 85 percent reduction in anthropogenic emissions below 1990 levels by 2045 (AB 1279); and
- ▶ carbon neutrality by 2045 (AB 1279).

Under a legislative-adjusted BAU scenario, the city's GHG emissions would be approximately 7 percent higher in 2030 compared to 2022 levels. After 2030, GHG emissions are expected to continue to increase, eventually reaching levels 28 percent above the 2022 inventory by 2045. Significant growth is expected in Bakersfield during the forecast period, driving increases in GHG emissions generating activities. However, under a legislative-adjusted BAU scenario, increased on-road vehicle fuel efficiency standards and zero-emission vehicle sales are expected to substantially reduce on-road transportation emissions. Therefore, given that on-road transportation is the largest source of GHG

emissions in the city, the GHG emissions under the legislative-adjusted BAU forecast are expected to grow at a lower pace compared to the BAU scenario. Without the legislative reductions, BAU scenario emissions would be approximately 31 percent higher in 2045 compared to the legislative-adjusted BAU forecast.

The results of both the BAU and legislative-adjusted BAU forecasts are shown below in Table 2 and Figure 2. Emissions forecasts for each sector are discussed in detail in Section 4 *GHG Emissions Forecast Methods*.

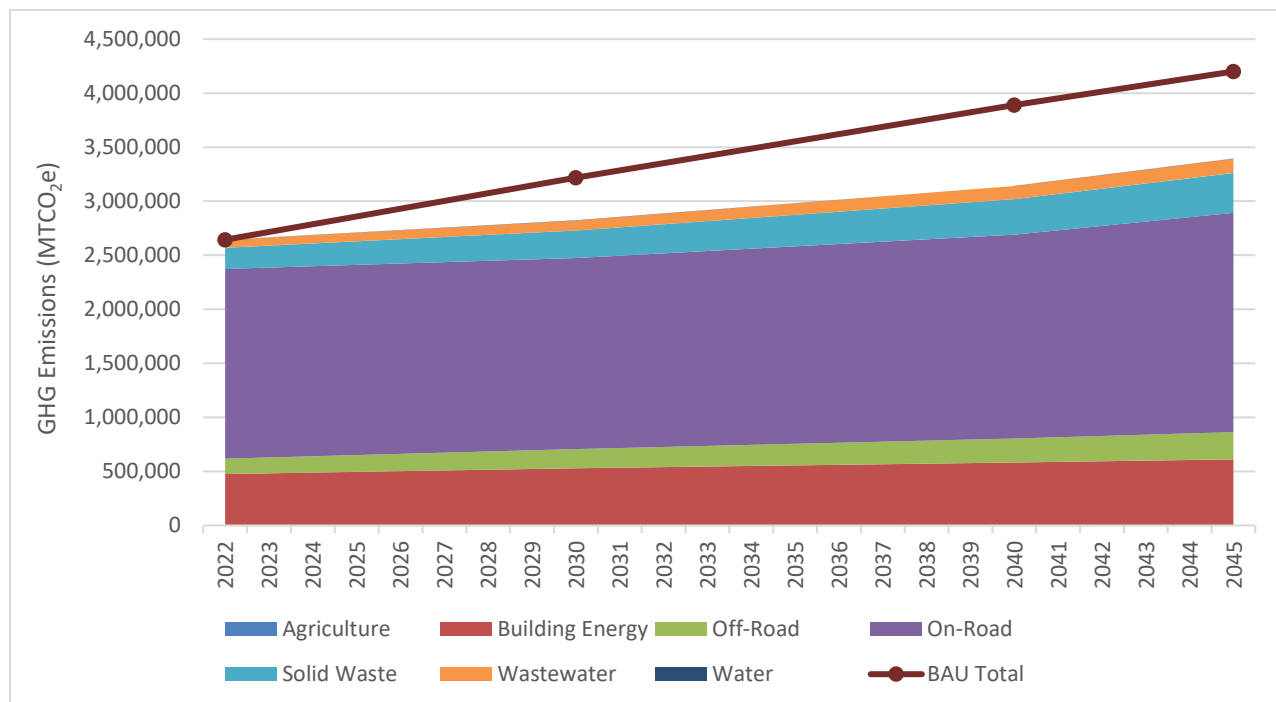
Table 2 City of Bakersfield 2022 GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts Results (MTCO₂e)

Sector	2022	2030		2040		2045	
		BAU	Legislative-Adjusted BAU	BAU	Legislative-Adjusted BAU	BAU	Legislative-Adjusted BAU
On-Road Transportation	1,754,459	2,102,167	1,766,784	2,472,284	1,885,596	2,625,084	2,028,812
Building Energy	472,748	584,045	527,824	738,333	579,284	815,478	609,782
Solid Waste	197,045	256,297	256,297	330,362	330,362	367,394	367,394
Off-Road Vehicles and Equipment	144,505	178,002	178,002	224,803	224,803	254,814	254,814
Wastewater Treatment	71,372	92,572	92,572	119,324	119,324	132,700	132,700
Agriculture	9,562	9,562	9,562	9,562	9,562	9,562	9,562
Water Supply	2,670	3,473	2,790	4,477	450	4,979	—
Total	2,652,362	3,226,120	2,833,833	3,899,146	3,149,382	4,210,011	3,403,065
<i>Percent Change from 2022 Levels</i>	—	22%	7%	47%	19%	59%	28%

Notes: Total may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent.

Source: Analysis conducted by Ascent in 2025.

Figure 2 City of Bakersfield GHG Emissions Inventory and Forecasts



Source: Analysis conducted by Ascent in 2025.

2.3 GHG REDUCTION TARGETS SUMMARY

As directed in SB 32 and AB 1279, the State has established the following GHG emissions reduction targets:

- ▶ 40 percent reduction below 1990 levels by 2030;
- ▶ 85 percent reduction in anthropogenic emissions below 1990 levels by 2045; and
- ▶ carbon neutrality by 2045.

The City aims to identify GHG reduction targets that would reduce community GHG emissions in proportion to the State's targets and goals. Community emissions levels from 1990 are not available for the city, which is the case for most local jurisdictions in California. Thus, community GHG reduction targets to inform SOAR Bakersfield were developed relative to the 2022 community emissions inventory, consistent with guidance provided by California Air Resources Board (CARB) (CARB 2017a).

Table 3 demonstrates state-aligned GHG reduction targets in comparison to the 2022 GHG emissions inventory and legislative-adjusted BAU forecasts for 2030, 2040, and 2045.

Table 3 City of Bakersfield Legislative-Adjusted BAU Forecasts and GHG Emissions Reduction Targets Below 2022 Levels

Source	2022	2030	2040	2045
City of Bakersfield GHG Emissions and Legislative-Adjusted BAU Forecast (MTCO ₂ e)	2,652,362	2,833,833	3,149,382	3,403,065
City of Bakersfield Target Percent Reduction Below 2022 Levels	N/A	37%	68%	84%
City of Bakersfield Target Annual Emissions (MTCO ₂ e)	N/A	1,682,826	853,861	424,061
Reduction from 2022 Needed to Meet Target (MTCO ₂ e)	N/A	969,536	1,418,027	2,228,301
Reduction from Legislative-Adjusted BAU Forecasts Needed to Meet Target (MTCO ₂ e)	N/A	1,151,008	2,284,521	2,979,004

Notes: BAU = business-as-usual; GHG = greenhouse gases; MTCO₂e = metric tons of carbon dioxide equivalent; N/A = Not Applicable.

Source: CARB 2022a; Analysis conducted by Ascent in 2025.

3 2022 GHG EMISSIONS INVENTORY METHODS

Nations, states, local jurisdictions, public agencies, and corporations estimate GHG emissions for different purposes. Several approaches exist to quantify GHG emissions, and the method chosen by governments or private entities is driven by the purpose of developing an inventory. State, federal, and international agencies have developed industry protocols and recommendations for local governments preparing GHG emissions inventories at the community level.

The traditional GHG emissions inventory used by local governments in the climate action planning process, known as a “production-based” inventory, estimates GHG emissions generated by activities occurring within a defined boundary during a single year. This has become the standard approach recommended by industry protocols and includes emissions that are generated from community activities that occur within the jurisdictional boundary of the community, such as those emitted from natural gas furnaces used for heating buildings throughout a community. It also includes certain “trans-boundary” emissions that are associated with activities occurring within the inventory’s boundary but are released into the atmosphere outside of the boundary. For example, electricity emissions in a production-based inventory are attributed to a community based on electricity consumption within the inventory boundary, even if the electricity was generated and produced GHG emissions outside of the inventory boundary. More information regarding considerations for preparing production-based inventories is included in Sections 3.2 through 3.7.

The production-based approach was chosen for the City’s community GHG emissions inventory, which is the focus of this report. This is consistent with recommendations and guidance from industry protocols (described further below), as well as State agencies, including the CARB and the Governor’s Office of Land Use and Climate Innovation (LCI). Production-based inventories provide local governments with the information needed to develop effective climate action policy within their communities. For this reason, the production-based inventory method is the most common approach taken by local governments across California and the nation.

3.1 PROTOCOLS AND METHODOLOGIES

3.1.1 U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions

Several inventory protocols have been developed to provide guidance for communities and local governments to account for emissions accurately and consistently. ICLEI – Local Governments for Sustainability USA (ICLEI) develops protocols for local-scale accounting of emissions that have become the industry standard for local governments developing GHG emissions inventories. The most current guidance for community-scale emissions inventories is ICLEI’s July 2019 publication *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions* (Community Protocol), Version 1.2 (ICLEI 2019). State agencies, including CARB and LCI, recommend that jurisdictions prepare community GHG emissions inventories using the guidelines included in the Community Protocol (CARB 2017a:100; LCI 2017:226).

The Community Protocol identifies six principles for GHG accounting and reporting. These principles were adapted from internationally recognized sources and were used to guide the development of the Community Protocol. ICLEI recommends that local governments consider these principles when preparing an inventory. The GHG accounting and reporting principles are summarized below.

- ▶ **Relevance, Including Policy Relevance, and Utility for Users:** The ultimate objective and intent of an inventory should be considered during the inventory development process. Inventories should be organized in a way that is understandable and useful for policymakers and the public while appropriately reflecting community GHG emissions and enabling the evaluation of emissions trends over time.
- ▶ **Accuracy:** The use of GHG emissions accounting methods that are expected to systematically under- or over-estimate emissions should be avoided. Decisionmakers should be able to take action with reasonable assurance as to the integrity of emissions estimates.

- ▶ **Completeness:** Community GHG emissions inventories should be as comprehensive as possible and include all emissions associated with the community, as well as community GHG emissions “sinks” (i.e., the opposite of an emissions source; any reservoir, natural or otherwise, that accumulates and stores GHG emissions)¹.
- ▶ **Measurability:** Methods used to quantify GHG emissions should be readily available, adequately substantiated and of known quality, and updated regularly as established methods evolve.
- ▶ **Consistency and Comparability:** Community inventories should consistently use preferred, established methods to enable tracking of emissions over time, evaluation of reduction measures effectiveness, and comparison between communities. Alternative methods should be documented and disclosed.
- ▶ **Transparency:** All relevant data sources, methods, and assumptions should be disclosed and described to allow for future review and replication. Similarly, all relevant issues should be documented and addressed coherently.

Consistent with these recommendations as well as industry standards and best practices, the City’s community GHG emissions inventory primarily follows methodologies provided by the Community Protocol. However, additional established methods were used for selected GHG emissions sources where the Community Protocol does not provide guidance, or where updated methods have been established that improve the accuracy of emissions estimates. This approach is consistent with guidance from the Community Protocol: “Protocol estimation methods must be used in Protocol-compliant inventories except where the user identifies and documents another method that is likely to better satisfy the Protocol reporting principles” (ICLEI 2019:20-21). The following sections describe additional methods used for estimating GHG emissions in the city.

3.2 EMISSIONS SECTORS AND SOURCES

There are several approaches for categorizing and grouping GHG emissions in community inventories. Generally, GHG emissions are organized into emissions sectors, which frequently include building energy, transportation, solid waste, water, and wastewater. Sometimes these sectors are broken down further, such as residential building energy and nonresidential building energy, and sectors may also be combined, such as water and wastewater. The purpose of categorizing GHG emissions into broad sectors is to provide local governments and the public with a useful organization of community emissions. Importantly, GHG emissions sectors may not align directly with economic sectors (e.g., hospitality), but there may be an overlap for some communities.

Within GHG emissions sectors, emissions are generated in a variety of ways. Motor vehicles burn fossil fuels and emit GHGs directly into the atmosphere; the electricity used in homes and businesses produces indirect emissions from power plants; and solid waste that ends up in landfills breaks down and releases GHG emissions over time. The Community Protocol organizes different types of community GHG emissions into two general categories:

- ▶ GHG emissions **sources** are those that release emissions directly into the atmosphere as a result of any physical process that occurs within the jurisdictional boundary of the inventory. Natural gas combustion for heating in homes and diesel fuel combustion in motor vehicles within the community are considered GHG emissions sources.
- ▶ GHG emissions **activities** are those that release emissions into the atmosphere either directly or indirectly as a result of the use of energy, materials, and/or services within the community. For example, GHG emissions from a community’s electricity use are accounted for and considered GHG emissions activities, even if the burning of fossil fuels to generate the electricity occurred and produced emissions outside of the inventory boundary.

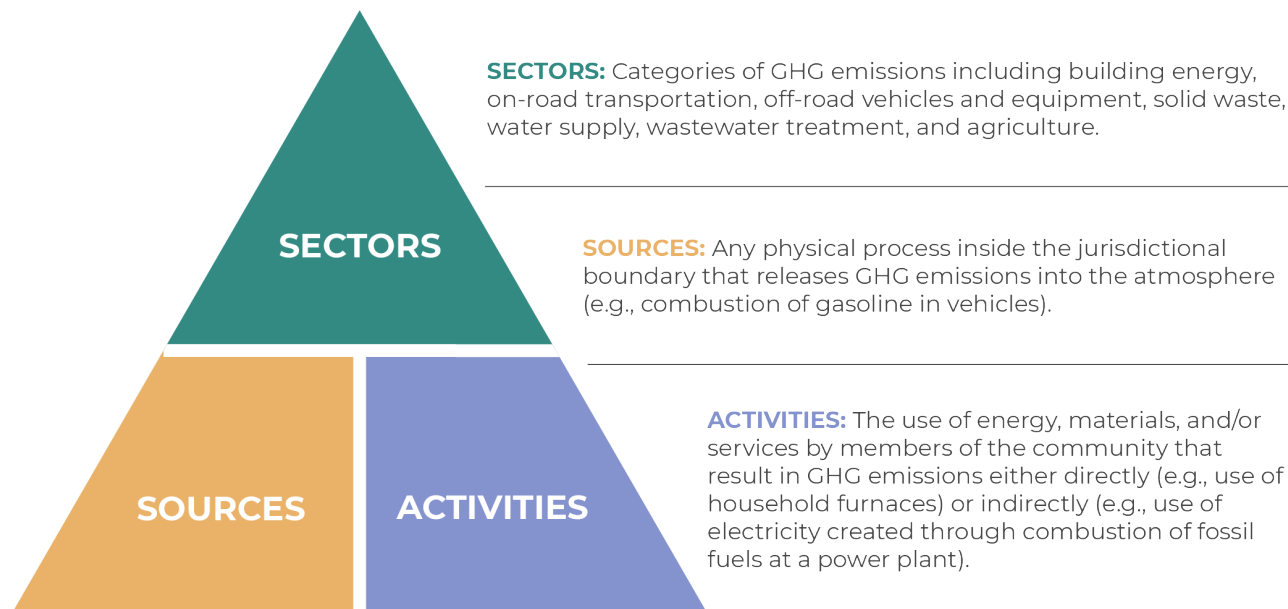
For the sake of clarity, this report uses “GHG emissions sources” to represent both direct in-boundary emissions *sources* as well as indirect emissions that are produced out-of-boundary as a result of *activities* that occur within the community. The GHG emissions sources in the City’s community inventory are organized under seven sectors:

¹ This GHG emissions inventory and the City’s CCAP focus on emissions sources; they do not incorporate an analysis of emissions sinks.

building energy, on-road transportation, off-road vehicles and equipment, solid waste, water supply, wastewater treatment, and agriculture.

Figure 3 depicts how sectors, sources, and activities are considered and categorized in the City's inventory.

Figure 3 Emissions Sectors, Sources, and Activities Hierarchy



Source: Developed by Ascent in 2022.

3.2.1 Community Protocol-Compliant Sources

When developing a community inventory, it is important for local governments to determine what will be included in the inventory scope. This may be influenced by factors such as the purpose and intended narrative of the inventory, the reporting framework that will be used, and the GHG emissions sources present in the community. While local governments have some flexibility in determining an inventory's scope, the Community Protocol requires the inclusion of a minimum of five emissions sources in community inventories:

- ▶ Use of electricity by the community.
- ▶ Use of fuel in residential and commercial stationary combustion equipment.
- ▶ On-road passenger and freight motor vehicle travel.
- ▶ Use of energy in potable water and wastewater treatment and distribution.
- ▶ Generation of solid waste by the community.

The Community Protocol strongly encourages local governments to include other emissions-generating sources in accounting and reporting as well. Given that Bakersfield has approximately 8,000 acres of agricultural land within the city limits, the GHG emissions inventory for Bakersfield also includes GHG emissions from agricultural activities.

3.2.2 Inclusion and Exclusion of Sources

The 2022 GHG emissions inventory is being developed within the context of the United States Environmental Protection Agency (EPA) Climate Pollution Reduction Grants program, which requires that the CCAP include a set of key GHG emissions sectors. This GHG emissions inventory aligns with the required sectors, however, the GHG

emissions forecasts and reduction targets primarily exclude large industrial entities. GHG emissions from industrial entities are regulated by CARB through the State's Greenhouse Gas Cap-and-Trade Program. While industrial GHG emissions are included in this inventory report for informational purposes, these emissions are not considered as part of the GHG emissions that the City of Bakersfield would be responsible for reducing. Additional information about GHG emissions from industrial entities is included in Section 3.7.11.

Table 4 provides an overview of the intersection between GHG emissions sectors included in the City's 2022 GHG emissions inventory and the sectors required under the Climate Pollution Reduction Grants Program.

Table 4 Sectors Included in GHG Inventory Compared to Climate Pollution Reduction Grant Requirements

Climate Pollution Reduction Grant Sectors	2022 GHG Emissions Inventory Sectors	Justification
Industry	Not included	Industrial GHG emissions are assessed as part of the GHG emissions inventory but not included in GHG emissions totals. See Section 3.7.11 for additional detail.
Electricity generation	Not included	Electricity generation facilities are categorized as "Industrial" in California, and as such are covered under the State's Cap-and-Trade program. See Section 3.7.11 for additional detail.
Electricity use	Building Energy, Water Supply	Primary end uses of electricity in the City of Bakersfield are included in the Building Energy and Water Supply sectors.
Commercial and residential buildings	Building Energy	Natural gas used in commercial and residential buildings is included in the Building Energy sector.
Agriculture	Agriculture	Agriculture emissions include the use of synthetic fertilizers. GHG emissions from livestock are not included because significant livestock operations do not exist in the City limits and limited data availability for any existing livestock operations.
Natural and working lands	Not included	GHG emissions from natural and working lands are not considered as part of this GHG emissions inventory. However, a supplementary report will be included with the CCAP that includes assessment of carbon stocks in natural and working lands.
Transportation	On-Road Transportation, Off-Road Transportation	The On-Road Transportation and Off-Road Transportation sectors include GHG emissions from fuel consumed in on-road vehicles and off-road equipment.
Waste and materials management	Solid Waste, Wastewater Treatment	The Solid Waste, Wastewater Treatment sectors include GHG emissions from the disposal of solid waste in landfills and treatment of wastewater generated in the City.

Source: Analysis conducted by Ascent in 2025.

3.3 BOUNDARIES

The scope and boundary chosen for estimating GHG emissions may vary depending on the focus and/or intent of the inventory. For example, while corporate inventories use the concept of ownership to guide GHG emissions accounting, where emissions generated by all sources and activities owned by the entity are accounted for, regardless of where emissions are produced, community-scale inventories serve to convey information about emissions associated with politically defined communities (ICLEI 2019:12).

As described in the previous sections, production-based community inventories include emissions that are produced within a community's geographic boundary as well as those that are produced outside the boundary but result from activities within the community. Inventories following the Community Protocol are required to include several emissions sources; however, certain emissions sources that are located within the inventory boundary may be excluded from a community inventory. The following section outlines considerations and the decision-making framework for determining which GHG emissions sources are included or excluded from an inventory.

3.3.1 City Inventory Boundary

The CCAP aims to reduce GHG emissions from sources within the Bakersfield city limits over which the City has regulatory authority or significant influence. Importantly, the CCAP will not apply to the greater metropolitan Bakersfield area. Because of this, the City's inventory only includes emissions generated from sources and activities occurring within the boundaries of the city; it does not account for GHG emissions generated from activities occurring outside of the City's jurisdiction, as the city does not have operational control of or authority over these emissions sources. Therefore, GHG emissions generated from activities within unincorporated places adjacent to the city (i.e., within the metropolitan Bakersfield area) or lands owned and/or managed by State and federal agencies (e.g., Federal Responsibility Areas) are excluded from the inventory.

Additionally, the City's community inventory does not account for embedded or lifecycle GHG emissions. The City's inventory evaluates emissions using the production-based approach; therefore, the City's inventory does not consider the upstream emissions generated by the consumption of goods and services within the community.

The GHG emissions sectors and sources included and excluded in the City's 2022 community inventory are presented in Table 5 below.

Table 5 2022 City of Bakersfield Summary of Sectors and Sources

Sector/Source	Included	Excluded
On-Road Transportation		
<i>On-Road Transportation</i>	Emissions from 100 percent of trips within the city (internal-internal) and 50 percent of trips starting or ending outside the city (internal-external and external-internal)	Emissions from 100 percent of pass-through trips starting and ending outside the city (external-external)
Building Energy		
<i>Electricity</i>	Emissions associated with electricity consumed within the city	
<i>Natural Gas</i>	Emissions from natural gas consumed within the city	
<i>Backup Generators</i>	Emissions from diesel, propane, liquid propane gas, and natural gas consumed in backup generators within the city	
Industrial		
<i>Natural Gas, Other Fuel Combustion, Electricity, and Process Emissions</i>		California's Cap-and-Trade Program, administered by the CARB, regulates large industrial facilities, fuel distributors, and electricity generators. These emissions sources are typically outside the regulatory scope of local governments, as cities and counties do not have jurisdiction over industrial operations that are subject to state-level GHG compliance mechanisms
Solid Waste		
<i>Community-Generated Solid Waste</i>	Emissions from all waste generated within the city	Emissions from waste generated outside of the city, but disposed of within the city, as no operational landfills exist within the city limits
Off-Road Vehicles and Equipment		
<i>Off-Road Vehicles and Equipment</i>	Emissions from off-road vehicles and equipment within the city	

Sector/Source	Included	Excluded
Wastewater Treatment		
<i>Wastewater Treatment</i>	Emissions associated with wastewater generated within the city	Emissions from wastewater generated outside of the city but treated within the city
Water Supply		
<i>Water Supply</i>	Emissions associated with water use within the city	
Agriculture		
<i>Fertilizer Application</i>	Emissions associated with fertilizer use within the city	
<i>Agricultural Equipment - Off-Road Vehicles and Equipment</i>	Emissions from agricultural off-road vehicles and equipment within the city, including those powered by gasoline, diesel, and natural gas	
<i>Agricultural Equipment – Irrigation Pumps</i>	Emissions from diesel and natural gas fuel use for irrigation pumps within the city	

Source: Analysis conducted by Ascent in 2025.

3.4 OVERVIEW OF ACTIVITY DATA AND EMISSIONS FACTORS

The basic calculation for estimating GHG emissions involves two primary inputs: activity data and emissions factors. Activity data refers to the relevant measurement of a community's activity resulting in emissions, and emissions factors represent the amount of a GHG emitted on a per unit of activity basis. Emissions factors are applied to activity data (i.e., the two values are multiplied together) to estimate GHG emissions. For example, in the building energy sector, activity data of annual community electricity consumption in megawatt-hours (MWh) is multiplied by an emissions factor in pounds of GHG per MWh, which results in pounds of GHG emissions value. This calculation-based methodology is used for estimating emissions from most sources in the City's inventory. An overview of activity data and emissions factors for each emissions source, along with data sources, is shown in Table 6. Detailed methods are described in the following sections.

Table 6 2022 City of Bakersfield Summary of Activity Data and Emissions Factors

Sector/Source	Input Type	Description and Data Sources
On-Road Transportation		
<i>On-Road Transportation (current methodology)</i>	Activity data	Vehicle miles traveled (VMT) data from the Kern Council of Governments (Kern COG) Travel Model
	Emissions factor	Kern County-specific emissions factors from CARB EMFAC2021 emissions model
Building Energy		
<i>Electricity</i>	Activity data	Electricity consumption data from Pacific Gas and Electric Company (PG&E)
	Emissions factor	Utility-specific emissions factors from The Climate Registry (TCR) and EPA
<i>Natural Gas</i>	Activity data	Natural gas consumption data from PG&E and Southern California Gas Company (SoCalGas)
	Emissions factor	Average emissions factors from TCR
<i>Backup Generators</i>	Activity data	Fuel consumption data from the San Joaquin Valley Air Pollution Control District (Valley Air District)
	Emissions factor	Average emissions factors from TCR
Solid Waste		
<i>Community-Generated Solid Waste</i>	Activity data	Waste disposal data from the California Department of Resources Recycling and Recovery (CalRecycle)
	Emissions factor	Mixed municipal solid waste emissions factor from EPA

Sector/Source	Input Type	Description and Data Sources
Off-Road Vehicles and Equipment		
<i>Off-Road Vehicles and Equipment</i>	Activity data	Off-road vehicles and equipment activity and emissions factors data from CARB
	Emissions factor	OFFROAD2021 emissions model
Wastewater Treatment		
<i>Wastewater Treatment</i>	Activity data	Wastewater generation and process-related data from the City
	Emissions factor	Emissions factors based on treatment processes from the City and ICLEI
Water Supply		
<i>Water Supply</i>	Activity data	Water consumption and associated electricity data from the City's Water Resources Department, California Water Service Company, and Greenfield County Water District; water conveyance energy intensity data obtained from the Department of Water Resources (DWR)
	Emissions factor	Electricity emissions factors from EPA Emissions & Generation Resource Integrated Database (eGRID) CAMX grid subregion
Agriculture		
<i>Fertilizer Application</i>	Activity data	California Department of Food and Agriculture (CDFA) 2022 Fertilizer Tonnage Report
	Emissions factor	Fertilizer emissions factors from CARB
<i>Agricultural Equipment – Off-Road Vehicles and Equipment</i>	Activity data	Off-road vehicles and equipment activity data and emissions factors from the CARB OFFROAD2021 emissions model
	Emissions factor	Off-road vehicles and equipment activity data and emissions factors from the CARB OFFROAD2021 emissions model
<i>Agricultural Equipment – Irrigation Pumps</i>	Activity data	Diesel- and natural gas-powered irrigation pumps data from the Valley Air District
	Emissions factor	Emission factors from TCR

Notes: CalRecycle = California Department of Resources Recycling and Recovery; CARB = California Air Resources Board; CDFA = California Department of Food and Agriculture; EPA = U.S. Environmental Protection Agency; ICLEI = ICLEI – Local Governments for Sustainability; PG&E = Pacific Gas and Electric Company; SoCalGas = Southern California Gas Company; Valley Air District = San Joaquin Valley Air Pollution Control District; TCR = The Climate Registry; VMT = vehicle miles traveled; Kern COG = Kern Council of Governments; DWR = Department of Water Resources; eGRID = Emissions & Generation Resource Integrated Database.

Source: Analysis conducted by Ascent in 2025.

3.5 GLOBAL WARMING POTENTIALS AND EMISSIONS UNITS

GHG emissions other than carbon dioxide (CO₂) generally have a stronger insulating effect and thus, a greater ability to warm the Earth's atmosphere through the greenhouse effect. This effect is measured in terms of a pollutant's global warming potential (GWP). CO₂ has a GWP factor of one, while all other GHGs have GWP factors measured in multiples of one relative to the GWP of CO₂. This conversion of non-CO₂ gases to one unit enables the reporting of all emissions in terms of carbon dioxide equivalent (CO₂e), which allows for the consideration of all gases in comparable terms and makes it easier to communicate how various sources and types of GHG emissions contribute to climate change. The standard unit for reporting emissions is MTCO₂e.

Consistent with the best available science, the inventory uses GWP factors published in the Sixth Assessment Report (AR6) from IPCC, where methane (CH₄) and nitrous oxide (N₂O) have GWP factors of 27.9 and 273, respectively (IPCC 2021). These values represent the GWP of a GHG on a 100-year time horizon. This means that CH₄ is approximately 28 times stronger than CO₂ and N₂O is 273 times stronger than CO₂ in their potential to warm Earth's atmosphere over the course of 100 years. The use of 100-year GWP values is consistent with CARB methods and reflects the long-term planning horizon of the CCAP.

3.6 DATA QUALITY AND ACCURACY

When preparing a GHG emissions inventory, the goal is to use the best available data and methodologies to develop the most accurate picture of a community’s emissions. However, some degree of inaccuracy is inherent in all inventories. As described by the Community Protocol, “While no community inventory is fully comprehensive (some emissions cannot be estimated due to a lack of valid methods, a lack of emissions data, or for other reasons), community inventories often aim to provide as complete a picture of GHG emissions associated with a community as is feasible” (ICLEI 2019:12). The accuracy of a GHG emissions inventory is primarily dependent on activity data (e.g., tons of solid waste generated by a community), emissions factors (e.g., grams of CO₂ per vehicle mile traveled [VMT] in a county), and scaling factors (e.g., percentage of county-level off-road vehicles and equipment emissions attributed to a local jurisdiction).

Development of the City’s GHG emissions inventory was a robust and comprehensive process rooted in industry standards and best practices, and it included extensive research and consultation with City staff and departments as well as regional and State agencies to ensure data was as accurate as possible.

3.7 INVENTORY DATA AND ASSUMPTIONS

3.7.1 Demographic and Land Use Data

Population, employment, and agricultural acres data for the city and Kern county were used to scale activity levels for certain emissions sources and sectors. Population data for the city and Kern county for 2022 were obtained from the U.S. Census Bureau American Community Survey 5-Year Estimates Data Profiles for 2022 (U.S. Census Bureau 2025). Employment data for the city for 2022 were not directly available, and employment was calculated based on the ratio of number of jobs to the city’s population from Kern COG 2022 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) (Kern COG 2022). Kern county employment data for 2022 was also obtained from the U.S. Census Bureau American Community Survey 5-Year Estimates Data Profiles for 2022 (U.S. Census Bureau 2025). Agricultural acres data for the city and Kern county were obtained from the California Department of Conservation (DOC) Farmland Mapping & Monitoring Program (FMMP) (DOC 2022). The population, employment, and agricultural acreage assumptions for the City of Bakersfield and Kern county are provided in Table 7.

Table 7 City of Bakersfield and Kern County Demographic and Land Use Data for 2022

Metric	City of Bakersfield	Kern County Total	Percent of Total
Population	404,321	906,883	44.6%
Employment	141,512	358,961	39.4%
Agricultural Acreage	41,684	2,747,115	1.5%

Sources: U.S. Census Bureau 2025, Kern COG 2022; DOC 2022. Table compiled by Ascent in 2025.

3.7.2 Sector-Specific Assumptions and Methods

The following sections describe in detail the methods, data, and assumptions that were used in estimating the city’s community GHG emissions in 2022.

The list below summarizes this information at a high level for each sector.

- **Building Energy:** Annual electricity and natural gas usage data for the city were provided by Pacific Gas and Electric Company (PG&E) and Southern California Gas Company (SoCalGas). Utility emissions factors were available from The Climate Registry (TCR) and EPA. Annual nonresidential backup generator usage was provided by San Joaquin Valley Air Pollution Control District (Valley Air District). Emissions factors for nonresidential backup generator fuels were obtained from TCR and PG&E.

- ▶ **On-Road Transportation:** For the on-road transportation sector, daily VMT for the city was obtained from the Kern COG's Travel Model, which was developed for Kern COG's 2018 RTP. Daily VMT data from the Travel Model were estimated using the Regional Technical Advisory Committee's (RTAC's) origin-destination method described in SB 375. Vehicle emissions factors were derived from the 2021 Emissions FACTor (EMFAC2021) model, CARB's statewide mobile source emissions inventory model.
- ▶ **Off-Road Vehicles and Equipment:** Off-road vehicles and equipment emissions were estimated from CARB's OFFROAD2021 model and scaled by population, employment, or service population (i.e., the sum of population and employment) depending on the vehicle or equipment type.
- ▶ **Solid Waste:** Emissions associated with waste generated by residents and businesses in the city were estimated using disposal data available from the CalRecycle for landfills receiving waste from the city. Landfill gas (LFG) collection information was obtained from the EPA.
- ▶ **Water Supply:** Water-related emissions were estimated using data for electricity consumption associated with supplying water in the city, which were provided by the City's Water Resources Department, California Water Service Company, and Greenfield City Water District. Water conveyance energy intensity data was obtained from the DWR.
- ▶ **Wastewater Treatment:** Emissions from wastewater treatment depend on the types of treatment processes and equipment that centralized wastewater treatment plants (WWTPs) use. Data regarding treatment processes, population served, digester gas combustion, biological oxygen demand (BOD₅) load, and daily nitrogen load were obtained from the City for the two facilities it operates that serve the city, WWTP No. 2 and WWTP No. 3, to estimate emissions from wastewater treatment.
- ▶ **Agriculture:** Emissions associated with the agriculture sector result from fertilizer application, the operation of agricultural equipment (i.e., fossil fuel-powered irrigation pumps and agricultural off-road vehicles and equipment). Agriculture emissions were estimated using data available from CARB, Valley Air District, and CDFA².

3.7.3 Utility Emissions Factors

Emissions of CO₂, CH₄, and N₂O per MWh of electricity can vary by location and from year to year depending on several factors. Utility-specific emissions factors for electricity were obtained and used throughout the inventory to estimate GHG emissions from electricity, and average natural gas emissions factors were used to estimate GHG emissions associated with natural gas consumption. Sources for electricity and natural gas emissions factors are shown below.

- ▶ **Electricity:** PG&E's electricity emissions factors for CO₂, CH₄, and N₂O were obtained from TCR and EPA's eGRID. PG&E's CO₂ emissions factor was obtained from TCR (TCR 2025) and the requirements of the Renewables Portfolio Standard included in SB 100. California-specific emissions factors for CH₄ and N₂O in 2022 were obtained from eGRID2022 (EPA 2024). Emissions factors for direct access electricity were also obtained from eGRID2022.
- ▶ **Natural Gas:** Utility natural gas emissions factors for CO₂, CH₄, and N₂O were obtained from TCR's 2022 Default Emission Factors (TCR 2022).

Specific utility emissions factors used in the inventory calculations are shown below in Tables 8 and 9. Emissions factors are shown in standard units for electricity (pounds of GHG per MWh) and natural gas (pounds of GHG per therm). Emissions factors are also presented in pounds of GHG per kilo British thermal unit (kBTU) to enable a comparison between energy types in similar terms.

² Emissions from livestock management (i.e., enteric fermentation and manure management) also generate emissions in the agriculture sector. However, there are no significant livestock operations within the city limits, and data on any existing operations is limited. Therefore, livestock management emissions were excluded from the City's emissions inventory.

Table 8 2022 City of Bakersfield Electricity Emissions Factors

Provider	Pollutant	Emissions Factor (lb/MWh)	Emissions Factor (lb/kBTU)
PG&E	CO ₂	56.08	0.0149
	CH ₄	0.03	0.000008
	N ₂ O	0.004	0.000001
Direct Access (CAMX)	CO ₂	497.4	0.146
	CH ₄	0.03	0.000008
	N ₂ O	0.004	0.000001

Notes: CH₄ = methane; CO₂ = carbon dioxide; kBTU = kilo British thermal unit; lb = pounds; MWh = megawatt-hours; N₂O = nitrous oxide; PG&E = Pacific Gas and Electric Company.

Source: Utility emissions factors available from TCR and EPA. Table compiled by Ascent Environmental in 2025.

Table 9 2022 City of Bakersfield Natural Gas Emissions Factors

Provider	Pollutant	Emissions Factor (lb/therm)	Emissions Factor (lb/kBTU)
PG&E and SoCalGas	CO ₂	11.7	0.117
	CH ₄	0.00104	0.0000104
	N ₂ O	0.000022	0.0000002

Notes: CH₄ = methane; CO₂ = carbon dioxide; kBTU = kilo British thermal unit; lb = pounds; MWh = megawatt-hours; N₂O = nitrous oxide; PG&E = Pacific Gas and Electric Company; SoCalGas = Southern California Gas Company.

Source: Emissions factors available from TCR. Table compiled by Ascent Environmental in 2025.

RESIDENTIAL ENERGY

Residential energy emissions in the city result indirectly from electricity consumption and directly from onsite combustion of natural gas. PG&E is the only provider of residential electricity in the city. PG&E and SoCalGas both provide residential natural gas in the city.

Annual residential electricity usage data in the City in kilowatt-hours (kWh) was obtained from PG&E. To calculate emissions in MTCO₂e from residential electricity consumption, emissions factors (shown in Table 11) for CO₂, CH₄, and N₂O were applied to electricity consumption data.

Annual residential natural gas consumption in therms was obtained from PG&E and SoCalGas. Natural gas emissions factors for CO₂, CH₄, and N₂O were applied to consumption data to estimate emissions in MTCO₂e from residential natural gas usage.

NONRESIDENTIAL ENERGY

Nonresidential energy emissions, which are generated by commercial and industrial uses, result indirectly from electricity consumption and directly from the onsite combustion of natural gas. A small proportion of nonresidential energy emissions are generated from the onsite combustion of diesel, liquefied petroleum gas (LPG), propane, and natural gas in generators. PG&E provides electricity to nonresidential uses in the city. Some nonresidential uses purchase electricity from third-party providers, which are categorized as “direct access” electricity customers. Nonresidential natural gas in the city is provided by both PG&E and SoCalGas.

Annual nonresidential electricity usage data in kWh was obtained from PG&E. Annual nonresidential natural gas consumption in therms was obtained from PG&E and SoCalGas. Emissions associated with nonresidential energy consumption were quantified using the same methods as described above for residential energy calculations.

Data for annual nonresidential backup generators were obtained from Valley Air District, expressed as gallons for diesel fuel and standard cubic feet for propane and natural gas. Emissions factors obtained from TCR were applied to fuel consumption data to estimate GHG emissions associated with nonresidential backup generator usage.

3.7.4 Building Energy

Total building energy use in the city resulted in approximately 472,748 MTCO_{2e} in 2022, with residential buildings and nonresidential buildings contributing approximately 284,905 MTCO_{2e} and 187,843 MTCO_{2e}, respectively. Residential building energy use accounted for approximately 10.5 percent of the city's total emissions in 2022 and represents the second-largest emissions sector in the inventory. Nonresidential building energy use generated approximately 7 percent of community emissions.

Over 80 percent of total building energy emissions were a result of natural gas combustion for heating and cooking in homes and businesses. Emissions associated with electricity use, primarily for lighting and heating, ventilation, air conditioning, and cooling (HVAC) and to power appliances, as well as direct access electricity usage, contributed nearly 20 percent of the city's building energy emissions. A marginal amount of nonresidential building energy emissions was associated with the consumption of diesel, propane, LPG, and natural gas in backup generators.

Nonresidential natural gas use accounted for approximately 25 percent of the city's 2022 building energy emissions, and residential natural gas use accounted for approximately 55 percent. Electricity from both residential and nonresidential buildings accounted for nearly 20 percent of emissions from the building energy sector combined, and nonresidential backup generators accounted for less than 1 percent of emissions from the building sector in 2022. Annual electricity, natural gas, and backup generator usage and GHG emissions are shown in Table 10, and additional information regarding each emissions source and calculations is discussed below.

Table 10 2022 City of Bakersfield Community Building Energy Use and GHG Emissions

Energy Type	Quantity	GHG Emissions
Electricity	MWh	MTCO _{2e}
Residential	885,100	23,289
Nonresidential	1,133,874	66,547
<i>Electricity Total</i>	<i>2,018,973</i>	<i>89,836</i>
Natural Gas	therms	MTCO _{2e}
Residential (PG&E)	32,972,875	180,706
Nonresidential (PG&E)	16,576,155	90,845
Residential (SoCalGas)	14,763,409	80,910
Nonresidential (SoCalGas)	5,232,930	28,679
<i>Natural Gas Total</i>	<i>69,545,369</i>	<i>381,139</i>
Backup Generators		MTCO _{2e}
Diesel (gallons)	143,914	1,469
Natural Gas (scf)	7,945	44
LPG (gallons)	45,441	259
Total	N/A	472,748

Notes: Totals in columns may not sum exactly due to independent rounding. GHG = greenhouse gas; MTCO_{2e} = metric tons of carbon dioxide equivalent; MWh = megawatt-hours; N/A = not applicable; scf = standard cubic feet.

Source: Analysis conducted by Ascent in 2025.

3.7.5 On-Road Transportation

Based on modeling conducted, on-road transportation in the city resulted in approximately 1,754,459 MTCO₂e in 2022, or 66 percent of the city's emissions in 2022. The on-road transportation sector represents the largest emissions sector in the city. Annual VMT and GHG emissions from on-road transportation are shown in Table 11. Additional details and calculation methodologies and assumptions are described below.

Table 11 2022 City of Bakersfield Community On-Road Transportation VMT and GHG Emissions

Source	Annual VMT	GHG Emissions (MTCO ₂ e)
On-Road Transportation	3,095,719,039	1,754,459

Notes: GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent; VMT = vehicle miles traveled.

Source: Analysis conducted by Ascent in 2025.

On-road transportation emissions are primarily the result of the combustion of gasoline and diesel fuels in passenger vehicles (i.e., cars, light-duty trucks, and motorcycles), medium- and heavy-duty trucks, and other types of vehicles permitted to operate "on road." To a smaller degree, emissions from on-road electric vehicles also result from upstream electricity generation; these emissions are represented in annual electricity emissions in the city.

Kern COG is the regional Metropolitan Planning Organization responsible for regional transportation planning for the 11 incorporated cities in Kern county, as well as unincorporated areas of the county. Kern COG's Travel Model provides weekday daily VMT estimates for the entire county as well as several planning areas in the Kern COG service territory. For the purposes of the City's CCAP, Kern COG provided weekday daily VMT estimates for the years 2017 and 2035 using the RTAC origin-destination method established through SB 375 and CARB recommendations. These VMT estimates are associated with trips that begin and/or end in the city. VMT estimates included 100 percent of vehicle trips that both originate from and end in the city (i.e., fully internal trips), 50 percent of trips that either end in or depart from the city (i.e., internal-external or external-internal trips), and zero percent of vehicle trips that are simply passing through the city boundaries (i.e., external-external, or "pass-through," trips). Weekday daily VMT for 2022 was interpolated using the data for 2017 combined with data for 2035, which was also provided by Kern COG, and then annualized by multiplying by a factor of 347, which is consistent with CARB recommendations (CARB 2018).

EMFAC2021, a statewide mobile source emissions inventory model developed by CARB, was used to generate emission factors for the City for calendar year 2022. The model accounts for all vehicle classes, model years, speeds, and fuel types. Total CO₂, CH₄, and N₂O emissions for Kern county in 2022 were divided by the total countywide VMT to derive their respective emission factors. These were then converted to CO₂e using the appropriate GWP values, resulting in a combined emission factor expressed in MTCO₂e/VMT. These emission factors are shown in Table 12 below (CARB 2022b).

This combined emission factor was then applied to the city's total VMT for 2022, which was calculated using the methodology described in the preceding paragraph, to estimate GHG emissions from on-road transportation. The Kern county emission factor was used as a proxy for the City of Bakersfield.

Table 12 2022 City of Bakersfield On-Road GHG Emissions Factors

CO ₂ (short tons)/VMT	CH ₄ (short tons)/VMT	N ₂ O (short tons) /VMT	CO ₂ e (short tons)/VMT
0.000610	0.0000000197	0.0000000539	0.000625

Notes: CH₄ = methane; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; N₂O = nitrous oxide; VMT = vehicle miles traveled.

Source: CARB 2022b. Table compiled by Ascent Environmental in 2025.

3.7.6 Off-Road Vehicles and Equipment

Based on modeling conducted, off-road vehicles and equipment operating in the city emitted approximately 142,176 MTCO₂e in 2022, or 5 percent of the 2022 inventory. The largest emissions-generating off-road categories include construction and mining equipment, transportation refrigeration units, and portable equipment. The estimated annual emissions, fuel consumed, and scaling factors used are presented in Table 13 by vehicle and equipment type. Additional details regarding calculation methods and assumptions are discussed below.

Table 13 2022 City of Bakersfield Community Off-Road Vehicles and Equipment GHG Emissions and Scaling Method

Off-Road Vehicles and Equipment Type	Gasoline Consumed (gallons)	Diesel Consumed (gallons)	Natural Gas Consumed (gallons)	GHG Emissions (MTCO ₂ e)	Scaling Method
Agricultural Offroad	4,077	220,594	—	2,329	Agricultural Acres
Airport Ground Support	20,550	4,002	2,371	245	Population
Construction and Mining	74,447	4,320,736	—	45,575	Service Population
Industrial	91,859	177,865	164,571	3,791	Employment
Lawn and Garden Equipment	935,351	17,668	—	8,969	Population
Light Commercial Equipment	942,979	75,781	60,426	9,936	Employment
Oil Drilling	—	68,771	—	714	Employment
Pleasure Craft	1,733,994	—	—	15,368	Population
Portable Equipment	—	1,763,197	—	18,356	Employment
Recreational Equipment	687,832	—	—	6,376	Population
Transportation Refrigeration Units	—	3,162,735	—	32,846	Service Population
Total	4,491,089	9,811,349	227,368	144,505	N/A

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent; N/A = not applicable.

Source: Analysis conducted by Ascent in 2025.

Emissions from the off-road vehicles and equipment sector result from fuel combustion in off-road vehicles and equipment. Data associated with this sector were available from CARB's OFFROAD2021 model. The model provides off-road fuel consumption data at the county level. Kern county off-road fuel consumption data from OFFROAD2021, which includes emissions from the city as well as other areas in the county, were apportioned to the city using custom scaling factors depending on the off-road vehicle and equipment type, as shown in Table 13 above. For example, due to the likely correlation between commercial activity and employment, the city's portion of emissions from light commercial equipment in the entire county is assumed to be proportional to the number of jobs in the city as compared to the county as a whole. The fuel consumption data was then multiplied by the emission factors obtained from TCR for each fuel type (diesel, gasoline, and natural gas) to calculate the associated emissions.

3.7.7 Solid Waste

Based on modeling conducted, the solid waste sector was responsible for approximately 197,045 MTCO₂e in 2022, or 7 percent of community GHG emissions. Community-generated solid waste emissions are associated primarily with the decomposition of mixed municipal solid waste generated by the city in landfills. This inventory also accounts for the compost organic waste generated within the city, which results in fugitive CH₄ and N₂O emissions. Table 14 summarizes emissions from the solid waste sector. Additional details regarding calculation methods and assumptions are discussed below.

Table 14 2022 City of Bakersfield Community Solid Waste Quantity and GHG Emissions

Source	Quantity (tons)	GHG Emissions (MTCO ₂ e)
Community-Generated Solid Waste	422,342	182,535
Compost Organic Waste	196,286	14,510
Total	618,629	197,045

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent.

Source: CalRecycle 2025; analysis conducted by Ascent in 2025.

COMMUNITY-GENERATED SOLID WASTE

CH₄ emissions generated by community-generated solid waste occur from the decay of landfill-disposed waste generated annually by homes and businesses in the city. A total of 422,342 tons of landfilled waste was reported for the city in 2022 (CalRecycle 2025).

The amount of CH₄ released from community-generated waste depends on the LFG management systems of the landfills where the waste is disposed of. Information regarding the use of LFG capture systems for facilities accepting waste from the city was available from the EPA's Landfill Methane Outreach Program and a review of landfill permit records. It was determined that 19 of the 20 facilities identified had an LFG capture system, and hence, the EPA recommended default LFG capture efficiency of 0.75 was used in emissions calculations (EPA 2009). For facilities without LFG capture systems, a default efficiency factor of 0 was used. The default waste emissions factor for mixed municipal solid waste (i.e. 0.06 metric ton of CH₄ per ton of waste) obtained from the EPA was used in calculations.

Table 15 below presents the information on the landfills that accepted waste from the City of Bakersfield, including landfill names, the waste tonnage delivered, and whether LFG capture systems are in place.

Table 15 Landfills Receiving Waste from Bakersfield in 2022: Tonnage and LFG Capture System Status

Landfill Name	2022 Waste Tonnage (ton)	LFG Systems in Place (Y/N)
American Avenue Disposal Site (American Avenue Disposal Site - RD10929)	2,064	Y
Antelope Valley Recycling & Disposal Facility (Antelope Valley Recycling & Disposal Facility - RD10141)	8	Y
Avenal Landfill (Madera Disposal Systems, Inc. - RD10596)	39,903	Y
Azusa Land Reclamation, Inc. (Azusa Land Reclamation, Inc. - RD10038)	137	Y
Bakersfield Metropolitan (Bena) Sanitary Landfill (Bakersfield Metropolitan (Bena) SLF - RD10487)	331,477	Y
Chiquita Canyon, Inc (Chiquita Canyon, Inc - RD11143)	225	Y
County of San Bernardino Solid Waste Management Division (Barstow Sanitary Landfill - RD11129)	1	Y
County of San Bernardino Solid Waste Management Division (Mid-Valley Sanitary Landfill - RD11131)	49	Y
County of San Bernardino Solid Waste Management Division (San Timoteo Sanitary Landfill - RD11132)	21	Y
County of San Bernardino Solid Waste Management Division (Victorville Sanitary Landfill - RD11133)	2	Y
Fairmead Landfill (Fairmead Landfill - RD10314)	4	Y
Foothill Sanitary Landfill (Disposal facility - RD10600)	2	Y
Forward Landfill (Forward Landfill - RD11122)	1	Y
Frank R. Bowerman Sanitary LF (Frank R. Bowerman Sanitary LF - RD10279)	3	Y
Merced County Regional Waste Management Authority (Highway 59 Landfill - RD11086)	249	Y
Olinda Alpha Sanitary Landfill (Olinda Alpha Sanitary Landfill - RD10278)	2	Y
Potrero Hills Landfill, Inc. (Potrero Hills Landfill, Inc - RD10775)	32	Y
Shafter-Wasco Recycling & Sanitary Landfill (Shafter-Wasco Recycling & Sanitary LF - RD10500)	27,381	Y

Landfill Name	2022 Waste Tonnage (ton)	LFG Systems in Place (Y/N)
Simi Valley Landfill and Recycling Center (Simi Valley Landfill and Recycling Center - RD10046)	18	Y
Taft Recycling & Sanitary Landfill (Taft Recycling & Sanitary Landfill - RD10501)	20,762	N
Total	422,342	N/A

Notes: Totals may not sum exactly due to independent rounding. LFG = landfill gas; N = No; N/A = not applicable; Y = Yes.

Source: CalRecycle 2025; analysis conducted by Ascent in 2025.

COMPOST ORGANIC WASTE

Fugitive CH₄ and N₂O emissions associated with organic waste primarily occur during the decomposition of biodegradable materials in solid waste landfills and wastewater treatment processes (composting). These emissions are unintentional releases. Composting data were available from the City. Emissions from composting operations were calculated using CARB's *Method for Estimating Greenhouse Gas Emission Reductions from Diversion of Organic Waste from Landfills to Compost Facilities* (CARB 2017b). Composting tonnage data was provided by the City and then multiplied by CARB's fugitive CH₄ and N₂O emissions factors for compost organic waste emissions, of 0.00196 MTCH₄/short ton and 0.00007 MTN₂O/short ton, to calculate the associated emissions.

3.7.8 Water Supply

Based on modeling conducted, water supply in the city resulted in GHG emissions of approximately 2,670 MTCO₂e, which represents less than 1 percent of total emissions. Water is supplied by the City's Water Resources Department, California Water Services Company, and Greenfield County Water District. GHG emissions associated with water supply occur from the indirect use of energy associated with water extraction, conveyance, treatment, and distribution to the point of use (e.g., homes, businesses).

In Kern county, the Water Association of Kern County (WAKC) reports that 26 percent of the water sources are from the State Water Project (SWP) (California Aqueduct), while the remaining 74 percent of the water sources are from local sources, groundwater and the federal Central Valley Project (CVP) (Friant-Kern Canal) (WAKC n.d.). Based on the review of the sources of water delivered by the City's Water Resources Department and California Water Services Company, from their respective 2020 Urban Water Management Plans, the city's water source composition is approximately the same as those described by WAKC for regional water supply sources.

Among these water sources, only water supplied through the SWP and the federal CVP is considered imported, and therefore potentially results in GHG emissions due to long-distance conveyance. All other sources are classified as local. Based on the review of the 2020 urban water management plans of the City's Water Resources Department and California Water Services Company, the majority of the local water supply infrastructure is either located within the City of Bakersfield's geographical boundaries or directly linked to municipal systems operated by the city. Therefore, it is expected that most of the electricity used for local water supply and treatment is already captured under the emissions estimates for building energy. In addition, upon further review, it was also determined that the federal CVP does not consume energy for water delivery to Kern County, as water is primarily conveyed with gravity (Friant Water Authority 2019). As a result, only the SWP, which accounts for 26 percent of the city's water supply, contributes to GHG emissions. Therefore, emissions associated with electricity used to import and convey water via the SWP are included in the City's inventory.

GHG emissions from the electricity consumed to convey water through the SWP were calculated using the CAMX eGRID GHG emissions factor, as the supplier(s) of electricity throughout the SWP are unknown.

Table 16 presents the total water supply to the city, the percentage attributable to the SWP, the SWP's energy intensity of water conveyance to Kern county, the associated (electricity) emissions factors, the total energy (electricity) used to convey the water, and the resulting total GHG emissions.

Table 16 2022 City of Bakersfield Community Water Supply Quantity and GHG Emissions

Calculation Variable	Value
Total Water Supplied	28,092 million gallons
SWP Percentage	26%
SWP Energy Intensity	1,614 kWh/million gallons
Emissions Factor (eGRID CAMX)	226 kg CO ₂ per MWh 0.014 kg CH ₄ per MWh 0.002 kg N ₂ O per MWh
Total Energy Consumed	11,790 MWh
Total GHG Emissions	2,670 MTCO₂e

Notes: CH₄ = methane; CO₂ = carbon dioxide; GHG = greenhouse gas; kg = kilogram; kWh = kilowatt-hour; MTCO₂e = metric tons of carbon dioxide equivalent; MWh = megawatt-hour; N₂O = nitrous oxide; SWP = State Water Project.

Source: WAKC n.d.; DWR 2016; EPA 2024; analysis conducted by Ascent in 2025.

3.7.9 Wastewater Treatment

Based on modeling conducted, wastewater treatment in the city resulted in GHG emissions of approximately 71,372 MTCO₂e, which represents approximately 3 percent of total emissions. Wastewater treatment emissions are summarized in Table 17, and additional details for this sector are provided below.

Table 17 2022 City of Bakersfield Wastewater Treatment GHG Emissions

Wastewater Treatment Type	GHG Emissions (MTCO ₂ e)
WWTP No. 2	33,155
WWTP No. 3	38,217
Total	71,372

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent; WWTP = wastewater treatment plant.

Source: Analysis conducted by Ascent in 2025.

CENTRALIZED WWTPS

Emissions associated with the treatment of sewage are highly dependent on the processes and components used by specific WWTPs, such as facultative lagoons, nitrification or denitrification, and digester gas combustion devices. There are two centralized WWTPs that serve nearly all of the city's homes and businesses in the city: WWTP No. 2 and WWTP No. 3. Both facilities are operated by the City and collect wastewater from customers' homes and businesses. Collected wastewater enters the regional sewer system and is then conveyed and pumped to the facility, where it is treated before being safely reintroduced to the environment.

WWTP No.2 consists of multiple treatment stages, including headworks, grit removal, primary clarifiers, trickling filters, secondary clarifiers, anaerobic digesters, and sludge drying beds. These processes collectively remove solids and biological contaminants from wastewater. After treatment, the effluent is repurposed for crop irrigation.

WWTP No.3 utilizes a comprehensive wastewater treatment process consisting of headworks, grit removal, primary clarifiers, aeration basins (activated sludge process with nitrification and denitrification), secondary clarifiers, tertiary treatment (disinfection using sodium hypochlorite), anaerobic digesters, and centrifuges for sludge dewatering. Only 2 million gallons per day of treated flow receives tertiary treatment and disinfection. The remaining treated effluent is either used for agricultural irrigation or directed to percolation ponds for groundwater recharge.

Specific data regarding facility-specific treatment processes, population served, digester gas combustion, BOD₅ load, and daily nitrogen load for WWTP No. 2 and WWTP No. 3 were obtained from the City. Digester gas combustion

refers to the process of burning biogas produced from the anaerobic digestion of organic material (typically sewage sludge or food/agricultural waste) in wastewater treatment plants. BOD₅ load refers to the five-day biochemical oxygen demand of wastewater, which is a key measure used to estimate the organic strength of sewage, and the amount of oxygen microorganisms will consume while degrading that organic matter over a five-day period. Lastly, daily nitrogen load refers to the total amount of nitrogen discharged into a wastewater treatment system or receiving water per day. Daily nitrogen load is an important metric in wastewater management and GHG emissions estimation, particularly for N₂O emissions.

Stationary CH₄ and N₂O emissions from the combustion of digester gas were calculated based on the volume of digester gas combustion provided by the City, using Community Protocol equations WW.1a and WW.2a, respectively. These equations contain factors for the fraction of CH₄ and N₂O in digester gas (ICLEI 2013).

Process CH₄ emissions from lagoons were calculated based on population data, using the Community Protocol equation WW.6 for anaerobic or facultative lagoons. Equation WW.6 contains factors for the maximum CH₄ production capacity of domestic wastewater and a CH₄ correction factor for anaerobic systems. Process N₂O emissions were calculated based on population data (48,587 persons served) using the Community Protocol equation WW.7 for WWTP No. 3, as it has nitrification/denitrification. Process N₂O emissions were calculated based on population data (83,918 persons served) using the Community Protocol equation WW.8 for WWTP No. 2, as it does not have nitrification or denitrification. These equations contain nitrogen loading factors and WWTP emissions factors specific to these treatment processes. Fugitive N₂O emissions from effluent discharge were calculated based on average daily nitrogen load data for WWTP No. 2 and WWTP No. 3 using the Community Protocol equation WW.12 (ICLEI 2013).

A summary of the operational data for the City's WWTPs that was used for GHG emissions calculations is provided in Table 18.

Table 18 2022 City of Bakersfield Wastewater Treatment GHG Emissions Calculation Parameters

Calculation Parameter	WWTP No. 2	WWTP No. 3	Equations Where Data was Used
Digester Gas (cubic feet/day)	—	206,813	WW.1a & WW.2a
Fraction of CH ₄ in Biogas	64%	64%	WW.1a & WW.2a
Population Served	48,587	83,918	WW.8/WW.7
Fraction of BOD ₅ Removed in Primary Treatment	93%	95%	WW.6
BOD ₅ Load (kg BOD ₅ /day)	84,151	133,045	WW.6
Nitrogen Load (kg Nitrogen/day)	5,474	6,975	WW.12
Industrial-Commercial Equivalent Factor	1.25	1.25	WW.8/WW.7
Emission factor (kg N ₂ O-Nitrogen/kg sewage-Nitrogen discharged)	0.005	0.005	WW.12

Notes: BOD₅ = five-day biochemical oxygen demand of wastewater; CH₄ = methane; GHG = greenhouse gas; kg = kilogram; N₂O = nitrous oxide; WWTP = wastewater treatment plant.

Source: Data provided by City of Bakersfield Wastewater Division in 2025; ICLEI 2013.

Energy-related emissions result from the energy required for wastewater treatment operations, including the energy used in wastewater conveyance as well as energy used throughout wastewater treatment processes and to provide power to the WWTP facilities. However, because both WWTP No. 2 and WWTP No. 3 are located within the city, it was assumed that energy-related emissions from wastewater treatment are captured in the emissions estimates for the building energy sector, as energy use (i.e., electricity and natural gas) associated with the City's WWTPs is incorporated in the utility energy use data provided by PG&E and SoCalGas.

3.7.10 Agriculture

Based on modeling conducted, emissions from the agriculture sector accounted for approximately 9,562 MTCO₂e in 2022, or less than 1 percent of the city's emissions. Emissions in this sector are generated from fertilizer application and the operation of irrigation pumps. Emissions from fertilizer application accounted for 30 percent of emissions from the agriculture sector. Emissions from diesel-powered irrigation pumps generated approximately 70 percent of agriculture emissions. Livestock operations also generate GHG emissions, and some livestock operations may exist within city boundaries; however, as mentioned previously, because these activities are not significant, and accurate data regarding livestock operations were limited, livestock-related emissions were excluded from the City's inventory.

The city's agricultural emissions in 2022 are summarized in Table 19, and additional details and information about this sector are included below.

Table 19 2022 City of Bakersfield Agriculture GHG Emissions

Agricultural Activity	GHG Emissions (MTCO ₂ e)
Fertilizer Application	2,819
Irrigation Pumps	6,743
Total	9,562

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent.

Source: Analysis conducted by Ascent in 2025.

FERTILIZER APPLICATION

The application of fertilizers and other soil amendments produces GHG emissions. Nitrogen fertilizers produce N₂O emissions, and the application of lime produces emissions of CO₂. Data for nitrogen fertilizer (including urea) and lime application were obtained from CDFA's *2022 Fertilizer Tonnage Report* (CDFA 2025). Tonnage data provided by CDFA is for the entire Kern county. The countywide data was then apportioned to the city based on its agricultural acreage share, based on DOC's FMMP. Emissions factors and quantification methods for GHG emissions associated with the application of nitrogen and lime were obtained from IPCC (IPCC 2006). Data for fertilizer and lime application and associated emissions are presented in Table 20 below.

Table 20 2022 City of Bakersfield Fertilizer and Lime Application Data and Emissions

Application Type	Application Amount (tons)	Source	GHG Emissions (MTCO ₂ e)
Nitrogen Fertilizer (including urea)	573	CDFA, DOC	2,786
Lime	83	CDFA, DOC	33

Notes: CDFA = California Department of Food and Agriculture; DOC = California Department of Conservation.

Source: Analysis conducted by Ascent in 2025.

Emissions factors and data sources for fertilizer and lime application are shown in Table 21.

Table 21 2022 City of Bakersfield Fertilizer and Lime Application Emissions Factors and Sources

Application Type	Fertilizer Emissions Factor (g N ₂ O/ton N)	Lime Application Emissions Factor (g CO ₂ /ton Lime)	Source
Nitrogen Fertilizer	17,820	N/A	IPCC
Lime	N/A	398,886	IPCC

Notes: CO₂ = carbon dioxide; g = grams; IPCC = Intergovernmental Panel on Climate Change; N = nitrogen; N₂O = nitrous oxide; N/A = not applicable.

Source: IPCC 2006; analysis conducted by Ascent in 2025.

AGRICULTURAL EQUIPMENT

Agricultural equipment emissions include emissions from diesel- and natural gas-powered irrigation pumps. According to Valley Air District's data, all irrigation pumps in the city are diesel-powered. Valley Air District provided the total diesel consumption data for these irrigation pumps. The consumption data was then multiplied by a standard emissions factor for diesel engines obtained from TCR to estimate GHG emissions from these diesel-powered irrigation pumps.

Activity data and associated GHG emissions from agricultural equipment are included in Table 22.

Table 22 2022 City of Bakersfield Agricultural Equipment Data and Sources

Equipment Type	Gallons of Fuel Used	GHG Emissions (MTCO ₂ e)	Source
Diesel-Powered Irrigation Pumps	660,457	6,743	Valley Air District

Notes: CARB = California Air Resources Board; N/A = not applicable; Valley Air District = San Joaquin Valley Air Pollution Control District.

Source: CARB 2022c; Analysis conducted by Ascent in 2025.

3.7.11 Additional Greenhouse Gas Emissions Sources

Additional GHG emissions sources were evaluated for the City’s inventory. Although these sources are not included in the total GHG emissions for the City’s inventory, they provide additional context for understanding emissions-generating activities in the city. Details regarding GHG emissions from regulated stationary sources and oil and gas operations are discussed below.

REGULATED STATIONARY SOURCES

GHG emissions are generated from a variety of regulated stationary sources operating within the county. These facilities are considered “covered” under the California Greenhouse Gas Cap-and-Trade Program (Cap-and-Trade). Cap-and-Trade establishes an aggregate GHG allowance budget on covered entities and provides a trading mechanism for compliance instruments (allowance or offset credit). Facilities regulated under Cap-and-Trade may purchase allowances to emit GHG emissions from facilities that reduce GHG emissions (e.g., solar farms) or sell emission offset credits to regulated facilities that need to reduce their emissions to meet CARB’s industry-wide emissions cap. Currently, CARB gives such allowances to facilities that emit more than 25,000 MTCO_{2e} per year. These entities primarily entail heavy industrial activities that consume large amounts of fuel and are eligible purchasers of Cap-and-Trade emissions allowances because the facility emits more than 25,000 MTCO_{2e} per year. With covered facilities in the City of Bakersfield, the State, not the City, is responsible for reducing emissions from this sector. For the purposes of developing the community inventory, emissions associated with Cap-and-Trade covered facilities are excluded. However, Table 23 provides an overview of the covered facilities that are located within the City of Bakersfield city limits, including the total emissions and the associated industry sector. While many facilities have reporting addresses that are within the City of Bakersfield, the facility locations were reviewed to include only facilities that have a physical location within the city.

Table 23 2022 City of Bakersfield County GHG Emissions from Regulated Stationary Sources

Facility Name	Total GHG Emissions (MTCO _{2e})	Industry Sector
San Joaquin Refining Company	92,440	Refinery and Hydrogen Plant
Bakersfield Renewable Fuels– Areas 1&2	17,586	Petroleum Refineries
San Joaquin Facilities Management	9,242	Oil and Gas Production
Vaquero Energy – Kern County	5,715	Oil and Gas Production
Total	124,983	-

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gases; MTCO_{2e} = metric tons of carbon dioxide equivalent.

Source: CARB 2023; table compiled by Ascent in 2025.

4 GHG EMISSIONS FORECAST METHODS

The GHG emissions forecast estimate the future changes in GHG emissions as influenced by growth in the city and State and federal legislation and regulations. The BAU scenario forecast estimates how GHG emissions may change only considering growth in population, employment and VMT. In this scenario, GHG emissions activity data is scaled based on appropriate demographic metrics, and GHG emissions are calculated using the same GHG emissions factors from the 2022 inventory. For example, residential building energy use from 2022 is scaled with population growth between 2022 and 2045 to estimate future residential electricity and natural gas consumption. The projected future activity is then multiplied by the GHG emissions factors used for electricity and natural gas in the 2022 inventory to obtain a BAU estimate of future residential buildings energy emissions. Under the legislative-adjusted BAU, the projection of future activity and GHG emissions factors considers the effects of adopted regulations and legislation that may influence future GHG emissions. Using the example of residential building energy, the BAU scenario forecasted electricity and natural gas consumption would be adjusted to reflect changes to energy efficiency standards, and the GHG emissions factors would be adjusted to reflect changes in the amount of renewable energy sources in grid-supplied electricity.

The following sections detail the methods used to calculate a BAU scenario forecast for each of the primary GHG emissions sectors, and the adjustments to the BAU forecast that were made to account for adopted State and federal legislation and regulations. The results provided for each sector focus primarily on the results of the legislative-adjusted BAU forecast. The results of the BAU forecast are available in Table 2.

4.1 DEMOGRAPHICS AND VEHICLE MILES TRAVELED PROJECTIONS

The GHG emissions forecasts were based on projected changes in city demographics (i.e., population, employment, and service population [residents plus employees]) and land use between 2022 and 2045. The city's 2045 population data is from the Local Agency Formation Commission 2023 Bakersfield Area Municipal Service Review and Sphere of Influence Update - Method 2, while the population data for interim years was interpolated using the 2022 and 2045 population data (City of Bakersfield 2023). Employment data for the city for 2022 and 2045 were not directly available, and employment was calculated based on the ratio of the number of jobs to the city's population for future years, as provided in the Kern COG 2022 RTP/SCS (Kern COG 2022).

The city's population and employment are expected to increase by approximately 92 and 70 percent between 2022 and 2045, respectively, and the service population is expected to increase by approximately 87 percent. These growth factors were used to forecast emissions for 2030, 2040, and 2045 for most sectors in the inventory. Additional information regarding growth factors used for each sector is included in the following sections.

Daily VMT data were obtained from Kern COG's Travel Model, which was developed for Kern COG's 2018 RTP. Daily VMT data from the Travel Model were estimated using the RTAC's origin-destination method described in SB 375. Annual VMT was estimated by scaling daily VMT by 347 days, as recommended by the CARB. Kern COG provided VMT data for 2017, and projected VMT data for 2035 and 2042. These data were used to interpolate estimated VMT for 2022, 2030, and 2040, and to extrapolate estimated VMT for 2045. VMT is projected to increase by approximately 50 percent between 2022 and 2045. Table 24 shows anticipated growth in the city for the forecast years.

Table 24 City of Bakersfield Demographic and Vehicle Miles Traveled Forecasts

Forecast Factor	2022	2030	2040	2045
Population	404,321	533,907	695,889	776,880
Employment	141,512	176,058	219,241	240,833
Service Population	545,833	709,965	915,130	1,017,713
Annual VMT	3,095,719,039	3,709,245,922	4,362,312,613	4,631,925,003

Notes: VMT = vehicle miles traveled.

Sources: City of Bakersfield 2023; Kern COG 2022.

4.2 LEGISLATION AND REGULATIONS CONSIDERED IN LEGISLATIVE-ADJUSTED BAU FORECAST

Legislative-adjusted BAU emissions forecasts were prepared using the same demographic and VMT data that were used for the BAU forecasts, while also accounting for State and federal legislation and regulations that would affect local emissions. These forecasts provide the City with a more robust understanding of future community emissions to assist with the prioritization of emissions reduction measures developed to meet GHG targets. A summary of applicable legislative reductions is provided in Table 25.

Table 25 Legislative Reductions Summary

Source	Legislative Reduction	Description	Sectors Applied
State	Renewables Portfolio Standards (SB 100 and SB 1020)	Establishes and updates the Renewables Portfolio Standards, which requires California energy utilities to procure 60 percent of electricity from eligible renewable and GHG-free sources by 2030, 90 percent by 2035, 95 percent by 2040, and 100 percent by 2045.	Building Energy
State	California's Building Energy Efficiency Standards (2019 and 2022 Title 24, Part 6)	Requires all new buildings in California to comply with energy efficiency standards established by CEC. Accounts for the energy efficiency gains in new residential and nonresidential buildings.	Building Energy
State	Advanced Clean Cars I Regulations	Establishes GHG emission reduction standards for model years 2017 through 2025 that are more stringent than federal CAFE standards.	On-Road Vehicles
State	Truck and Bus Regulation	Requires diesel trucks and buses that operate in California to be upgraded to reduce GHG emissions.	On-Road Vehicles
Federal	Fuel Efficiency Standards for Medium- and Heavy-Duty Vehicles	Establishes fuel efficiency standards for medium- and heavy-duty engines and vehicles.	On-Road Vehicles

Notes: CAFE = Corporate Average Fuel Economy; CEC = California Energy Commission; EPA = U.S. Environmental Protection Agency; GHG = greenhouse gas; SUV = sports utility vehicle; SB = Senate Bill.

4.3 BUILDING ENERGY

4.3.1 Building Energy Assumptions

Building energy emissions in the city result directly from the onsite combustion of natural gas and indirectly from electricity consumption. The combustion of fossil fuels (i.e., diesel, liquified petroleum gas [LPG], propane and natural gas) in backup generators also contributes to the city's building energy emissions. PG&E provides all the electricity in the city. Natural gas in the city is provided by PG&E and SoCalGas.

ELECTRICITY EMISSIONS FACTORS

California utility providers, including PG&E, are required to achieve 60 percent GHG-free electricity by 2030, 90 percent by 2035, 95 percent by 2040, and 100 percent by 2045. According to PG&E's power content label, PG&E already achieved a GHG-free electricity share of 95.2 percent in 2022, surpassing the 2040 target of 95 percent ahead of schedule (PG&E 2023). Therefore, to estimate future emissions factors, a linear interpolation was applied between PG&E's 2022 GHG-free electricity share (95.2 percent) and the 100 percent target for 2045. Based on this approach, PG&E's emissions factors for 2030 and 2040 were projected to be 36.6 and 12.2 pounds of CO₂ per megawatt-hour (lb CO₂/MWh), respectively. Emissions factors for CH₄ and N₂O are assumed to follow the same trajectory as CO₂ under SB 1020 requirements.

In addition, the 2022 GHG-free electricity percentage and GHG emissions factors for the CAMX eGRID subregion were first obtained from the EPA's eGRID database. Using these 2022 values as a baseline, emissions factors for the CAMX eGRID subregion for the forecast years (2030, 2040, and 2045) were calculated based on the GHG-free electricity targets established by SB 100 and SB 1020. Emissions factors for the CAMX eGRID were used when the specific electricity supplier was unknown (e.g., water conveyance).

Table 26 summarizes the baseline and target GHG-free electricity percentages, as well as the corresponding emissions factors for both PG&E and the CAMX eGRID subregion for the forecast years. By 2045, with the achievement of 100 percent GHG-free electricity, the emissions factor is projected to be zero.

Table 26 PG&E and CAMX eGRID Electricity GHG Emissions Factors Adjusted for SB 100 and SB 1020

Calculation Factor	Units	2022	2030	2040	2045
SB 100 and SB 1020 GHG-free electricity percentage targets	Percent GHG-free	N/A	60%	95%	100%
PG&E GHG-free electricity percentage baseline and projections	Percent GHG-free	95.2%	96.9%	99.0%	100%
PG&E eGRID baseline and interpolated emissions factors	MTCO ₂ e/MWh	0.0263	0.0172	0.0057	0
CAMX eGRID GHG-free electricity percentage baseline and projections	Percent GHG-free	50%	60%	95%	100%
CAMX eGRID baseline and interpolated emissions factors	MTCO ₂ e/MWh	0.2265	0.1819	0.0227	0

Notes: eGRID = Emissions & Generation Resource Integrated Database; GHG = Greenhouse Gas; MTCO₂e = metric tons of carbon dioxide equivalent; MWh = megawatt-hour; N/A = Not Applicable; PG&E = Pacific Gas & Electric Company; SB = Senate Bill.

Source: Analysis conducted by Ascent in 2025.

NATURAL GAS EMISSIONS FACTORS

Natural gas emissions are based on emissions factors obtained from the TCR's 2022 Default Emission Factors, which are estimated to be 11.7 pounds of carbon dioxide equivalent per therm (lb CO₂e/therm) for stationary combustion in buildings and 11.6 lb CO₂e/therm for electricity generation in backup generators (TCR 2022). Emissions factors associated with natural gas combustion are not anticipated to change over time, as there are no legislative actions that are expected to substantially reduce the carbon intensity of pipeline natural gas.

BACKUP GENERATOR FUEL EMISSIONS FACTORS

Emissions from diesel fuel used to power backup generators are based on emissions factors obtained from TCR, which are estimated to be 22.6 pounds of carbon dioxide equivalent per gallon (lb CO₂e/gal) (TCR 2025). Emissions factors associated with diesel combustion are not anticipated to change over time, as there are no legislative actions that would reduce the carbon intensity of diesel as it relates to tailpipe emissions.

Emissions from propane and LPG used to power backup generators are both based on LPG's emissions factor from TCR, which is estimated to be 12.6 lb CO₂e/gal (TCR 2025). This emissions factor is also not anticipated to change over time, as there are no legislative actions that would reduce the carbon intensity of LPG.

ENERGY EFFICIENCY

Future energy use was adjusted to reflect lower emissions-intensity under California's Building Energy Efficiency Standards (California Code of Regulations Title 24 Part 6, hereafter referred to as "Title 24"). Title 24 standards apply to new residential and nonresidential construction. The 2019 Title 24 standards apply to projects constructed after January 1, 2020, and the 2022 Title 24 standards apply after January 1, 2023. To estimate adjusted future energy consumption resulting from Title 24 requirements in new construction, electricity- and natural gas-specific adjustment factors were calculated using the difference in the average energy use in residential and nonresidential buildings between those built to 2019 Title 24 standards and those built to 2022 Title 24 standards. Adjustment factors were calculated using data available from the California Energy Commission (CEC) that were developed for the 2022 Title 24 standards. In addition to accounting for Title 24 requirements by land use type (i.e., residential and nonresidential), CEC also developed estimates for energy usage rates by climate zone, and the city's climate zone

(Zone 13) was used for the residential buildings analysis. Climate zone-specific data for nonresidential buildings were unavailable; therefore, nonresidential adjustment factors relied on statewide averages. The 2025 Title 24 will go into effect statewide in January of 2026; however, detailed data on the changes in building-level energy consumption between the 2025 code and previous code cycles was not available at the time of this analysis.

The adjustment factors (specific to both building type and energy type) were applied to the BAU growth in energy use to estimate the energy consumption and associated GHG emissions of future development with legislative adjustments. The adjustment factors are shown in Table 27. They are presented in terms of the percent change in energy use for buildings compliant with the 2022 Title 24 standards compared to those built to meet the 2019 Title 24 standards. Positive values indicate an anticipated increase in energy use, while negative values indicate an anticipated decrease in energy use. It is important to note that although average electricity use in new residential buildings is anticipated to rise (due to an increase in electrical demand associated with electric appliances installed instead of natural gas appliances), emissions from new residential buildings are expected to be lower than they would be under 2019 Title 24 as a result of overall lower building emissions intensities (due to lower emissions factors associated with electricity compared to natural gas).

Table 27 Building Energy Adjustment Factors for 2022 Standards Compared to 2019 Standards

Building Type	Electricity	Natural Gas
Residential Buildings	12%	-29%
Nonresidential Buildings	-10%	-11%

Source: Analysis conducted by Ascent in 2025.

4.3.2 Building Energy Results

Emissions from future electricity, natural gas, and backup generator (i.e., natural gas, diesel, propane, and liquefied petroleum gas [LPG]) use were estimated by multiplying anticipated energy use by forecasted emissions factors. To estimate future energy use, energy consumption for each source was first scaled by the population or employment growth factors detailed in Table 28. Population growth was used to scale residential energy, and employment growth was used for nonresidential energy (including backup generators). Future energy use was adjusted to reflect increased energy efficiency stringency under 2022 Title 24 standards, which are expected to achieve a reduction in emissions associated with new buildings. PG&E and eGRID CAMX subregion's electricity emissions factors were also adjusted to reflect the anticipated decline in the emissions intensity of grid-supplied electricity based on California's Renewables Portfolio Standards requirements, pursuant to SB 100 and 1020. Natural gas, diesel, propane, and LPG emissions factors were not adjusted, as the emissions intensity of these energy sources is anticipated to stay constant. The assumptions for future electricity emissions factors are described above. Table 28 below summarizes the scaling factors and legislative reductions used to forecast building energy use by energy type.

Table 28 Building Energy Emissions Forecast Methods by Energy Type

Energy Type	Forecast Methods	
	Scale Factor	Applied Legislative Reductions
Electricity	Scaled by population growth for residential building energy; scaled by employment growth for nonresidential building energy.	Changes in average energy use in new construction from 2022 Title 24 compared to 2019 Title 24 applied to forecasted increases in energy consumption. California Renewables Portfolio Standards requirements (i.e., 90 percent GHG-free electricity by 2035, 95 percent by 2040, and 100 percent by 2045) applied to PG&E and eGRID CAMX subregion's electricity emissions factors.
Natural Gas		
Backup Generators	Scaled by employment growth.	No legislative reductions were applied to backup generator energy use.

Notes: GHG = greenhouse gas; PG&E = Pacific Gas and Electric Company.

Source: Analysis conducted by Ascent in 2025.

RESIDENTIAL BUILDING ENERGY RESULTS

Between 2022 and 2030, electricity and natural gas emissions from residential buildings would increase by approximately 16 percent from 284,905 to 331,481 MTCO₂e, accounting for legislative adjustments and overall population growth of approximately 32 percent over the same time. Total residential building energy emissions are anticipated to rise through 2045. Emissions would be approximately 47 percent higher in 2045 compared to 2022 because population growth would outpace emissions reductions gained. Electricity emissions are expected to fall below 2022 levels by 2030, becoming 0 MTCO₂e by 2045, but natural gas emissions are expected to increase through 2045. These trends reflect the high level of population growth expected in the city, despite PG&E's compliance with SB 100 and SB 1020 requirements, and 2022 Title 24 standards for new buildings. Table 29 shows the 2022 inventory and legislative-adjusted BAU forecasted emissions from the residential building energy sector by energy type for 2030, 2040, and 2045.

Table 29 Residential Building Energy GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO₂e)

Energy Type	2022	2030	2040	2045
Electricity	23,289	20,639	9,150	0
Natural Gas	261,616	310,843	382,785	418,756
Total	284,905	331,482	391,935	418,756

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent.

Source: Analysis conducted by Ascent in 2025.

NONRESIDENTIAL BUILDING ENERGY RESULTS

Between 2022 and 2030, electricity, natural gas, and backup generator emissions from nonresidential buildings would increase by approximately 5 percent from 187,843 to 196,343 MTCO₂e, accounting for legislative adjustments and overall employment growth of approximately 24 percent over the same time. Unlike the residential building energy sector, total nonresidential building energy emissions are anticipated to peak in 2030 and then drop to around the same level as 2022 in 2040 and increase slightly in 2045. Employment growth in the city is expected to drive a steady increase in nonresidential natural gas and backup generator emissions through 2045, but this rise in emissions would be offset by significant reductions in electricity emissions after 2030. Emissions from nonresidential electricity are anticipated to rise slightly through 2030. However, due to the implementation of legislative actions, these emissions are expected to decline by 2040 and ultimately reach zero by 2045. Table 30 shows the 2022 inventory and legislative-adjusted BAU forecasted emissions for the nonresidential building energy sector by energy type for 2030, 2040, and 2045.

Table 30 Nonresidential Building Energy GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO₂e)

Energy Type	2022	2030	2040	2045
Electricity	66,547	53,276	12,309	0
Natural Gas	119,567	140,918	172,363	188,086
Others (Diesel and LPG)	1,729	2,149	2,676	2,940
Total	187,843	196,343	187,348	191,026

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent; LPG = liquefied petroleum gas.

Source: Analysis conducted by Ascent in 2025.

4.4 ON-ROAD TRANSPORTATION

4.4.1 On-Road Transportation Assumptions

State and federal regulations are expected to reduce on-road GHG emissions by requiring improvements in vehicle fuel efficiency and accelerating the transition to zero-emission vehicles (ZEVs). The legislative-adjusted BAU forecast for the on-road transportation source takes into consideration the following State and federal regulations:

- ▶ Innovative Clean Transit Regulation, which requires all California public transit agencies to begin phasing in zero-emission buses (ZEB) starting in 2023 and transition to 100 percent ZEB fleets by 2040 and
- ▶ Advanced Clean Trucks Regulation, which requires truck and van manufacturers to sell a growing share of ZEVs beginning in model year 2024.

All these regulations are reflected in EMFAC2021's emissions data for the forecast years (2030, 2040 and 2045), which serve as the basis for the on-road transportation source's legislative-adjusted BAU forecast. In addition to these regulations, EMFAC2021's data also takes into consideration future increases in light-duty ZEV sales, which would be influenced by California's Advanced Clean Cars I regulation. Table 31 summarizes the scaling factor and legislative reductions used to forecast on-road transportation emissions.

Table 31 On-Road Transportation Emissions Forecast Methods

Source	Forecast Methods	
	Scale Factor	Applied Legislative Reductions
On-Road Transportation	Forecasted VMT provided by Kern COG.	EMFAC2021 forecasts vehicle fleet distributions by vehicle type and the emissions factors anticipated for each vehicle category based on both vehicle emissions testing and approved legislative reductions. EMFAC2021's forecasts incorporate the effects of the ACC I Regulations (future increases in light-duty ZEV sales), fuel efficiency standards for medium- and heavy-duty vehicles, as well as truck and bus regulations that were adopted as of 2021.

Notes: ACC = Advanced Clean Cars; ACF = Advanced Clean Fleets; EMFAC2021 = California Air Resources Board Emission Factor 2021 model; Kern COG = Kern Council of Governments; VMT = vehicle miles traveled.

Source: Analysis conducted by Ascent in 2025.

Accordingly, EMFAC2021's VMT and emissions estimates for forecast years were used to calculate on-road transportation emissions under the legislative adjustment scenario. As with the inventory methodology, total CO₂, CH₄, and N₂O emissions for Kern county for the forecast years were divided by the total countywide VMT to derive their respective emission factors for the forecast years. These were then converted to CO₂e using the appropriate GWP values, resulting in a combined emission factor expressed in MTCO₂e/VMT. These emission factors are shown in Table 32 below (CARB 2022b). The VMT forecasted for future years by Kern COG were then multiplied by these emission factors to estimate on-road transportation GHG emissions under the legislative-adjusted BAU scenario.

Table 32 On-Road Transportation Projected GHG Emissions Factors (Legislative-Adjusted BAU Forecasts)

Year	CO ₂ (short tons)/VMT	CH ₄ (short tons)/VMT	N ₂ O (short tons) /VMT	CO ₂ e (short tons)/VMT
2030	0.000512	0.0000000127	0.0000000453	0.000525
2040	0.000464	0.0000000079	0.0000000435	0.000476
2045	0.000470	0.0000000070	0.0000000459	0.000483

Notes: CH₄ = methane; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; N₂O = nitrous oxide; VMT = vehicle miles traveled.

Source: CARB 2022b. Table compiled by Ascent Environmental in 2025.

4.4.2 On-Road Transportation Results

GHG emissions from on-road vehicles would continue to increase throughout the years due to the predicted increase in the city's service population, despite the State and federal regulations. Table 33 shows the 2022 inventory and

legislative-adjusted BAU forecasted emissions from on-road transportation for 2030, 2040, and 2045. The city's on-road transportation GHG emissions are projected to increase by around 16 percent by 2045 compared to 2022 inventory levels.

Table 33 On-Road Transportation GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO₂e)

Source	2022	2030	2040	2045
On-Road Transportation	1,754,459	1,766,784	1,885,596	2,028,812

Notes: BAU = business-as-usual; GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent.

Source: Analysis conducted by Ascent in 2025.

4.5 OFF-ROAD VEHICLES AND EQUIPMENT

4.5.1 Off-Road Vehicles and Equipment Assumptions

Similar to the inventory methodology discussed in Section 3.7.6, Kern County-level off-road vehicles and equipment fuel consumption data for future forecast years were obtained from OFFROAD2021 and then apportioned to the city using custom scaling factors depending on the off-road vehicle and equipment type. Refer to Table 13 in Section 3.7.6 for the scaling methods for each off-road vehicle and equipment type. The city-specific fuel consumption data were then multiplied by the emission factors obtained from TCR for each fuel type (diesel, gasoline, and natural gas) to estimate the associated future emissions. No legislative reductions could be applied to this sector, so legislative-adjusted BAU emissions are equivalent to BAU emissions.

4.5.2 Off-Road Vehicles and Equipment Results

Between 2022 and 2030, emissions associated with off-road vehicles and equipment used in the city would increase by approximately 24 percent from 142,176 to 175,882 MTCO₂e, accounting for overall growth in various demographic indicators. Table 34 shows the 2022 inventory and legislative-adjusted BAU forecasted emissions from the off-road vehicles and equipment sector for 2030, 2040, and 2045.

Table 34 Off-Road Vehicles and Equipment GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO₂e)

Source	2022	2030	2040	2045
Agricultural Offroad	2,329	2,121	1,898	1,801
Airport Ground Support	245	348	511	562
Construction and Mining	45,575	57,687	69,927	75,896
Industrial	3,791	4,297	4,657	4,916
Lawn and Garden Equipment	8,969	4,460	1,700	1,384
Light Commercial Equipment	9,936	11,035	8,076	8,238
Oil Drilling	714	939	1,055	1,109
Pleasure Craft	15,368	20,808	28,838	33,914
Portable Equipment	18,356	25,999	36,502	42,645
Recreational Equipment	6,376	8,719	12,334	14,378
Transport Refrigeration Units	32,846	41,589	59,305	69,971
Total	144,505	178,002	244,803	254,814

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent.

Source: Analysis conducted by Ascent in 2025.

4.6 SOLID WASTE

4.6.1 Solid Waste Assumptions

Solid waste sector emissions are associated primarily with the decomposition of mixed municipal solid waste generated by the city in landfills, while a smaller proportion of emissions are produced by the decomposition of compost organic waste. No legislative reductions could be applied to this sector, so legislative-adjusted BAU emissions are equivalent to BAU emissions, which were scaled by service population growth within the city.

4.6.2 Solid Waste Results

Between 2022 and 2030, solid waste emissions generated from activities in the city would increase by approximately 30 percent from 197,045 to 256,297 MTCO₂e, accounting for overall service population growth of approximately 30 percent over the same time. Table 35 shows the 2022 inventory and legislative-adjusted BAU forecasted emissions from the solid waste sector for 2030, 2040, and 2045.

Table 35 Solid Waste GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO₂e)

Source	2022	2030	2040	2045
Community-Generated Solid Waste	182,535	237,424	306,035	340,340
Compost Organic Waste	14,510	18,873	24,327	27,054
Total	197,045	256,297	330,362	367,394

Notes: BAU = business-as-usual; GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent.

Source: Analysis conducted by Ascent in 2025.

4.7 WATER SUPPLY

4.7.1 Water Supply Assumptions

Water supply emissions occur indirectly from the consumption of electricity associated with extracting, conveying, treating, and distributing imported water to the city. For water supplied from local sources, the electricity usage associated with extracting, conveying, treating, and distributing water is captured in the building energy sector because these activities take place within the city, and PG&E provided electricity usage data that reflects electricity consumption for all end uses within the city. As noted in section 3.7.8, only the water imported to the city from the SWP consumes additional energy. Therefore, electricity consumption associated with the water import and conveyance from the SWP to the city is accounted for in the city's GHG inventory and forecast. Given that the energy provider for importing and conveying water from SWP is unknown, the average grid emission factor for the eGRID CAMX subregion was used for the calculation. Imported water consumption electricity was scaled by the service population to estimate future energy demand for imported water supplies. The eGRID CAMX GHG emissions factor was adjusted to account for the Renewables Portfolio Standards requirements for GHG-free electricity to estimate legislative reductions, which was shown in Table 26 in Section 4.3 Building Energy. Table 36 summarizes the scaling factor and legislative reductions used to forecast water supply emissions.

Table 36 Water Supply Emissions Forecast Methods

Source	Forecast Methods	
	Scale Factor	Applied Legislative Reductions
Water Supply	Scaled by service population growth.	California Renewables Portfolio Standards requirements (i.e., 60 percent GHG-free electricity by 2030, 90 percent by 2035, 95 percent by 2040, and 100 percent by 2045) applied to the eGRID CAMX subregion electricity emissions factors.

Notes: GHG = greenhouse gas; eGRID = Emissions & Generation Resource Integrated Database.

Source: Analysis conducted by Ascent in 2025.

4.7.2 Water Supply Results

Between 2022 and 2030, water supply emissions in the city would increase by approximately 4 percent from 2,670 to 2,790 MTCO_{2e}, accounting for legislative adjustments and overall service population growth of approximately 30 percent over the same time. After rising in 2030, emissions associated with water supply would decrease significantly by 2040 and would be eliminated in 2045. This trend reflects steadily declining electricity emissions factors associated with California's Renewables Portfolio Standards, despite a projected increase in water consumption due to service population growth. Table 37 shows the 2022 inventory and legislative-adjusted BAU forecasted emissions from the water supply sector for 2030, 2040, and 2045.

Table 37 Water Supply GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO_{2e})

Source	2022	2030	2040	2045
Water Supply	2,670	2,790	450	0

Notes: BAU = business-as-usual; GHG = greenhouse gas; MTCO_{2e} = metric tons of carbon dioxide equivalent.

Source: Analysis conducted by Ascent in 2025.

4.8 WASTEWATER TREATMENT

4.8.1 Wastewater Treatment Assumptions

Wastewater treatment-related emissions are generated from process and fugitive emissions at centralized WWTPs in the city, which include WWTP No. 2 and WWTP No. 3. No legislative reductions could be applied to this sector, so legislative-adjusted BAU emissions are equivalent to BAU emissions.

4.8.2 Wastewater Treatment Results

Between 2022 and 2030, wastewater treatment emissions in the city would increase by approximately 30 percent from 71,372 to 92,572 MTCO_{2e}. This change reflects an increase in wastewater generation resulting from service population growth within the city of approximately 30 percent over the same time. Table 38 shows the 2022 inventory and legislative-adjusted BAU forecasted emissions from the wastewater treatment sector for 2030, 2040, and 2045.

Table 38 Wastewater Treatment GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO_{2e})

Source	2022	2030	2040	2045
Centralized WWTPs	71,372	92,572	119,324	132,700

Notes: BAU = business-as-usual; GHG = greenhouse gas; MTCO_{2e} = metric tons of carbon dioxide equivalent; WWTP = wastewater treatment plant.

Source: Analysis conducted by Ascent in 2025.

4.9 AGRICULTURE

4.9.1 Agriculture Methods

It is assumed that the city's fertilizer application and irrigation pump activity levels will remain constant at 2022 levels throughout the forecast years. As noted in Section 3.7.10, agricultural land acreage was estimated using data from the FMMP, which reflects land typically protected by regulations such as the Williamson Act, and therefore unlikely to change significantly over time. Additionally, agricultural acreage alone may not serve as a reliable long-term proxy for fuel or fertilizer use, as external factors such as market conditions, climate variability, and changes in operational intensity can drive year-to-year differences in crop selection, equipment usage, and irrigation demand. In light of these uncertainties and data limitations, the city's future fertilizer application and irrigation pump activity levels are

assumed to remain similar to the 2022 baseline. No legislative reductions could be applied to this sector, so legislative-adjusted BAU emissions are equivalent to BAU emissions.

Methods to estimate emissions associated with agricultural off-road equipment are presented in Section 4.5.1.

4.9.2 Agriculture Results

Between 2022 and 2030, agricultural emissions in the city is expected to remain constant at 9,562 MTCO₂e. Table 39 shows the 2022 inventory and legislative-adjusted BAU forecasted emissions from agriculture for 2030, 2040, and 2045.

Table 39 Agriculture GHG Emissions Inventory and Legislative-Adjusted BAU Forecasts (MTCO₂e)

Source	2022	2030	2040	2045
Fertilizer Application	2,819	2,819	2,819	2,819
Irrigation Pumps	6,743	6,743	6,743	6,743
Total	9,562	9,562	9,562	9,562

Notes: BAU = business-as-usual; GHG = greenhouse gas; MTCO₂e = metric tons of carbon dioxide equivalent.

Source: Analysis conducted by Ascent in 2025.

4.10 DISCUSSION

As discussed and shown in Table 2 and Figure 2 (in Section 2.2), the city's legislative-adjusted BAU emissions would increase by approximately 5 percent between 2022 and 2030. On-road transportation is expected to represent the largest emissions-generating sector in the city, accounting for 63 percent of total emissions in 2030. Building energy is also expected to contribute significantly to emissions in 2030, accounting for 18 percent of emissions. Solid waste is anticipated to generate 9 percent of emissions. The primary drivers of future changes in GHG emissions in the city are substantial population and economic growth.

Although legislative-adjusted BAU emissions are expected to rise 5 percent by 2030, BAU emissions would increase significantly more, approximately 22 percent between 2022 and 2030. The slower increase in emissions under the legislative-adjusted BAU forecast scenario, despite significant growth projected in the city, is associated with reductions that would be achieved from several legislative actions, including:

- ▶ increased renewable and carbon-free sources in PG&E's electricity supply (approximately 96.9 percent by 2030);
- ▶ improved building emissions intensity through compliance with Title 24 standards; and
- ▶ reductions in on-road vehicle emissions factors as forecasted in EMFAC2021.

As shown in Table 2, the city's legislative-adjusted BAU emissions are expected to decrease by 2040 and further by 2045. Going forward, new legislative actions that would affect emissions may be adopted by regional, State, and federal agencies; however, because information regarding these regulatory changes is currently unknown, emissions reductions from future potential legislative actions are not quantified in this report. Where new regulations or actions are imminent and reasonably foreseeable, they can be incorporated as complementary actions to locally based GHG reduction measures.

5 REDUCTION TARGETS

5.1 STATEWIDE GREENHOUSE GAS REDUCTION TARGETS

As directed in SB 32 and AB 1279, the State has established the following GHG emissions reduction targets:

- ▶ 40 percent reduction below 1990 levels by 2030;
- ▶ 85 percent reduction in anthropogenic emissions below 1990 levels by 2045; and
- ▶ carbon neutrality by 2045.

The City aims to reduce community GHG emissions in proportion to the State's targets and goals. Community emissions levels from 1990 are not available, which is the case for most local jurisdictions in California. Thus, community GHG reduction targets that align with State targets were developed relative to the 2022 community emissions inventory, consistent with guidance provided by CARB (CARB 2017a). Community GHG emissions in 2022 were 2,714,021 MTCO_{2e}. The methodology used to calculate the City's emissions reduction targets is described below.

5.2 CALIFORNIA'S 2022 CLIMATE CHANGE SCOPING PLAN AND 2022 GHG INVENTORY

CARB's *2022 Scoping Plan for Achieving Carbon Neutrality* (2022 Scoping Plan) reports statewide GHG emissions for eight sectors: agriculture, residential and commercial, electric power, high global warming potential (GWP) gases, industrial, recycling and waste, transportation, and cap-and-trade (CARB 2022a). CARB's California GHG Emission Inventory for 2022 also reports statewide GHG emissions for these eight sectors (CARB 2024). For each sector, the 2022 Scoping Plan reports the 1990 emissions levels and ranges of reductions needed by 2030 for the State to achieve the SB 32 target of reducing statewide emissions to 40 percent below 1990 levels, and the AB 1279 target of reducing statewide emissions to 85 percent below 1990 levels. CARB also estimates the GHG emissions anticipated to be removed through carbon dioxide removal technologies and natural and working lands net sinks to achieve carbon neutrality by 2045, pursuant to AB 1279.

Chapter 5, "Challenge Accepted," of the 2022 Scoping Plan provides the following guidance to local agencies seeking to adopt GHG reduction targets in climate action planning efforts: although net zero targets can often be valuable and achievable, and mitigation is important, targets need to be considered in the larger context of these goals. This means any GHG targets on a local scale should take into consideration the actions and outcomes included in the Final 2022 Scoping Plan. Jurisdictions considering "net zero" targets should carefully consider the implications such targets may have on emissions in neighboring communities and the ability of the state to meet our collective targets (CARB 2022a:219). However, not all emissions sector reductions can be achieved at the local level because local agencies often do not have jurisdiction over the emissions sectors included in the statewide inventory used to develop the statewide targets. For example, the State's Cap-and-Trade program addresses GHG emissions from large stationary sources. The City's influence to reduce emissions from these types of facilities is limited, and therefore, the City should focus on emissions sources and activities over which it has significant influence or land use authority.

The statewide targets account for all emissions sectors in the State's GHG emissions inventory, statewide population forecasts for 2030 and 2045, and all statewide reductions necessary to achieve the statewide targets under SB 32 and AB 1279 in all sectors. The targets reported in the 2022 Scoping Plan are framed as targets that must be met on a statewide basis; however, this does not mean that the statewide sector targets must be applied uniformly to every local jurisdiction or special district.

5.3 COMMUNITY GREENHOUSE GAS EMISSIONS REDUCTION TARGETS

Based on a review of the 2022 Scoping Plan and an understanding of activities occurring within the city, the City has direct or indirect jurisdiction over activities that generate emissions and contribute to reductions in five of the seven emissions sectors included in the statewide inventory: agriculture, residential and commercial, electric power, recycling and waste, and transportation. The City has limited influence over high GWP gases, and large industrial facilities covered under the Cap-and-Trade program. Lastly, while industrial facilities regulated under Cap-and-Trade do exist within city boundaries, the State is responsible for achieving emissions reductions from these sources, and the City has limited ability to influence industrial facilities' GHG emissions. Therefore, by excluding these sectors under this approach, community GHG reduction targets have been established in proportion with statewide reductions for all sectors relevant to City jurisdiction to the extent feasible using available data. This target setting approach is consistent with the California Supreme Court decision in *Center for Biological Diversity v. California Department of Fish and Wildlife and Newhall Land and Farming (2015) 62 Cal.4th 204*, which determined that the approach of assessing a project's consistency with statewide emissions reduction goals must include a "reasoned explanation based on substantial evidence" that links the project's emissions to the statewide GHG reduction goals.

As outlined in the 2022 Scoping Plan, CARB's strategy for reducing statewide emissions to reach the levels required by AB 1279 relies on the advancement of mechanical technology and nature-based solutions for carbon dioxide removal (CDR). CARB acknowledges that there will be a need to advance technologies for and regulate the mechanical removal and storage of atmospheric carbon. While the City lies in a geography that has high potential for the development and expansion of these technologies, the City cannot directly increase carbon dioxide removal within its boundary, except for increasing carbon sequestration through nature-based solutions. As such, the City excludes the consideration of CDR in the development of local state-aligned GHG reduction targets.

The first step in determining community targets under this approach is to compare the State's GHG inventories for 1990 and 2022 (i.e., the City's baseline inventory year) for the five relevant sectors. All sectors that were included in the statewide inventory are shown below in Table 20 for 1990 and 2022. Table 40 also includes statewide forecasted emissions by sector provided by the 2022 Scoping Plan for 2045. According to the inventories available from CARB, statewide emissions from the relevant sectors were approximately 435 million MTCO₂e (MMTCO₂e) in 1990 and 371 MMTCO₂e in 2022 (CARB 2024). Thus, 2022 statewide emissions were approximately 64 MMTCO₂e (15 percent) lower than the 1990 levels.

Table 40 2022 Scoping Plan Estimated Change in Emissions by Sector (MMTCO₂e)

GHG Emissions by Sector	1990	2022	2030	2045
Agriculture	26	30	20	15
Residential and Commercial	44	40	27	4
Electric Power	108	60	39	9
High GWP	3	21	10	9
Industrial	98	73	41	12
Recycling and Waste	7	8	9	8
Transportation	152	140	81	8
Carbon Dioxide Removal		0	-7	-75
Total	438	371	220	-10
<i>Adjusted Total (Excludes High GWP, Industrial and CDR Sectors)</i>	<i>435</i>	<i>277</i>	<i>176</i>	<i>44</i>

Notes: GHG = greenhouse gases; GWP = global warming potential; MMTCO₂e = million metric tons of carbon dioxide equivalent.

Source: CARB 2017a, 2022a, 2024.

It is important to note that the 2022 Scoping Plan includes estimated changes in net emissions for the natural and working lands sector (i.e., carbon sequestration) and CDR technologies. As mentioned previously, the State will rely heavily on mechanical CDR to achieve its CDR targets. The City's CCAP focuses on anthropogenic sources of GHG emissions, and therefore, the 85 percent reduction below 1990 levels by 2045 is used for identifying the City's long-term target, consistent with AB 1279.

According to the 2022 Scoping Plan, statewide emissions from the sectors relevant to the City's inventory must be reduced to 176 MMTCO₂e by 2030 for the State to achieve its 2030 goal. This represents an emissions reduction of approximately 101 MMTCO₂e, or 37 percent, by 2030, relative to 2022 levels of 277 MMTCO₂e. Additionally, statewide emissions from the sectors relevant to the City's inventory must be reduced to 44 MMTCO₂e, an emissions reduction of approximately 233 MMTCO₂e, or 84 percent, by 2045, relative to 2022 levels of 277 MMTCO₂e. An interim 2040 target was also identified based on interpolation between the 2030 and 2045 targets. Therefore, consistent with State targets and considering relevant emissions sectors, the City's community state-aligned GHG reduction targets are as follows:

- ▶ 2030 target: 37 percent below 2022 levels (1,682,826 MTCO₂e);
- ▶ 2040 target: 68 percent below 2022 levels (853,861 MTCO₂e); and
- ▶ 2045 target: 84 percent below 2022 levels (424,061 MTCO₂e).

Table 41 shows how the City's targets were derived based on adjusted statewide GHG emissions data and projections and summarizes the City's legislative-adjusted BAU forecasts and targets for 2030, 2040, and 2045.

Table 41 Statewide and City of Bakersfield Legislative-Adjusted BAU Forecasts and GHG Emissions Reduction Targets Below 2022 Levels

Source	2022	2030	2040	2045
Scoping Plan Emissions Limit (MMTCO ₂ e)	371	220	55	-10
Adjusted Scoping Plan Emissions Limit ¹ (MMTCO ₂ e)	277	176	89	44
Adjusted Statewide Target Percent Reduction from 2022 Levels	N/A	37%	68%	84%
City of Bakersfield GHG Emissions and Legislative-Adjusted BAU Forecast (MTCO ₂ e)	2,652,362	2,833,834	3,149,382	3,403,065
City of Bakersfield Target Percent Reduction Below 2022 Levels	N/A	37%	68%	84%
City of Bakersfield Target Annual Emissions (MTCO ₂ e)	N/A	1,682,826	853,861	424,061
Reduction from 2022 Needed to Meet Target (MTCO ₂ e)	N/A	969,536	1,798,501	2,228,301
Reduction from Legislative-Adjusted BAU Forecasts Needed to Meet Target (MTCO ₂ e)	N/A	1,151,008	2,295,521	2,979,004

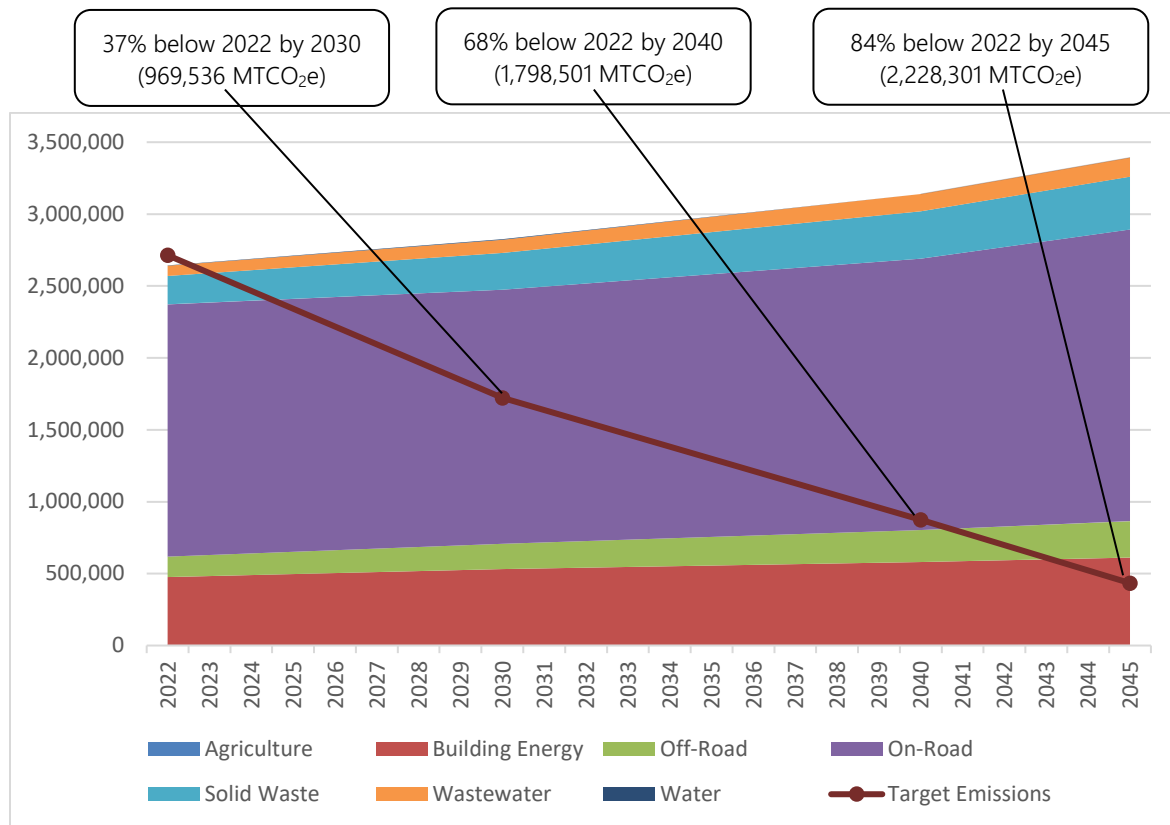
Notes: BAU = business-as-usual; GHG = greenhouse gases; MMTCO₂e = million metric tons of carbon dioxide equivalent; MTCO₂e = metric tons of carbon dioxide equivalent; N/A = Not Applicable; 2022 Scoping Plan = California's 2022 Scoping Plan for Achieving Carbon Neutrality.

¹ Excludes high GWP, industrial and CDR sectors because the City does not have jurisdiction to substantially influence emissions in these sectors.

Source: CARB 2022a; analysis conducted by Ascent in 2025.

Figure 4 depicts the community legislative-adjusted BAU forecasts by sector, as distinguished by colored wedges, and the City's community emissions reduction targets relative to the 2022 emissions inventory. The space between the trajectory of the black line (i.e., targets) and the top of the colored wedges (i.e., forecasted emissions) represents the "gap" in emissions that will need to be addressed through local actions for the City to meet its state-aligned reduction targets.

Figure 4 City of Bakersfield Community Legislative-Adjusted BAU Forecasts and GHG Emissions Reduction Targets Below 2022 Levels



Source: Analysis conducted by Ascent in 2025.

6 REFERENCES

- California Air Resources Board. 2017a. *California's 2017 Climate Change Scoping Plan*. Available: https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/scoping_plan_2017.pdf. Accessed May 1, 2025.
- . 2017b. *Method for Estimating Greenhouse Gas Emission Reductions from Diversion of Organic Waste from Landfills to Compost Facilities*: <https://ww2.arb.ca.gov/sites/default/files/classic/cc/waste/cerffinal.pdf>. Accessed May 1, 2025.
- . 2018 (July). EMFAC2017 Volume II – Technical Documentation. Available: <https://ww2.arb.ca.gov/sites/default/files/2023-01/emfac2017-volume-ii-pl-handbook.pdf>. Accessed April 5, 2025.
- . 2022a (November 16). *2022 Scoping Plan for Achieving Carbon Neutrality*. <https://ww2.arb.ca.gov/sites/default/files/2023-04/2022-sp.pdf>. Accessed May 3, 2025.
- . 2022b. EMFAC Emission Inventory (Model Version: EMFAC 2021 v1.0.2). Available: <https://arb.ca.gov/emfac/emissions-inventory/0aab195e7474e6a66cebfa6ad29a71aed1cb5494>. Accessed April 10, 2025.
- . 2022c. OFFROAD2021 Off-road Emissions Inventory. Available: <https://arb.ca.gov/emfac/offroad/emissions-inventory/0aab195e7474e6a66cebfa6ad29a71aed1cb5494>. Accessed April 10, 2025.
- . 2023. Mandatory GHG Reporting – Reported Emissions: 2022 GHG Facility and Entity Emissions. Available: <https://ww2.arb.ca.gov/mrr-data>. Accessed April 13, 2025.
- . 2024. Current California GHG Emissions Inventory Data: GHG Emissions Data. GHG Emissions Summaries. Available: https://ww2.arb.ca.gov/sites/default/files/2024-09/nc-ghg_inventory_scopingplan_sum_00-22.xlsx. Accessed May 10, 2025.
- California Department of Conservation. 2022. Farmland Mapping & Monitoring Program. Available: <https://www.conservation.ca.gov/dlrp/fmmp>. Accessed April 2, 2025.
- California's Department of Food & Agriculture. 2025. Fertilizing materials tonnage report for 2022. Available: https://www.cdfa.ca.gov/is/ffldrs/pdfs/2022_Tonnage.pdf. Accessed April 15, 2025.
- California Department of Resources Recycling and Recovery. 2025. Jurisdiction Disposal and Beneficial Reuse by Destination database. Available: <https://www2.calrecycle.ca.gov/RecyclingDisposalReporting/Reports/JurisdictionDisposalAndBeneficial>. Accessed: May 1, 2025.
- California Department of Water Resources. 2016. State Water Project Energy Intensity of Water Supplies data portal. Available: <https://www.arcgis.com/apps/Style/index.html?appid=c112a21431884158b58fc5564e66c439>. Accessed May 3, 2025.
- California Governor's Office of Land Use and Climate Innovation. 2017. *General Plan Guidelines, Chapter 8: Climate Change*. Available: <https://opr.ca.gov/planning/general-plan/guidelines.html>. Accessed May 6, 2025.
- CalRecycle. See California Department of Resources Recycling and Recovery.
- CARB. See California Air Resources Board.
- CDFA. See California Department of Food and Agriculture.
- City of Bakersfield. 2023. Kern Local Agency Formation Commission: Bakersfield Area Municipal Service Review and Sphere of Influence Update. Accessed: May 1, 2025.
- DOC. See California Department of Conservation.
- DWR. See California Department of Water Resources.

- EPA. See U.S. Environmental Protection Agency.
- Friant Water Authority. 2019. Environmental Assessment/Initial Study Friant-Kern Canal Middle Reach Capacity Correction Project. Available: https://files.ceqanet.opr.ca.gov/257475-3/attachment/MquQcSSGC9XiBbqByqzqx_SgEdaEPAtfew9kBC8g9FJlrHBGAu6b3Wcl0ac7pcyd9FMvPwRnXfafMPUV0. Accessed May 18, 2025.
- ICLEI. See ICLEI – Local Governments for Sustainability.
- ICLEI – Local Governments for Sustainability. 2013. *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions*. Appendix F: Wastewater and Water Emission Activities and Sources. Version 1.1. Available: <https://icleiusa.org/us-community-protocol/>. Accessed April 12, 2025.
- . 2019. *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions*. Version 1.2. Available: <https://icleiusa.org/us-community-protocol/>. Accessed April 12, 2025.
- IPCC. See Intergovernmental Panel on Climate Change.
- Intergovernmental Panel on Climate Change. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Agriculture, Forestry and Other Land Use*. Available: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_11_Ch11_N2O&CO2.pdf. Accessed April 22, 2025.
- . 2021 (August). *Climate Change 2021: The Physical Science Basis. Chapter 7: The Earth's energy budget, climate feedbacks, and climate sensitivity - Supplementary Material*. Available: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf. Accessed April 22, 2025.
- Kern COG. See Kern Council of Governments.
- Kern Council of Governments. 2022. Regional Transportation Plan/Sustainable Communities Strategy. Available: https://www.kerncog.org/wp-content/uploads/2022/12/2022_RTP.pdf. Accessed: April 12, 2025.
- LCI. See California Governor's Office of Land Use and Climate Innovation.
- Pacific Gas and Electric Company. 2023. 2022 Power Content Label. Retrieved from: 2022 PCL Pacific Gas and Electric Company ADA. Accessed: June 25, 2025.
- PG&E. See Pacific Gas and Electric Company.
- TCR. See The Climate Registry.
- The Climate Registry. 2022. *2022 Default Emission Factor Document*. Available: <https://theclimateregistry.org/wp-content/uploads/2022/11/2022-Default-Emission-Factors-Final.pdf>. Accessed April 1, 2025.
- . 2025. *2025 Default Emission Factor Document*. Available: <https://theclimateregistry.org/wp-content/uploads/2025/03/2025-Default-Emission-Factors-03-2025.pdf>. Accessed April 1, 2025.
- U.S. Census Bureau. 2025. American Community Survey 5-Year Estimates Data Profiles for 2022. Available: <https://data.census.gov/table/ACSSDP1YCD1192023.DP02?q=DP02:+Selected+Social+Characteristics+in+the+United+States>. Accessed April 5, 2025.
- U.S. Environmental Protection Agency. 2009. WARM component-specific decay rate methods. Available: https://www.epa.gov/sites/default/files/2016-03/documents/warm_decay_rate_structure_10_30_2009.pdf?utm_source=chatgpt.com. Accessed June 7, 2025.
- . 2024. *Historical Emissions & Generation Integrated Database (eGRID) data*. Available: <https://www.epa.gov/egrid/historical-egrid-data>. Accessed April 1, 2025.
- Water Association of Kern County. N.d. Water in Kern County. Available: <https://www.wakc.com/water-overview/kern-county/>. Accessed April 10, 2025.
- WAKC. See Water Association of Kern County.